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THE

POPULAR EDUCATOR.

LESSONS IN ETHNOLOGY.—I.

INTRODUCTION—TRANSMISSION OF QUALITIES, ETC.

THE term Ethnology is derived from two Greek words, ἔθνος (eth-nos), a body of men, a nation, caste, or *race;* and λόγος (log-os), a word, *discourse*, etc. It is the science which treats of the races of mankind. It was formerly called Ethnography, the second part of this word being taken from γράφω (graph-o), I engrave, I *write*. Ethnography then was a writing about, or a description of, the races of the world. As, however, inquiries on this subject have of late taken a wider range, and assumed a more scientific aspect—it being held needful now not merely to describe the characteristics of a race, but also to attempt to discover how those characteristics arose—Ethnology, the latter part of which is derived from the same root as the word *logic*, has become the more appropriate term. A cognate science is Anthropology, and it is necessary to distinguish between the two. According to Dr. Latham, anthropology specially investigates the relation in which man stands to the inferior animals; but this is too limited a view. For what is the etymological construction of the word *anthropology?* It is made up of ἄνθρωπος (an-thro-pos), *man*, and λόγος, meaning (as already explained) *discourse*. Anthropology, then, is a discourse about man, and its cultivators profess "to study man in all his leading aspects, physical, mental, and historical, to investigate the laws of his origin and progress, to ascertain his place in nature, and his relation to the inferior forms of life." Such, at least, is the comprehensive programme of the Anthropological Society of London, which, founded in 1863, succeeded, within a short space of time after its foundation, in battling its way into public notice. Ethnology would, then, be one department of the great science of anthropology, and this we deem the correct view.

Having now traced out the limits of the field, it is needful next to enter on its exploration. No two members of the same family come into the world in all respects alike, and the original differences grow more, instead of less manifest, as the young people advance to maturity. When at length they go forth to push their way in the world, perhaps one enters the Church, another the army, and a third the navy; while a fourth goes out to India, returning home only in the evening of his days. To the original differences have now been superadded others resulting from diversity of climate, food, habitation, profession, and mental and moral habits. The modifications of colour and general appearance produced by the tropical climate on that member of the family who spent the best years of his life in India will be specially apparent. Every one knows that, in all likelihood, he will be darker than his compeers. As colour is one of the points on which the various races of men depart widely from each other, it should be noted how great are the alterations in this respect which can be effected by ordinary influences, even within the first generation. A traveller, speaking from observation, says that a European acquires a tawny skin by residing for some time in Egypt, and a bronzed one by living in Abyssinia; he becomes pallid on the Arabian coast, of an unhealthy white in Syria, clear brown in the deserts of Arabia, and ruddy in the Syrian mountains. Nay, more, his hair becomes darker, acquires a softer texture, and shows a tendency to curl. It will be perceived that the changes in the colour and in the texture of the hair constitute an approach, however faint, to a race of mankind more remote than any other from the European.

A second and important question now arises. Are slight differences of organisation among members of a family, either appearing by some occult law at birth, or produced at a subsequent period by various natural causes, transmitted from one generation to another? The answer must be that they are so, though not uniformly, yet at least occasionally. In various works, among which we would instance one—Dr. Theodor Waitz's excellent "Introduction to Anthropology," edited in English by J. F. Collingwood, Esq., Hon. Secretary of the Anthropological Society—much important evidence is adduced with regard to the descent of natural or acquired peculiarities to the second, if not to remoter generations. For instance, an officer whose little finger had accidentally been cut across, and had in consequence become crooked, transmitted the same defect to his offspring. Another officer, wounded at the battle of Eylau, had his scar reproduced on the foreheads of his children. When the newborn infants of Europeans are compared with those of savage nations, the shape of the toes in the former is found to have been modified by the fact that their parents were in the habit of wearing shoes. It has often been observed that the Hapsburg, or Austrian royal family, for some generations back, have had a thick upper lip, which first appeared after an ancestor of theirs had intermarried with the Polish family of Jagellon. A gentleman communicates the information that he has himself witnessed a single white lock of hair in two successive generations of a family, which family moreover bore a surname that may possibly have been first suggested by the phenomenon now described. Observations analogous to those which have just been recorded have been made also in the case of the lower animals. We have space for only two. In Carolina, a dog which had accidentally lost its tail transmitted the defect to its descendants for three or four generations. A sheep in Massachusetts, with a long body and short legs, in 1791 became the progenitor of an apparently permanent breed, possessing the same characteristics. This now occurs in various parts of North America, is called the otter sheep, and is prized by farmers, as its short limbs prevent its being able to leap over the fences. It is thus abundantly evident that physical peculiarities are transmissible both in the case of man and of the lower animals. So are instincts, temper, etc., in animals, and mental and moral qualities in man. A vicious horse generally breeds another of the same kind; a docile one similarly repeats itself. Children among ourselves generally take after their parents. True, numerous instances have occurred in which a wise man has begotten a fool, or the son of a poet has been prosaic to the last degree, or the first-born of an eminent naturalist has cared nothing for his distinguished father's pursuits. But it is not by any means always so; witness, for example, the Hookers, father and son, both of the highest eminence in botany. The two sets of facts may be harmonised by remembering that the sons who departed so widely from their fathers' mental characteristics, may in this respect have closely resembled their mothers. In many cases the intellect of an able man is inherited from his mother, so much so, that, as has been pointed out, the popular phrase is not *father*- but *mother*-wit. There is, then, nothing in what has now been stated to overthrow the observation that mental and moral qualities can be transmitted from parents to children. Nay, more; when mothers have had to pass through scenes of terror—like some of those which arose in connection with the first French revolution—the fright in which they have been has in some cases told on the intellect of any children to whom they may have shortly afterwards given birth; thus new mental types may be created by passing events. So, also, training laboriously imparted to dogs, tends to become to them a second nature, and more or less to modify the instincts of their offspring; there being in this, as in similar cases, a certain analogy between man and the inferior animals. With such a law of variability operating during thousands of years, it was inevitable that diverse races should appear both among mankind and the other members of the animated creation now inhabiting the world.

But here we are met by the highest question in ethnology. Can it be established on strictly scientific evidence, that the several types of mankind have had a common origin? Or have they from the first been totally distinct? Before entering on this inquiry, some terms, which it will be necessary to employ in the argument, must be defined. All who have any acquaintance with natural science have at least a general idea what a species means, though modern investigations have rendered it for the present almost impossible correctly to explain it. Till lately, nearly all naturalists held that each species of animals or of plants was produced by a separate act of creation, and that the number could not be increased unless by a fresh exertion of creative power. Then each species could vary within certain limits, and even give rise to types which might be mistaken for new species, but were designated varieties. Nay, more, there were sometimes crosses, called hybrids, between distinct species; but these, it was held, could not perpetuate themselves, but speedily died out, unless kept up by new intercommunion between the parent species. Crosses between mere varieties were occasionally termed mongrels. These explanations being made, readers will thoroughly understand the nature of the question—Are the several types which we see among mankind distinct species? or are they simply permanent varieties? In other words, had the European and the negro a common parent? or were they from the first totally distinct? The ethnologist does not consider it legitimate to go beyond the limits of his special science, and ask whether or not revelation has decided the point, but confines himself to strictly scientific evidence.

It was formerly held that there was decisive proof derivable from natural science in favour of the unity of the human race. This was the nature of the argument employed:—Hybrids between distinct species are unable permanently to propagate themselves. For instance, the mule, which is a hybrid between the horse and ass, is incapable of continuing its race. If the European and the negro were distinct species, the race intermediate between then—we mean the mulatto one—would be a hybrid, and, if left to itself, would speedily become extinct. Yet it does not do so, but holds its own. Therefore it is not a hybrid between two species, but a mongrel between two varieties of one species; and the negro and European differ from each other only as permanent varieties in other parts of Nature do. A good deal of weight still attaches to this argument, but not at all so much as was once believed. The doctrine that hybrids are never fertile has of late been impeached in two quarters. Darwin has done so with great ability in his extensively circulated works; and ethnologists of the American school—some of them, however, possibly influenced by the disturbing effect exerted by the "irrepressible negro" on social and political life in the United States—have for a considerable number of years maintained the same view. Darwin believes that the domestic dogs of the world did not come from one, but from several species; yet they show none of that tendency to die out which the law of hybridism was supposed to require. The origin of dogs is, however, a point on which differences of opinion may exist. It is therefore important to observe that there have been fertile hybrids known between animals so undeniably distinct as the stag and the cow, the swan and the goose, and various other animals. Singularly enough, those species which are most closely allied have had fewer fertile hybrids between them than others which are more remote. So far as is at present known, some hybrids perpetuate their race, and others do not. If the law of hybridity is thus complex, then the argument which is founded on it, with respect to the close affinity of the European and the negro, is considerably weakened, though still it is not divested of all its force.

Another objection has been made to the validity of the argument. It has been stated that the mulatto race is a feeble one, which soon dies out; and that thus it manifests the weakness of hybridity. Dr. Nott of America maintained this, with respect to the mulattoes of South Carolina, when he resided in that part of the United States; but he saw reason to modify his views when some time afterwards he went to Mobile, New Orleans, Pensacola, and other places on or near the Gulf of Mexico. There he found a far stronger and healthier race of mulattoes than he had seen in South Carolina, which he accounted for by saying that the fathers of many of them—French, Spaniards, and other members of the Latin race—had a nearer affinity with negroes than the Anglo-Saxons possessed. But, on the hybrid doctrine, was not this likely to produce results just the opposite of those observed? As has been said, there are so many mulattoes in Brazil, that if the race had manifested a tendency to die out, the fact would before now have been perfectly apparent.

It was once maintained by a careful observer (Flourens) that the negro must needs be specifically distinct from the European, since the former possessed, between two layers of his skin, an organ containing a dark pigment, or colouring matter, thus differing not in hue simply, but in structure, from the white man. But Flourens afterwards abandoned this view, and took up the common one—namely, that the black pigment in the negro is deposited in the same layer of skin as it is in the dark races of India, who, ethnologically viewed, are quite distinct from the African races; nay, more, in the same layer which receives the colouring matter when a native of this country becomes somewhat bronzed by exposure to a tropical sun. Besides, the negroes themselves vary greatly in colour, the extreme type with which we are familiar being indigenous only on the low, moist parts of Central Africa, while the inhabitants of the hills are considerably lighter. Both in Sierra Leone, too, and the States of America the children of negroes in contact with civilisation tend somewhat to advance in intellect, and improve in personal appearance. Should the process go on for a few generations, the result would at last be very considerable.

We believe that the majority of the ethnologists of Europe still hold the unity of the human race, whilst others, such as M. Broca of Paris, whose work on hybridity has been translated into English, and edited by Dr. Carter Blake, Assistant Secretary of the Anthropological Society, take the contrary view. Many Americans, as already stated, agree with Broca. The preponderance of opinion among scientific ethnologists is apparently still, however, in favour of that doctrine long ago enunciated by the Apostle Paul in his address delivered on Mars hill before the Athenian Areopagus. "He [God] hath made of one blood all nations of men for to dwell on all the face of the earth."

LESSONS IN ITALIAN.—XXXIII.

IRREGULAR VERBS OF THE FIRST CONJUGATION.

The *Irregular Verbs* are those which deviate in some tenses and persons from the regular verb of the same conjugation which is given for their model.

The first irregular conjugation contains only *andáre*, *dáre*, *fáre*, *stáre*, and their derivatives.

As all Italian verbs may be generally conjugated with or without personal pronouns, we now think proper to omit them in the conjugation of the irregular verbs, feeling confident that the student is thoroughly acquainted with them. For a similar reason we omit the conjugation of the compound tenses, which the reader now will be easily able to form and conjugate for himself.

1. The irregular verb *andáre*, to go, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Andáre, *to go.—Pres. Gerund.* Andándo, *going.—Past Part.* Andáto, andáta, andáti, andáte, *gone.——Compound Tenses.—Past.* Éssere andáto, *to have* or *be gone.—Past Gerund.* Esséndo andáto, *having* or *being gone.*

Ind. *Pres.* Vádo *or* vo, vái, va; andiámo, andáte, vánno.—*Imp.* Andáva, andávi, andáva; andavámo, andaváte, andávano.—*Ind. Pret.* Andái, andásti, andò; andámmo, andáste, andárono.—*Fut.* Andrò, andrái, andrà; andrémo, andréte, andránno.—*Cond. Pres.* Andréi, andrésti, andrébbe; andrémmo, andréste, andrébbero.

Imp. Va, váda; andiámo, andáte, vádano.

Sub. *Pres.* Che váda, che váda *or* vádi, che váda; che andiámo, che andiáte, che vádano.—*Imp.* Che andássi, che andássi, che andásse: che andássimo, che andáste, che andássero.

After this example conjugate *riandáre*, to go again.

2. The irregular verb *dáre*, to give, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Dáre, *to give.—Pres. Gerund.* Dándo, *giving.—Past Part.* Dáto, *given.——Compound Tenses.—Past.* Avére dáto, *to have given.—Past Gerund.* Avéndo dáto, *having given.*

IND. *Pres.* Do, dái, dà; diámo, dáte, dánno.—*Imp.* Dáva, dávi, dáva; davámo, daváte, dávano.—*Ind. Pret.* Diédi *or* détti; désti; diéde, dètte, *or* diè. Démmo; déste; diédero, déttero, diérono, *or* diédono.*—*Fut.* Darò, darái, darà; darémo, daréte, daránno.—*Cond. Pres.* Daréi, darésti, darébbe; darémmo, daréste, darébbero.

IMP. Dà, día *or* déa; diámo, dáte, díano *or* díeno.

SUB. *Pres.* Che día; che día or díi; che día. Che diámo; che diáte; che díano, díeno, déano.—*Imp.* Che déssi, che déssi, che désse; che déssimo, che déste, che déssero.

After this example conjugate *ridáre*, to give again; *addáre* or *addársi*, to apply one's self.

3. The irregular verb *fáre*, to make, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Fáre, *to make.—Pres. Gerund.* Facéndo, *making.—Past Part.* Fátto, *made.——Compound Tenses.—Past.* Avére fátto, *to have made.—Past Gerund.* Avéndo fátto, *having made.*

IND. *Pres.* Fo *or* fáccio, fái, fa; facciámo, fáte, fánno.—*Imp.* Facéva, facéa, *or* fè; facévi; facéva or facéa. Facevámo; faceváte; facévano or facéano.—*Ind. Pret.* Féci *or* féi; facésti; féce, fè, *or* féo. Facémmo; facéste; fécero *or* fénno.—*Fut.* Farò, farái, farà; farémo, faréte, faránno. —*Cond. Pres.* Faréi, farésti, farébbe; farémmo, faréste, farébbero.

IMP. Fa, fáccia; facciámo, fáte, fácciano.

SUB. *Pres.* Che fáccia, che fáccia or fácci, che fáccia; che facciámo, che facciáte, che fácciano.—*Imp.* Che facéssi, che facéssi, che facésse; che facéssimo, che facéste, che facéssero.

After this example conjugate the following irregular verbs:—

Assuefáre, *to accustom.*	Rifáre, *to make up again.*
Confáre, *to become.*	Sfáre, *to undo.*
Contraffáre, *to mimic.*	Sopraffáre, *to ask too much.*
Disfáre, *to undo.*	Soddisfáre, *to satisfy.*
Liquefáre, *to melt.*	Strafáre, *to do too much.*
Misfáre, *to do wrong.*	Stupefáre, *to stupefy.*

4. The irregular verb *stáre*, to stand, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Stáre, *to stand.—Pres. Gerund.* Stándo, *standing.—Past Part.* Státo, *stood.——Compound Tenses.—Past.* Éssere státo, *to have stood.—Past Gerund.* Esséndo státo, *having stood.*

IND. *Pres.* Sto, stái, sta; stiámo, státe, stánno.—*Imp.* Stáva, stávi, stáva; stavámo, staváte, stávano.—*Ind. Pret.* Stétti, stésti, stétte; stémmo, stéste, stéttero.—*Fut.* Starò, starái, starà; starémo, staréte, staránno.—*Cond. Pres.* Staréi, starésti, starébbe; starémmo, staréste, starébbero.

IMP. Sta, stía *or* stíe; stiámo, státe, stíano *or* stíeno.

SUB. *Pres.* Che stía, che stía or stíi, che stía; che stiámo, che stiáte, che stíano *or* stíeno.—*Imp.* Che stéssi, che stéssi, che stésse; che stéssimo, che stéste, che stéssero.

After this example conjugate the following irregular verbs:—

Distáre, *to be distant.*	Ristáre, *to stop.*
Instáre, *to insist.*	Soprastáre, *to defer, delay.*

IRREGULAR VERBS OF THE SECOND CONJUGATION.

Verbs ending in *ere* are of two sorts. The first have their infinitives long, such as *bére*, *cadére*, etc.; the second short, such as *assórbere*, *conóscere*, etc.

I.—IRREGULAR VERBS ENDING IN *ére* LONG.

1. The irregular verb *bére*, to drink, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Bére, *to drink.—Pres. Gerund.* Bevéndo, *drinking.—Past Part.* Beúto, *drunk.——Compound Tenses.—Past.* Avére beúto, *to have drunk.—Past Gerund.* Avéndo beúto, *having drunk.*

IND. *Pres.* Béo, béi, bée; beiámo, beéte, béono.—*Imp.* Beéva, beévi, beéva; beevámo, beeváte, beévano.—*Ind. Pret.* Bévvi, beésti, bévve; beémmo, beéste, bévvero.—*Fut.* Berò, berái, berà; berémo, beréte, beránno.—*Cond. Pres.* Beréi, berésti, berébbe; berémmo, beréste, berébbero.

IMP. Béi, béa; beiámo, beéte, béano.

SUB. *Pres.* Che béa, che béa, che béa; che beiámo, che beiáte, che béano.—*Imp.* Che beéssi, che beéssi, che beésse; che beéssimo, che beéste, che beéssero.

After this example conjugate the following irregular verbs:—*Imbére*, to imbibe; *ribére*, to drink again; *strabére*, to drink hard.

The Italians prefer the regular verb *bévere*.

2. The irregular verb *cadére*, to fall, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Cadére, *to fall.—Pres. Gerund.* Cadéndo, *falling.—Past Part.* Cadúto, *fallen.——Compound Tenses.—Past.* Éssere cadúto, *to have fallen.—Past Gerund.* Esséndo cadúto, *having fallen.*

IND. *Pres.* Cádo or cággio, cádi, cáde; cadiámo or caggiámo, cadéte, cádono or cággiono.—*Imp.* Cadéva *or* cadéa, cadévi, cadéva *or* cadéa; cadevámo, cadeváte, cadévano *or* cadéano.—*Ind. Pret.* Cáddi, cadétti, or cadéi; cadésti; cádde, cadéo, cadétte, or cadè. Cadémmo; cadéste; cáddero, cadéro, cadér, cadéttero, *or* cadérono.—*Fut.* Cadrò *or* caderò, cadrái *or* caderái, cadrà *or* caderà; cadrémo *or* caderémo, cadréte *or* caderéte, cadránno or caderánno.—*Cond. Pres.* Cadréi, caderéi, cadería, *or* cadría; cadrésti or caderésti; cadrébbe, caderébbe, cadería, *or* cadría. Cadrémmo or caderémmo; cadréste *or* caderéste; cadrébbero, caderébbero, or caderíano.

IMP. Cádi, cáda; cadiámo, cadéte, cádano.

SUB. *Pres.* Che cáda or cággia, che cáda *or* cággia, che cáda *or* cággia; che cadiámo or caggiámo, che cadiáte *or* caggiáte, che cádano or cággiano.—*Imp.* Che cadéssi, che cadéssi, che cadésse; che cadéssimo, che cadéste, che cadéssero.

After this example conjugate the following irregular verbs:—

Accadére, *to happen.*	Discadére, *to fall away.*
Decadére, *to decay.*	Ricadére, *to fall again.*

Scadére, *to become due.*

3. The irregular verb *calére*, to matter, is thus conjugated:—

INF. *Pres.* Calére, *to matter.—Past Part.* Calúto, *mattered.*

IND. *Pres.* Cále, *it matters.—Imp.* Caléva or caléa, *it mattered.—Ind. Pret.* Cálse, *it mattered.—Fut.* Carrà, *it will matter.—Cond. Pres.* Carrébbe, *it would matter.*

SUB. *Pres.* Cáglia, *it may matter.—Imp.* Calésse, *it might matter.*

4. The irregular verb *dolére* or *dolérsi*, to grieve, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Dolérsi, *to grieve.—Pres. Gerund.* Doléndosi, *grieving.—Past Part.* Dolútosi, *grieved.——Compound Tenses.—Past.* Éssersi dolúto, *to have grieved.—Past Gerund.* Esséndosi dolúto, *having grieved.*

IND. *Pres.* Mi dólgo or dóglio, ti duóli, si duóle or dóle; ci dogliámo, vi doléte, si dólgono or dógliono.—*Imp.* Mi doléva *or* doléa, ti dolévi, si doléva *or* doléa; ci dolevámo, vi doleváte, si dolévano.—*Ind. Pret.* Mi dólsi, ti dolésti, si dólse; ci dolémmo, vi doléste, si dólsero.—*Fut.* Mi dorrò, ti dorrái, si dorrà; ci dorrémo, vi dorréte, si dorránno.—*Cond. Pres.* Mi dorréi or dorría, ti dorrésti, si dorrébbe; ci dorrémmo, vi dorréste, si dorrébbero.

IMP. Duóliti, si dólga; dogliámoci, dolétevi, si dólgano.

SUB. *Pres.* Che mi dólga *or* dóglia, che ti dólga *or* dóglia, che si dólga *or* dóglia; che ci dogliámo, che vi dogliáte, che si dólgano *or* dógliano. —*Imp.* Che mi doléssi, che ti doléssi, che si dolésse; che ci doléssimo, che vi doléste, che si doléssero.

After this example conjugate—

Condolérsi, *to complain.*	Ridolére, *to lament again.*

Observation.—Dolére signifies also *to ache*, and then it is used impersonally: for example:—

Mi duóle la tésta, *my head aches*, or *I have the headache.*
Mi dólgono i dénti, *my teeth ache*, or *I have the toothache.*

5. The irregular verb *dovére*, to owe, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Dovére, *to owe.—Pres. Gerund.* Dovéndo, *owing.—Past Part.*—Dovúto, *owed.——Compound Tenses.—Past.* Avére dovúto, *to have owed.—Past Gerund.* Avéndo dovùto, *having owed.*

IND. *Pres.* Débbo, dévo, or déggio; débbi, dévi, *or* déi; débbe, déve, *or* dée. Dobbiámo, deggiámo, *or* debbiámo; dovéte; débbono, dévono, dénno, déggiono, *or* déono.—*Imp.* Dovéva or dovéa, dovévi *or* dovéi, dovéva *or* dovéa; dovevámo, doveváte, dovévano *or* dovéano.—*Ind. Pret.* Dovéi *or* dovétti, dovésti, dovè *or* dovétte; dovémmo, dovéste, dovérono *or* dovéttero.—*Fut.* Dovrò, doverò, *or* devrò; dovrái; dovrà. Dovrémo; dovréte; dovránno.—*Cond. Pres.* Dovréi, doveréi, dovría, *or* dovería; dovrésti *or* doverésti; dovrébbe, dovría, *or* dovería. Dovrémmo; dovréste; dovrébbero, dovríano, *or* doveríano.

IMP. Débbi or dévi,* débba; dobbiámo, dovéte, débbano.

SUB. *Pres.* Che débba *or* déggia; che débba *or* déggia; che débba or déggia. Che dobbiámo *or* deggiámo; che dobbiáte *or* deggiáte; che débbano, dévano, *or* déggiano.—*Imp.* Che dovéssi, che dovéssi, che dovésse; che dovéssimo, che dovéste, che dovéssero.

6. The irregular verb *giacére*, to lie down, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Giacére, *to lie down.—Pres. Gerund.* Giacéndo, *lying down.—Past Part.* Giaciúto, *lain down.——Compound Tenses. Past.* Avére giaciúto, *to have lain down.—Past Gerund.* Avéndo giaciúto, *having lain down.*

IND. *Pres.* Giáccio or giácio, giáci, giáce; giacciámo *or* giaciámo, giacéte, giácciono or giáciono.—*Imp.* Giacéva *or* giacéa, giacévi, giacéva;

* *Diér, diéro, dénno,* are used in poetry.

* Some Italians think that there is no imperative; but as this mood is employed by some of the best grammarians, we prefer their opinion.

giaceváme, giaceváte, giacévano.—*Ind. Pret.* Giàcqui, giacésti, giàcque; giacémmo, giacéste, giácquero.—*Fut.* Giacerò, giacerái, giacerà; giaccrémo, giaceréte, giaceránno.—*Cond. Pres.* Giaceréi, giaccrésti, giacerébbe; giacerémmo, giaceréste, giacerébbero.

Imp. Giáci, giáccia *or* giácia; giacciámo *or* giaciámo, giacéte, giàcciano *or* giáciano.

Sub. *Pres.* Che giáccia *or* giácia; che giáccia, giácia, giácci, giáci; che giáccia *or* giácia. Che giacciámo *or* giaciámo; cho giacciàte *or* giaciáte; chc giàcciano *or* giáciano.—*Imp.* Che giacéssi, che giacéssi, che giacésse; che giacéssimo, che giacéste, che giacéssero.

KEY TO EXERCISES IN LESSONS IN ITALIAN.—XXXII.

Exercise 41.

1. Mr. N. has invited me to dinner; I think you will find there a large party. 2. Will you go out on horseback to-day? 3. My sisters will soon arrive. 4. Peter will return to you all that he has taken. 5. Why did you not return my salutation? 6. Once we shall render an account of our actions. 7. I will answer your letter on the ninth of this month. 8. When will you leave off? 9. I should have finished already if you had not hindered me. 10. Leave off, then. 11. I shall inform your father of your negligence. 12. I would eat a fig if I did not fear the toothache. 13. I would not sell my meerschaum pipe if circumstances did not oblige me. 14. If you really loved the Italian language, you would study it with more diligence. 15. I (should) wish that you would finish the work which you have begun. 16. John brings plums, pears, and apples. 17. This watch does not go well; send it to the watchmaker that he may repair it. 18. Do not open the windows.

Exercise 42.

1. Returning to the house, I have found your brother. 2. Not speaking Italian, you must feel yourself annoyed here. 3. Not knowing where to find her, I have returned. 4. I am loved by my school-fellows; thou art praised by the master. 5. Frederick is punished. 6. Good children are loved by their parents. 7. The poor man is forsaken by all the world. 8. Honour thy father and thy mother, and thou shalt be honoured. 9. This book shall be bound to-morrow. 10. Be virtuous, and you shall certainly be rewarded for it. 11. The bad will one day be punished. 12. Harriet would be praised by her masters if she were more diligent. 13. We were well treated by our aunt. 14. John has been punished for not having finished his exercise. 15. Speak loud, that you may be heard. 16. It is sad to be hated by all. 17. He feels pleasure in being praised. 18. We have gathered many strawberries. 19. The strawberries which we have gathered are delicious. 20. The figure which my brother has drawn was very beautiful. 21. Have you sent my books to the bookbinder? 22. Yes; I have sent them to him yesterday.

Exercise 43.

1. Our neighbour pretends to understand everything that we say. 2. My uncle will arrive this evening; we shall amuse ourselves well. 3. Why do you grieve? 4. I grieve for the death of my cousin. 5. Rejoice, friends, in the little which you have. 6. Do not rely on him. 7. Remember your promise. 8. Wrap yourself with your cloak. 9. I shall make use of your books. 10. They make use of mine. 11. We often make use of this carriage. 12. I dress myself. 13. Dress yourself also. 14. We shall dress ourselves by-and-by. 15. Francis, will you not wash yourself yet? 16. I will wash myself this instant. 17. At what hour do you usually rise? 18. I rise every morning at six, and I go to bed at nine. 19. Charles will rise to-morrow at four; he will set out for Cronstadt. 20. We rise later than you. 21. Formerly we did not rise so late. 22. Rest yourself a little. 23. I will rest myself a moment; I am very tired. 24. What is this young man's name? 25. I believe his name is William. 26. These gentlemen are much amused at the ball. 27. They intend to go there next week also.

Exercise 44.

1. They say that Mrs. Johnson will get married. 2. The bird is known by its song. 3. One eats and drinks well in this hotel. 4. People know their friends in misfortunes. 5. One most always seeks a fortune where it is not. 6. They speak fifty-three languages in Europe. 7. Have you heard what is reported of a boy in New York? 8. It is no longer spoken of. 9. It was spoken of long since. 10. What must be done to prevent such a misfortune? 11. It is necessary always to labour; it is not necessary to be idle. 12. It will be needful to have patience. 13. What are you doing? 14. I must write. 15. It was necessary that I should write a letter. 16. Will you accompany me? 17. I am going. 18. Are you going already? 19. It is necessary for me to go. 20. Your mother is not going yet. 21. Excuse me, my mother is already gone, and my brothers will go directly. 22. Wait a moment longer; we will go together. 23. Let us go, gentlemen. 24. If I had come a little later, I should have come with your sisters. 25. Were you in church? 26. Yes; I have this moment come out of it.

PLANE TRIGONOMETRY.—I.

INTRODUCTION—CIRCULAR MEASURE OF ANGLES—FUNCTIONS OF ANGLES—RELATIONS OF TRIGONOMETRICAL RATIOS TO ONE ANOTHER.

Trigonometry is derived from two Greek words, τριγωνον (trigo′-non), *a triangle*, and μετρεω (met′-re-o), *I measure*. Its meaning would thus appear to be the science of *computing triangles*, and its scope somewhat akin to Geometry. Geometry enables us, certain sides and angles of a triangle being given, to *construct* or draw the visible triangle to which they belong; while Trigonometry tells us how to *calculate* the parts or area of a triangle when the numerical values of certain of its sides or angles, or even the numerical value of the ratios they bear to one another, are known to us. Trigonometry is used in the practical arts of surveying and navigation; and the power of computing triangles—and by that means many other figures, since all figures bounded by straight lines may be split up into triangles—is very useful. A moderate study of the science is enough for these purposes—that is to say, will establish a sufficient number of formulæ to enable us, with the aid of a book of tables, to calculate the elements of any triangle when sufficient data are given. It will also enable us to solve many mathematical problems, for the formulæ and equations of Trigonometry are extensively used in calculations not relating to angles or triangles at all.

Trigonometry is divided into Plane and Spherical Trigonometry, the latter of which treats of triangles drawn upon spherical surfaces, and is comparatively special in its application. We are at present only concerned with Plane Trigonometry.

It is presumed that the learner is acquainted with the ordinary or *sexagesimal* method of measuring angles, according to which the circumference of every circle is considered as divided into 360 equal parts, called *degrees*, each degree being divided into 60 *minutes*, and each minute into 60 *seconds*, the signs for which are respectively $^{\circ}\ {}'\ {}''$. The fourth part of the circumference, or 90°, is called a quadrant, and subtends a right angle at the centre. A right angle is thus described as 90°, and every angle is measured by the number of degrees, minutes, and seconds in the arc or portion of the circumference which subtends or lies opposite to it.

I. *Circular Measure of Angles.*—Trigonometry, it has been before observed, is, in its primary signification, the science which deals with the relations existing between the sides and angles of triangles. But to enable us to deal freely with such utterly dissimilar expressions as *lines* and *angles* in combination with each other, it is necessary to bring them—to speak figuratively—"to the same denomination;" and a system called *circular measure* has been devised, by which any angle may be described (or, in other words, its size expressed) by a statement of the ratio existing between two lines, both of which are known, and both of which may be obtained without difficulty for any given angle. The unit by which all angles are measured on this system is *that angle whose subtending arc is equal in length to the radius*, and is called the *circular unit*, as the angle A C U in Fig. 1, where arc A U = radius A C.

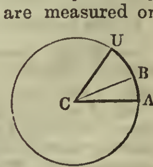


Fig. 1.

To express any other angle, A C B, in terms of the circular unit:—Let A be the value sought, a the subtending arc, and r the radius. By Euclid VI. 33—

$$\widetilde{ACB} : ACU : : \text{arc } AB : \text{arc } AU;$$

but A C U is the unit, or 1, and arc A U = radius.

$$\text{Therefore} \quad A : 1 : : a : r,$$

$$\text{or } A = \frac{a}{r}. \quad \ldots\ldots\ldots\ldots \quad (1)$$

That is to say, the size or value of an angle may be expressed in circular measure by the ratio subsisting between the arc and the radius, or more specifically *by dividing the arc by the radius*. We have thus found means to express the size of an angle by the relation between the length of two *lines*.

By a calculation based upon the more abstruse results of the science, it has been ascertained approximately that the circumference of a circle = the diameter × 3·14159. This number occurs so frequently, that it is the custom to represent it by a symbol—the Greek letter π (pronounced *pi*). As diameter = twice radius, we have—

$$\text{Circumference} = 2\,\pi\, r. \qquad (2)$$

$$\text{Whence the arc subtending a right angle} = \frac{\pi r}{2}, \qquad (3)$$

since a right angle is subtended by a quadrant, or one-fourth of the circumference.

Let any angle of A° be subtended by an arc, a; then, by the last formula, and by Euclid VI. 33, before quoted—

$$A^\circ : 90^\circ :: a : \frac{\pi r}{2}. \qquad \text{Whence } \frac{A^\circ}{90^\circ} = \frac{a}{\frac{\pi r}{2}} = a \cdot \frac{2}{\pi r}.$$

$$\text{Multiplying by } 90^\circ,\ A^\circ = \frac{180^\circ}{\pi} \cdot \frac{a}{r}. \qquad (4)$$

From this either arc, radius, or angle (in common measure) may be found when the other two are given. Thus: To what radius is an arc of 10 feet drawn which subtends an angle of 12°?

$$\text{By (4) } 12^\circ = \frac{180^\circ}{3{\cdot}14159} \cdot \frac{10}{r}.$$

$$\text{Whence } 12\,r = \frac{180}{3{\cdot}14159} \times 10, \text{ and } r = \frac{1800}{3{\cdot}14159 \times 12} = 47{\cdot}74 \text{ ft.}$$

To express the circular unit in sexagesimal measure :—

By (4), since in this case $a = r$,

$$\text{Circular unit} = \frac{180^\circ}{\pi} \times \frac{r}{r} = \frac{180^\circ}{3{\cdot}14159} = 57{\cdot}29578^\circ\ (= 206{,}265'').$$

Substituting $\frac{\pi r}{2}$ [see (3)] for a in (1), we get—

$$\text{Circular measure of right angle} = \frac{\pi}{2}.$$

II. "*Functions*" *of an Angle.*—Although circular measure gives us one means of describing or measuring an angle by lines only, there are other more convenient lines pertaining to every angle than the arc and radius above referred to. They are found by constructing (according to directions given hereafter) a certain simple geometrical figure, the chief parts of which are the angle (which we will call A) and a circle. The lines so produced bear varying ratios to each other as the angle A varies in size; *consequently their ratios form measures of the angle.* These lines —or, more properly, their ratios to the radius to which the circle is drawn—are called "functions of the angle," and their ratios to the radius, for any *given* angle, are always the same, whatever be the length of the radius.

The practical utility of this system of lines or "functions" lies in the fact that the figure includes a right-angled triangle, of which the angle A forms part, and that all the functional lines before mentioned either are or may be represented by sides of this triangle. The scale to which the figure is drawn (dependent on the radius adopted for the circle) does not alter the shape of the triangle, or, consequently, the angle-measuring ratios (as we may style them) which exist between its sides. In short, we have now the means of describing (or measuring) every angle which forms part of a right-angled triangle *in terms of the sides*, an enormous practical convenience, upon which the whole science of Trigonometry is based; for it must be remembered that all plane rectilineal figures which require to be calculated may be split up into such triangles, and thus dealt with in detail.

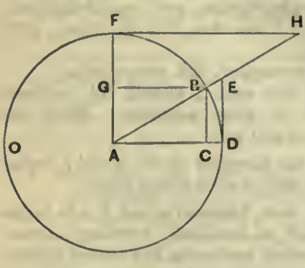


Fig. 2.

To explain the foregoing :— Let the angle be D A B in Fig. 2, of less than 90°. Placing one limb, A D, in a horizontal position, take any length A D or A B as a radius, and describe the circle D B O. From the extremity of one radius, A B, let fall the perpendicular, B C, upon the other. B C is called the *sine* of the angle B A D to the radius chosen (A B in this case). At the extremity of the radius A D draw the perpendicular D E, to meet the other radius (produced). D E is called the *tangent*, and A E the *secant* of the angle D A B, to the radius chosen.

The difference between an acute angle and a right angle is called its *complement* (*i.e.*, the angle lacking to complete or fill up the right angle); thus, the complement of D A B is clearly B A F. A slight inspection of the figure shows that B G holds the same relation to B A F that B C holds to D A B; B G is therefore the sine of B A F, F H its tangent, and A H its secant. Now the function of any angle is said to be the co-function of its complement; thus B G is the *cosine*, F H the *cotangent*, and A H the *cosecant* of D A B, just as the three lines described in the last paragraph are respectively the cosine, cotangent, and cosecant of B A F. It is not, however, usual to speak of "co functions;" all six of the lines described above (or, rather, their ratios to the radius) are called functions of D A B. Two others, not of much utility, are sometimes introduced—viz., C D, the *versed sine*, and the corresponding line G F, the *coversed sine* of D A B.

We will now express the above functions of B A C in terms of the sides of the triangle A C B. The functions are *the ratios borne by certain lines to the radius* in the figure just described; and as a ratio or proportion may always be expressed in the form of a fraction, the functions may be obtained *by dividing these lines by the radius.* $\frac{BC}{AB}$ is therefore a correct expression of the value of the sine of B A C, A B being a radius. A B, A D, and A F, being all radii, are equal and interchangeable. So are B G and A C. Moreover, the triangles A F H, E D A, and A C B are evidently equiangular, and therefore, by Euclid VI. 4, the same ratios exist between their corresponding sides; for instance, F H : A F : : A C : C B, or $\frac{FH}{AF} = \frac{AC}{CB}$. Bearing these considerations in mind, and putting A for the angle B A C, and using the common abbreviations, we get the following list :—

$$\sin. A = \frac{BC}{AB}. \qquad \cot. A = \frac{FH}{AF} = \frac{AC}{BC}.$$

$$\cos. A = \frac{BG}{AB} = \frac{AC}{AB}. \qquad \sec. A = \frac{AE}{AD} = \frac{AB}{AC}.$$

$$\tan. A = \frac{DE}{AD} = \frac{BC}{AC}. \qquad \text{cosec. } A = \frac{AH}{AF} = \frac{AB}{BC}.$$

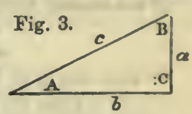
$$\text{Moreover,}\quad \text{vers. } A = \frac{DC}{AB} = \frac{AD - AC}{AB} = \frac{AB - AC}{AB} = 1 - \frac{AC}{AB}$$

$$= 1 - \cos. A. \qquad (5)$$

$$\text{And}\quad \text{covers. } A = \frac{FG}{AB} = \frac{AF - AG}{AB} = \frac{AB - BC}{AB} = 1 - \frac{BC}{AB}$$

$$= 1 - \sin. A. \qquad (6)$$

Fig. 2 having served its purpose of giving a *raison d'être* for this list, and some explanation of the otherwise meaningless names of the functions, may now be laid aside. The right-angled triangle, which is its one claim to notice, reappears in a permanent form in Fig. 3, with its angles indicated by the same capitals as before, and its sides by italics, a being the side opposite to A, and so on. C being the right angle, c is the *hypothenuse*, and b is "the side adjacent to the angle." The angle B is the *complement of* A, since the two acute angles in a right-angled triangle must always equal one right angle (for all the angles of *every* triangle = *two* right angles).

Fig. 3.


To suit the altered lettering, we append a new list of functions :—

$$\sin. A = \frac{a}{c}. \qquad \tan. A = \frac{a}{b}. \qquad \sec. A = \frac{c}{b}.$$

$$\cos. A = \frac{b}{c}. \qquad \cot. A = \frac{b}{a}. \qquad \text{cosec. } A = \frac{c}{a}.$$

It is plain that, if we know the numerical value of any one of these ratios, we can find A. In other words, if the ratio between any two sides of a right-angled triangle is given, we can define all the angles. By means which cannot yet be explained, a table of ratios for all angles (in degrees and minutes) under 90° has been drawn up, by reference to which the angle corresponding to any given ratio can be identified at once. This is called the table of *natural sines and cosines.* and from it all other functions can be readily obtained by means of the equations in the next section. Tables have also been computed of *the logarithms* of these numerical values, including every function of all the angles just mentioned. By substituting the logarithmic values for the natural or actual values of the ratios, the processes of calculation are immensely facilitated, just as lengthy calculations of natural numbers are often solved with little trouble by the aid of their logarithms. In the next lesson we will find the natural sines, etc., of two or three angles which can be solved geometrically; but, as stated above, the solution in most cases rests upon other and more abstruse grounds.

III. *Relations of Trigonometrical Ratios to one another.*—Since the square of the hypothenuse of a right-angled triangle = the squares of the other two sides (Euclid I. 47), we have, by Fig. 3—

$$a^2 + b^2 = c^2.$$

Dividing by c^2, $\dfrac{a^2}{c^2} + \dfrac{b^2}{c^2} = \dfrac{c^2}{c^2}$; *i.e.*, $\left(\dfrac{a}{c}\right)^2 + \left(\dfrac{b}{c}\right) = 1$;

or, $\quad \sin.^2 \mathrm{A} + \cos.^2 \mathrm{A} = 1. \quad \ldots \quad \ldots \quad \ldots \quad (7)$

Dividing the first equation by b^2, we get $\left(\dfrac{a}{b}\right)^2 + 1 = \left(\dfrac{c}{b}\right)^2$;

or, reversing the order, $\quad \sec.^2 \mathrm{A} = 1 + \tan.^2 \mathrm{A}. \quad \ldots \quad (8)$

Dividing the same by a^2, we get $1 + \left(\dfrac{b}{a}\right)^2 = \left(\dfrac{c}{a}\right)^2$;

or, reversing as before, $\quad \operatorname{cosec.}^2 \mathrm{A} = 1 + \cot.^2 \mathrm{A}. \ldots \quad (9)$

$$\text{Since } \frac{a}{b} \cdot \frac{b}{a} = 1, \quad \tan. \mathrm{A} \cdot \cot. \mathrm{A} = 1. \quad \ldots \quad (10)$$

$$\text{Again, } \tan. \mathrm{A} = \frac{a}{b} = \frac{\frac{a}{c}}{\frac{b}{c}}, \quad \therefore \tan. \mathrm{A} = \frac{\sin. \mathrm{A}}{\cos. \mathrm{A}}. \quad \ldots \quad (11)$$

$$\text{Again, } \cot. \mathrm{A} = \frac{b}{a} = \frac{1}{\frac{a}{b}}, \quad \therefore \cot. \mathrm{A} = \frac{1}{\tan. \mathrm{A}}. \quad \ldots \quad (12)$$

$$\text{Again, } \cot. \mathrm{A} = \frac{b}{a} = \frac{\frac{b}{c}}{\frac{a}{c}}, \quad \therefore \cot. \mathrm{A} = \frac{\cos. \mathrm{A}}{\sin. \mathrm{A}}. \quad \ldots \quad (13)$$

$$\text{Again, } \sec. \mathrm{A} = \frac{c}{b} = \frac{1}{\frac{b}{c}}, \quad \therefore \sec. \mathrm{A} = \frac{1}{\cos. \mathrm{A}}. \quad \ldots \quad (14)$$

$$\text{Again, } \operatorname{cosec.} \mathrm{A} = \frac{c}{a} = \frac{1}{\frac{a}{c}}, \quad \therefore \operatorname{cosec.} \mathrm{A} = \frac{1}{\sin. \mathrm{A}}. \quad \ldots \quad (15)$$

From these equations, (7) to (15), we can find the value of any function in terms of any other function, as in the following examples:—

It has already been shown, in (5) and (6), that

$$\text{vers. } \mathrm{A} = 1 - \cos. \mathrm{A}.$$
$$\text{covers. } \mathrm{A} = 1 - \sin. \mathrm{A}.$$

To show sin. A *in terms of cos.* A, *and vice versâ:*

From (7) we get $\quad \sin.^2 \mathrm{A} = 1 - \cos.^2 \mathrm{A}.$

$$\therefore \sin. \mathrm{A} = \sqrt{1 - \cos.^2 \mathrm{A}}. \quad \ldots \quad \ldots \quad \ldots \quad (16)$$

And similarly, $\quad \cos. \mathrm{A} = \sqrt{1 - \sin.^2 \mathrm{A}}. \quad \ldots \quad (17)$

Cot. in terms of sin.—By (13) and (17),

$$\cot. \mathrm{A} = \frac{\cos. \mathrm{A}}{\sin. \mathrm{A}} = \frac{\sqrt{1 - \sin.^2 \mathrm{A}}}{\sin. \mathrm{A}}. \quad \ldots \quad \ldots \quad (18)$$

Cos. in terms of tan.—By (14), $\quad \cos. \mathrm{A} = \dfrac{1}{\sec. \mathrm{A}}$;

whence, by (8), $\quad \cos. \mathrm{A} = \dfrac{1}{\sqrt{1 + \tan.^2 \mathrm{A}}}. \quad \ldots \quad (19)$

Cosec. in terms of sec.—Using consecutively (15), (16), and (14),

$$\operatorname{cosec.} \mathrm{A} = \frac{1}{\sin. \mathrm{A}} = \frac{1}{\sqrt{1 - \cos.^2 \mathrm{A}}} = \frac{1}{\sqrt{1 - \frac{1}{\sec.^2 \mathrm{A}}}} = \frac{1}{\frac{\sqrt{\sec.^2 \mathrm{A} - 1}}{\sec.^2 \mathrm{A}}}$$

$$= \frac{1}{\frac{\sqrt{\sec.^2 \mathrm{A} - 1}}{\sec. \mathrm{A}}}. \quad \therefore \operatorname{cosec.} \mathrm{A} = \frac{\sec. \mathrm{A}}{\sqrt{\sec.^2 \mathrm{A} - 1}}. \quad (20)$$

Sin. in terms of tan.—By (11) and then (19),

$$\sin. \mathrm{A} = \tan. \mathrm{A} \cos. \mathrm{A} = \tan. \mathrm{A} \cdot \frac{1}{\sqrt{1 + \tan.^2 \mathrm{A}}}.$$

$$\therefore \sin. \mathrm{A} = \frac{\tan. \mathrm{A}}{\sqrt{1 + \tan.^2 \mathrm{A}}}. \quad \ldots \quad \ldots \quad \ldots \quad (21)$$

Other important results are—

$$\text{From (8), } \tan. \mathrm{A} = \sqrt{\sec.^2 \mathrm{A} - 1}. \quad \ldots \quad \ldots \quad (22)$$
$$\sec. \mathrm{A} = \sqrt{1 + \tan.^2 \mathrm{A}}. \quad \ldots \quad \ldots \quad (23)$$
$$\text{From (9) } \cot. \mathrm{A} = \sqrt{\operatorname{cosec.}^2 \mathrm{A} - 1}. \ldots \quad \ldots \quad (24)$$
$$\operatorname{cosec.} \mathrm{A} = \sqrt{1 + \cot.^2 \mathrm{A}}. \quad \ldots \quad \ldots \quad (25)$$

The learner should take the trouble to express *every* function in terms of every other function, writing down both reasoning and results in each case, and will thus acquire a great and most useful familiarity with the ratios existing between the various functions. Only the plain rules for solving simple equations are required for this.

EXERCISE 1.

1. If tan. A = 0·8, calculate sin. A (say to four places of decimals).

By (21) $\sin. \mathrm{A} = \dfrac{\tan. \mathrm{A}}{\sqrt{1 + \tan.^2 \mathrm{A}}} = \dfrac{\cdot 8}{\sqrt{1 + \cdot 64}} = \dfrac{\cdot 8}{\sqrt{1 \cdot 64}} = \dfrac{\cdot 8}{1 \cdot 2806} = Ans.$

2. If cos. A = 0·45, calculate sin. A.
3. If tan. A = 0·22, calculate cos. A.
4. What is the value of sin. A when cosec. A = 1·25 ?
5. Calculate cot. A on the assumption that tan. A = $\frac{1}{3}$.
6. If versin. A = $\frac{1}{2}$, calculate all the other functions of A.
7. Show that cosec. A − sin. A = cos. A cotan. A.
8. Show that $\dfrac{1 + \cos. \mathrm{A}}{\sin.^2 \mathrm{A}} = \dfrac{1}{1 - \cos. \mathrm{A}}$.

LESSONS IN GREEK.—XLII.

STRENGTHENED STEMS (*continued*).

III. *Verbs whose Pure Stem is in the Present and Imperfect strengthened by the insertion of* αν (*less often* αιν) *before the terminations.*

(*a*) *ἄν or* αιν *is introduced without any other change.*

All verbs of this kind form their tenses from a triple stem—namely, the present and imperfect from the strengthened stem, the second aorist from the pure stem, the future and perfect from a third stem which arises from the pure stem and an added ε, which in the inflection passes into η. The α in the termination ανω is short.

1. αισθανομαι, *I feel*, aor. ησθ-ομην, αισθεσθαι; perf. ησθημαι, fut. αισθησομαι.
2. ἁμαρτανω, *I miss the mark*, *fail*, *sin*, aor. 2 ἡμαρτον, fut. ἁμαρτησομαι, perf. ἡμαρτηκα, perf. pass. ἡμαρτημαι, aor. pass. ἡμαρτηθην.
3. απεχθανομαι, *I am hateful*, aor. απηχθομην, inf. απεχθεσθαι, fut. απεχθησομαι, perf. απηχθημαι (*I am hated*).
4. αυξανω (and αυξω), *I increase*, fut. αυξησω, aor. 1 ηυξησα (perf. ηυξηκα), perf. pass. ηυξημαι, fut. pass. αυξησομαι, aor. pass. ηυξηθην.
5. βλαστανω, *I sprout*, aor. 2 εβλαστον, fut. βλαστησω, perf. εβλαστηκα and βεβλαστηκα.
6. δαρθανω, commonly as a compound—καταδαρθανω, *I sleep*, aor. 2 κατεδαρθον, fut. καταδαρθησομαι, perf. καταδεδαρθηκα.
7. ολισθανω, *I slip*, *I slide*, aor. 2 ωλισθον, fut. ολισθησω, perf. ωλισθηκα.
8. οσφραινομαι, *I smell*, aor. 2 ωσφρομην, fut. οσφρησομαι.
9. οφλισκανω, *I am liable*, *I owe*, aor. 2 ωφλον, fut. οφλησω, perf. ωφληκα, perf. mid. or pass. ωφλημαι. Mark the double strengthening in ισκ and αν.

(*b*) *ἄν is added, together with the insertion of the nasal* ν, *before the characteristic consonant of the pure stem.*

Thus in λανθανω, pure stem λαθ-, between α and θ, ν is introduced, forming λανθ-, to which αν is added, forming λανθαν-. The short vowel in the pure stem passes in the tenses (except the second aorist) into the corresponding long one: μανθανω is an exception. The ν before a *p* sound and a *k* sound undergoes the usual changes.

10. θιγγανω (pure stem θιγ), *I touch*, aor. 2 εθιγον, fut. θιξομαι.
11. λαγχανω, *I obtain by lot*, aor. 2 ελαχον, fut. ληξομαι, perf. ειληχα, perf. mid. or pass. ειληγμαι, aor. pass. εληχθην.

12. λαμβανω, *I take*, aor. 2 ελᾰβον, imperat. λαβε, fut. ληψομαι, perf. ειληφα, perf. mid. or pass. ειλημμαι, aor. mid. ελαβομην, aor. pass. ειληφθην.
13. λανβανω, *I lie concealed*, aor. 2 ελαθον, fut. λησω, perf. λεληθα (*I am concealed*); mid. επιλανθανομαι, *I forget*, aor. επελαθομην, fut. επιλησομαι, perf. επιλελησμαι.
14. πυνθανομαι, *I ask, inquire, learn*, aor. επυθομην, perf. πεπυσμαι, πεπυσαι, etc., fut. πευσομαι.
15. μανθανω, *I learn*, aor. εμᾰθον, fut. μαθησομαι, perf. μεμαθηκα. The α, contrary to the rule, remains short.
16. τυγχανω, *I hit the mark, I get, obtain* (with gen.), *it happens*, aor. 2 ετῠχον, fut. τευξομαι, perf. τετυχηκα (ΤΥΧΕ).

VOCABULARY.

- Αγγελια, -ας, ἡ, message.
- Αγε, come! come then! (imperat. of αγω, I lead).
- Αναστρεφω, I turn round (trans. and intrans.).
- Ανθεμον, το, bloom, flower.
- Βουλευμα, -ᾰτος, το, a counsel, determination.
- Βραχυς, -εια, -υ, short.
- Γενναιος, -α, -ον, of noble race, noble, brave.
- Δευρο, hither.
- Δοκεω, I think, I am of opinion, I seem.
- Ελπομαι (poet. of ελπιζω), I hope (ελπις).
- Επαρκεω (with dat.), I help.
- Επιβουλη, -ης, ἡ, a plot.
- Επιορκεω, I forswear myself, I swear falsely (with acc.).
- Ευεργεσια, -ας, ἡ, a benefit.
- Εξαμαρτανω, I fail, sin (here the εξ strengthens the meaning).
- Ιδιος, -α, -ον, one's own.
- Καμηλος, -ου, ὁ and ἡ, a camel.
- Καταδαρθανω, I sleep, fall asleep.
- Λυγρος, -α, -ον, sad.
- Οπισω, behind.
- Προσηκων, -ηκουσα, -ηκον, gen. -ηκοντος, seemly, suitable.
- Πω (enclitic), in some way.
- Συμφορα, -ας, ἡ, an event, especially misfortune.
- Χθων, -ονος, ἡ, the earth.
- Χρυσιον (dimin. of χρυσος), το, gold.
- Ὡς, as; ὡς ταχιστα, as quickly as possible, as soon as.

EXERCISE 125.—GREEK-ENGLISH.

1. Λησειν δια τελους μη δοκειτω ὁ πονηρος. 2. Δικαια δρασας συμμαχου τευξῃ Θεου. 3. Γραμματα μαθειν δει και μαθοντα νοῦν εχειν. 4. Ὁ βασιλευς της προς ἑαυτον επιβουλης ουκ ῃσθετο. 5. Οἱ Περσαι τοις Ἑλλησιν απηχθοντο. 6. Φιλιππος αυτος απεφαινετο δια χρυσιου μαλλον, η δια των ὁπλων ηυξηκεναι την ιδιαν βασιλειαν. 7. Οἱ στρατιωται βραχυν χρονον κατεδαρθον. 8. Ὡς ωσφροντο ταχιστα των καμηλων οἱ ἱπποι, οπισω ανεστρεφον. 9. Θεον επιορκων μη δοκει λεληθεναι. 10. Καλον· μηδεν εις φιλους ἁμαρτειν. 11. Μακαριος οστις ετυχε γενναιου φιλου.

EXERCISE 126.—ENGLISH-GREEK.

1. The king is aware of the plot against him. 2. Who (τίς) has not erred (*sinned*)? 3. Wise men do not err (*it is not of wise men to err*) twice in the same thing. 4. The wicked man is hateful to the good. 5. Being wicked you will not lie hidden at last. 6. My brothers in learning (simply the participle) have a learning mind. 7. The good will obtain good things. 8. The men fell asleep. 9. I slept a short time. 10. I have obtained noble friends. 11. I learn to bear misfortune. 12. He lay hid doing a wicked deed (that is, *he did a wicked deed, and was not found out*). 13. They hope to lie hid, being wicked (that is, *they are wicked, and hope not to be discovered*).

IV. *Verbs whose Pure Stem is in the Present and Imperfect strengthened by the addition of the two consonants σκ, or the syllable ισκ.*

Σκ are appended when the characteristic of the stem is a vowel, and ισκ when it is a consonant. Most of the verbs whose pure stem ends in a vowel form the future, etc., after the analogy of pure verbs, as εὑρισκω, fut. εὑρησω (ΕΥΡΕ). Some of these verbs, however, take in the present and imperfect a reduplication, which consists in the repetition of the first consonant of the stem with the vowel ι.

1. ἁλ-ισκ-ομαι (ᾰ), *I am taken, captured* (used of a city), imp. ἡλισκομην; (ʽΑΛΟ) fut. ἁλωσομαι, aor. 2 ἡλων and ἑάλων (μι), *I was taken*; perf. ἡλωκα and ἑάλωκα, *I have been taken*. The active is formed by αἱρεῖν, *to take, overcome*.
2. αρεσκω, *I please*, fut. αρεσω, aor. ηρεσα, perf. mid. or pass. ηρεσμαι, aor. pass. ηρεσθην.
3. γηρασκω (or γηραω), *I grow old*, fut. γηρασομαι, aor. 1 εγηρᾱσα, inf. γηρᾱσαι, perf. γεγηρακα, *I am old*.
4. γιγνωσκω, *I learn, I know* (ΓΝΟ), fut. γνωσομαι, aor. 2 εγνων (μι), perf. εγνωκα, perf. mid. or pass. εγνωσμαι, aor. pass. εγνωθην.
5. διδρασκω, *I run away* (only in compounds, as αποδ-, εκδ-, διαδ-), fut. δρασομαι, perf. δεδρᾱκα, aor. 2 εδρᾱν (μι).
6. εὑρισκω, *I find*, aor. 2 εὑρον, imper. εὑρε (ʽΕΥΡΕ), fut. εὑρησω, perf. εὑρηκα; mid. *I procure*, aor. ευρομην, perf. mid. or pass. εὑρημαι, aor. pass. εὑρεθην.
7. ἡβασκω, *I grow to maturity*, fut. ἡβησω, aor. 1 ἡβησα, perf. ἡβηκα (ἡβαω, *I am young*, but ανηβαω, *I become young again*, rejuvenesco).
8. θνησκω, commonly αποθνησκω, *I die* (ΘΑΝ), aor. 2 απεθανον, fut. αποθανοῦμαι, perf. τεθνηκα (not αποτεθνηκα), fut. 3 τεθνηξω, *I shall be dead*.
9. θρωσκω, *I spring, leap*, aor. 2 εθορον, fut. θοροῦμαι, perf. τεθορα.
10. ἱλασκομαι, *I propitiate*, fut. ἱλᾱσομαι, aor. ἱλᾱσαμην, aor. pass. ἱλασθην.
11. μιμνησκω (with gen.), *I remember* (ΜΝΑ), fut. μνησω, aor. 1 εμνησα, perf. mid. μεμνημαι (Lat. *memini*), subj. μεμνωμαι, -ῃ, -ῆται, imper. μεμνησο, plup. εμεμνημην, opt. μεμνημην, -ῇο, -ῇτο, or μεμνῳμην, -ῷο, -ῷτο, fut. 3, μεμνησομαι, aor. εμνησθην, fut. μνησθησομαι.
12. πασχω, formed from παθσκω (Lat. *patior*), *I suffer*, aor. 2 επᾰθον (ΠΕΝΘ), fut. πεισομαι, perf. πεπονθα.
13. πινισκω, *I drink*, fut. πῑσω, aor. 1 επισα.
14. πιπρασκω, *I sell*, perf. πεπρᾱκα, perf. mid. or pass. πεπρᾱμαι, inf. πεπρᾶσθαι, aor. επρᾱθην, fut. 3 πεπρασομαι.
15. στερισκω (and στερεω), *I deprive, rob*, fut. στερησω, aor. 1 εστερησα; mid. and pass. στερισκομαι, στεροῦμαι, fut. στερησομαι, perf. εστερημαι, aor. εστερηθην.
16. τιτρωσκω, *I wound*, fut. τρωσω, aor. 1 ετρωσα, perf. mid. or pass. τετρωμαι, aor. ετρωθην, fut. τρωθησομαι and τρωσομαι.
17. φασκω, *I am of opinion, I give an opinion, affirm* (the indicative and imperative are very rare), impf. εφασκον, fut. φησω, aor. 1 εφησα.
18. χασκω, *I open the mouth* (ΧΑΝ), aor. 2 εχᾰνον, fut. χανουμαι, perf. κεχηνα, *I stand open*.

Observe that διδασκω, *I teach*, retains the *k* sound in fut., διδαξω, aor. 1 εδιδαξα, perf. δεδιδαχα, aor. pass. εδιδαχθην.

VOCABULARY.

- Αλυπος, -ον, without grief, griefless.
- Αμνημονεω (with gen.), I have not in mind, I do not remember, I forget.
- Δεκας, -αδος, ἡ, the number ten, a decade, or period of ten years.
- Εξευρισκω, I find out, discover.
- Επαναφερω (Lat. *re-fero*), I bring back, refer to something.
- Ευγενης, -ες, well-born, noble.
- Μοιρα, -ας, ἡ, fate, lot.
- Μορσιμος, -ον, determined by fate, fated.
- Πασχω, -ευ, I fare well, receive a favour.
- Πενθεω, I bewail.

EXERCISE 127.—GREEK-ENGLISH.

1. Ολιγους εὑρησεις ανδρας ἑταιρους πιστους εν χαλεποις πραγμασιν. 2. Πασιν ανθρωποις μορσιμον εστιν αποθανεῖν. 3. Πενθοῦμεν τους τεθνηκοτας. 4. Ἡδεως των παλαιων πραξεων μεμνηνται οἱ ανθρωποι. 5. Ουκ αν εὑροις ανθρωπον παντα ολβιωτατον. 6. Η καλως ζην, η καλως τεθνηκεναι, ὁ ευγενης βουλεται. 7. Ει δεινα δι' ὑμετεραν κακοτητα πεπονθατε, μη τι θεοις τουτων μοιραν επαναφερετε. 8. Ει τις γηρασας ζην ευχεται, αξιος εστι γηρασκειν πολλας εις ετων δεκαδας.

EXERCISE 128.—ENGLISH-GREEK.

1. I have found no companion faithful in difficulties. 2. It is fated for thee to die. 3. I bewail my deceased father. 4. They will bewail the deceased general. 5. I gladly call to mind the great men of old (παλαι). 6. I found no man very happy in all respects. 7. I wish to live honourably or to die honourably. 8. Through thy fellow thou wilt suffer much. 9. It is possible to discover many things, but not all. 10. Even the wise have not discovered a life devoid of grief.

KEY TO EXERCISES IN LESSONS IN GREEK.—XLI.

EXERCISE 121.—GREEK-ENGLISH.

1. The expedition will sail to-morrow. 2. A north wind blew against the expedition. 3. In the sea-fight in the Crisean gulf the Peloponnesians slew as many of the Athenians as did not escape by swimming. 4. When the enemy approach the city, the soldiers will snatch up their arms and run to the gates. 5. Human affairs have often been bewailed, even by many wise men who thought that life was a state of punishment. 6. Who would not weep for a friend in misfortune? 7. The citizens hoped that they would escape the enemy. 8. The children will play at ball. 9. Our age has now disturbed faith. 10. The enemy put into confusion the ranks of the Greeks.

VOLTAIC ELECTRICITY.—X.

ELECTRIC DECOMPOSITION (*continued*)—INFLUENCE OF WEAK CURRENTS IN THE FORMATION OF MINERALS—ELECTROTYPING—ELECTRO-PLATING—ETCHING BY ELECTRICITY.

BEYOND those whose lives almost depend upon the amount of knowledge they are able to store in their minds, there is a large class of amateur students, if we may call them so, who adopt such a branch of science as electricity as a hobby or pastime for their leisure hours. When the art of electrotyping first became known there were many of these amateurs of science who took it up, and helped towards bringing it to perfection. With a battery cell and some sulphate of copper they were able to reproduce medals, or fac-simile copies of scarce coins, natural objects, etc.—greatly to their own satisfaction—and thus electrotyping became for a time the rage. But photography, with its beautiful results, and its especial charm of portraiture, came upon the scene, and electrotyping was henceforth committed to trade purposes only. The sun proved to be a far quicker artist than the electric battery; and perhaps also the paintings of the former were more generally attractive than the sculptures of the latter. Experimentally, however, electrotyping is full of interest.

As a continuous current of small intensity is of great moment in many of these experiments, a single cell of Daniell's battery is frequently employed. A slight modification of this, as represented in the annexed figure (Fig. 60), was recommended by the late Dr. Golding Bird. B is the battery cell, which, however, differs from the ordinary construction, the sulphate of copper being placed in the inner vessel, C. This cell is made of glass tube, closed below by a disc of plaster, and inside it is a piece of copper plate usually coiled round so as to present a large surface. The outer cell is filled with a weak solution of salt, and a plate, or sometimes a spiral riband of zinc, is placed at the bottom of it. By means of this cell a weak but nearly uniform current, lasting several weeks, may be obtained.

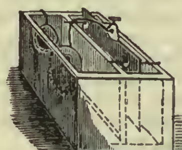


Fig. 63.

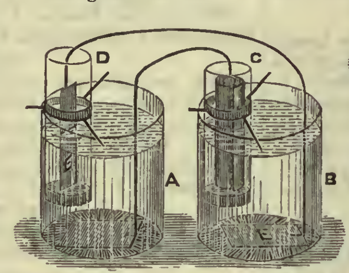


Fig. 60.

The decomposing cell, A, is very similar to that described in our last lesson; the tube, D, being filled as before with the solution to be decomposed. In it is immersed a strip of platinum, E, which is connected with the negative pole of the battery, and serves as the negative electrode, while the plate of zinc in the outer cell is connected with the copper plate in C. The metal is precipitated on the surface of E.

By this apparatus, and a careful choice of the salts employed, nearly all the metals may be deposited, and for the most part they exhibit a highly crystalline structure; this, however, depends to a great extent upon the power of the current generated, it being found as a general rule that when the current is weak the deposit is harder and more polished, while a powerful current causes a more loose and spongy precipitate.

A very interesting series of experiments was conducted some years ago by Mr. Crosse, with a view of ascertaining the effects of weak continuous currents on various minerals, and also to discover how far the formation of many of the rarer minerals could be explained in this way. This gentleman, whose experiments on aërial electricity have already been referred to, was one of the most original investigators of electrical phenomena, and has shown how much may be learnt of the secrets of Nature by patient inquiry into apparently simple phenomena.

He employed a great number of very weak batteries, water being in many of them the exciting liquid. The wires leading from these were then connected with pieces of stone of various kinds, placed in jars so as almost to touch one another, and covered with spring water or solutions of different substances.

After the lapse of some months they were carefully examined, and in most cases crystals of different minerals were formed. Many other remarkable effects were also discovered. In some instances arragonite and other minerals were closely imitated.

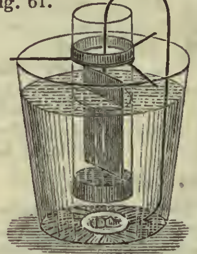
In a similar way, by placing pieces of brick or stone in metallic solutions, crystals and streaks of the metals were formed in their substance. The results of all the experiments seemed to indicate that the electric currents which are known to exist in the crust of the earth have had a great influence in the formation of many minerals, and in the production of metallic veins.

Several works especially devoted to electricity will furnish the student with more detailed accounts of these and similar experiments, which will be found extremely interesting, and will serve as a guide to him in repeating them and trying fresh ones.

The chemical effects of the electric current were at first looked upon merely as scientific curiosities: now, however, they are found to be of great practical importance, as the arts of electrotyping and electro-plating are merely applications of them. Mr. Spencer was the first in this country to discover the art of depositing copper on moulds, though a Russian, named Jacobi, slightly anticipated him. He was, however, quite an independent discoverer, and this is not the only instance in which an important scientific discovery has been effected almost simultaneously by two independent workers.

His apparatus was of the most simple kind; a common glass tumbler (Fig. 61), filled with a solution of sulphate of copper, serving for his outer cell, while a lamp-glass, with its lower end closed by a disc of plaster of Paris, was suspended in it to serve as the inner. This was filled with a weak solution of common salt, and had immersed in it a plate of zinc with a wire fastened to one end. To the other end of this wire a medal was attached, which was placed in the copper solution immediately under the porous disc. In a short time the copper from the solution began to deposit on the coin, and after the lapse of a few hours it was thick enough to be removed, when it was found to present an exact copy of the original, every line and mark being faithfully and accurately reproduced.

Fig. 61.



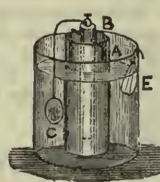


Fig. 62.

On repeating the experiment with the same coin, intending to procure a thicker copy, the deposit was found to adhere so closely that it could not be removed. To guard against the recurrence of this, the object to be copied was warmed and rubbed over with wax, which was then wiped off as cleanly as possible. Enough, however, remained to prevent the deposited metal uniting with the coin, and when a sufficiently stout layer of copper had been thrown down, it was taken from the solution, and on being held over the flame of a spirit-lamp, the cast at once separated from the original. Of course the cast was a reverse, the raised parts in the one being sunk in the other. By employing it, however, as a fresh mould, and depositing on that, an exact reproduction of the original was obtained, and any number of these could be procured from the mould.

The next great step in this art was the discovery that non-metallic substances might be employed for the construction of the mould, if some conducting material were applied to their surface. Considerable difficulty and expense would frequently be incurred were a metal mould indispensable; in fact, but little practical application could be made of the art. Now, however, the mould is made of some material easily worked, common white wax mixed with a little spermaceti being most usually employed. Gutta-percha and similar substances are, however, frequently used, and answer well. The surface of these is thoroughly rubbed over with finely-powdered black lead, and a wire is then fastened to one side of the mould, by which it is connected with the zinc plate.

We must refer the student who wishes to become acquainted with all the practical details of the process, to one of the many works specially treating of the subject. These will give

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full particulars as to the best modes of proceeding, and the causes and remedies of the failures he may meet with. In these lessons we can only indicate the principles and general outline of the art.

The single-cell system is the simplest, and for ordinary purposes will answer well. The whole may then be arranged as shown in Fig. 62. A porons cell, A, of unglazed earthenware, similar to those employed in Daniell's battery, must be procured, and filled with a weak solution of sulphnric acid (one part of acid to from twelve to twenty parts of water) or of brine. A zinc rod or plate, B, is immersed in this, and suspended by a plug driven through a hole in it, so that it may not touch the sides of the cell. This is then placed in a vessel, D, filled with a saturated solution of sulphate of copper, to which a little sulphuric acid has been added. As this solution would decrease in strength

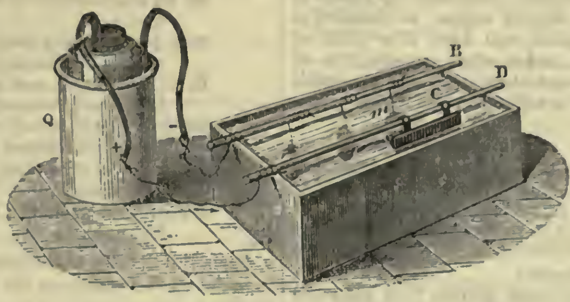

Fig. 64.

by use, a small bag, E, of muslin or calico, filled with crystals of the salt, is suspended in the vessel, and serves to maintain the strength. The wax cast of the medal having been well covered with black lead, is now immersed in this solntion, care being taken to guard against air-bubbles remaining on its surface; the wire connected to it is then fastened to the binding-screw on the top of the zinc rod. All is now complete, and if the arrangements have been properly carried out, a deposit of copper will shortly be formed on the wire, and then will spread gradually over the face of the wax. The length of time required to form a deposit sufficiently thick to be removed with safety depends upon the strength of the exciting solution. It is usually found, however, that about twenty-four or thirty hours is snfficient. It

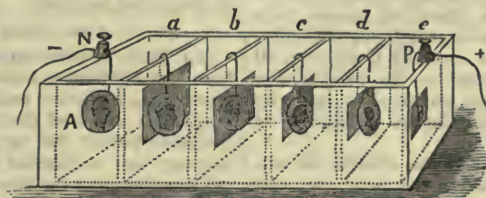

Fig. 65.

is better to employ a somewhat weak exciting liquid, as many more failures are caused by the power of the battery being too great than by its being too small. When the cnrrent is powerfnl the metal is deposited more rapidly, but it has a much coarser grain, and is as a result much more brittle and nneven in texture.

Sometimes the inner cell is dispensed with, and a partition of porous wood or earthenware is made across the cell (Fig. 63), so that the acid with the zinc plate in it may be in one compartment, and the copper solution in the other.

Though very good results may be obtained in this way, it is considered preferable to employ a battery and decomposing cell separate from one another. If an ordinary battery is employed, it should, however, be as constant as possible, and be charged with a weak exciting liquid. The object to be copied is then placed in the decomposing cell and connected with the

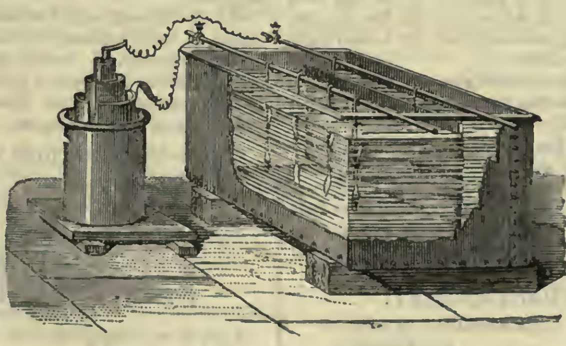
Fig. 66.

negative pole, while at a little distance from it there is snspended a sheet of copper connected with the positive pole. Fig. 64 will illustrate the arrangement, Q being the battery, and the sqnare vessel the decomposing trough. Two metallic rods, B and D, are laid across this, and connected respectively with the two poles of the battery. From one of these the sheet of copper is suspended, while from the other hang the monlds on which the copper is to be precipitated: care mnst be taken that this one is connected with the zinc of the battery. Several moulds may be acted on at the same time as shown.

From what has already been said, it will be at once nnderstood that the solution of sulphate of copper will be decomposed, and its copper thrown down on the negative pole, while a similar amonnt of copper will be dissolved at the positive electrode. Thus the copper plate, C, will lose as much in weight as the moulds will gain. The addition of crystals of the sulphate is therefore, in this case, entirely unnecessary.

When this plan is adopted it is well to allow rather more time than with the single cell, as then a more pliable deposit is obtained. The temperature, has, however, a considerable effect in altering the speed of the process, the action being much more rapid when the temperature of the solntion is high, while in cold weather scarcely any deposit can be obtained without warming it.

There is one disadvantage in the nse of a vertical trough, and that is that the solution becomes rather stronger at the lower part, and consequently the deposit of copper is thicker at the lower side of the mould than at the npper. With a small mould the difference is too slight to be of much practical importance, but with a large one it would cause inconvenience, and seriously interfere with the result. To obviate this, the cell is so constructed that the copper plate may lie flat on the bottom, and the mould is then snspended face downwards over it; and in this way a uniform thickness is attained.

When several moulds have to be operated upon, a great saving may be effected by using a trough divided by means of partitions into a number of separate cells, as shown in Fig. 65. The cells, *a*, *b*, *c*, *d*, *e*, are virtually so many distinct cells; separate vessels may indeed be employed if more convenient. At the ends of the trough binding-screws, N and P, are placed; to one of these is fixed one of the moulds, A; to the other a plate of copper, B. The different moulds are now taken, wires are fixed to them in the usual way, and to the other ends of these wires plates of copper are attached. Each wire is then bent so that the copper may be in one cell and the mould in the next; and the whole is arranged so that the moulds may all face towards the positive pole, as shown in the figure.

The negative battery wire may now be connected with N, and the positive should be placed against the copper plate in cell *a*, nntil a deposit begins to form on the mould in that cell; then it may be moved to the plate in *b*, and so on till it reaches the last plate, B, when it may be fastened to the screw, P. This will render the action more regular and certain in all the cells.

The great advantage attending the use of this compound trongh is that for every eqnivalent of zinc consumed in the battery, an equivalent of copper will be deposited in *each* cell, and thus if there are five cells, only about one-fifth the amount of zinc will be dissolved that would be required if the other plan were adopted. In the application of the art to business this is a matter of great importance.

One of the most interesting, if not important applications of electrotyping is to the art of pictorial illnstration. Althongh the pictures and diagrams in the POPULAR EDUCATOR and other publications are rightly described as woodcuts—in that they are cut by the engraver upon blocks of box-wood—such blocks are not submitted to the press for printing from. A certain number of copies might be so produced, but long before the many thousands required were obtained the wood-block would be worn out. To obviate this difficulty, the block, after being engraved, is moulded in soft gutta-percha. This mould is afterwards given a conducting surface by the means already explained, and is then fit for metallic deposition by means of the electric current. The thin shell of copper so obtained is afterwards backed up by type-metal, and fixed to a block of mahogany, so that in dimensions, and in other respects, it is an exact fac-simile of the original wood-block, with the exception that its surface is hard enough to withstand the rough usage of the press.

Electro-plating is an art of no less importance than electrotyping, and it is carried on in a similar way. The difference between them is that in the former a layer of some superior metal, usually gold or silver, is deposited on a foundation of some baser material in such a way as to be permanently united with it, while in the latter the layer of metal must be strong enough to be separated from the mould.

In electro-plating, too, it is the outer surface that has to be seen; the deposit must, therefore, be more even and polished; the operation is, however, very similar. The decomposing trough must, of course, contain a solution of the metal to be precipitated, and also a plate of it in order to maintain the strength. Fig. 66 shows the usual arrangement of the apparatus. The surface of the metal is nearly always dull when it leaves the trough; it is, however, scoured with a wire brush and afterwards burnished, and is susceptible of a very high polish.

With some metals it is found almost impossible to make a deposit of silver adhere; they are, therefore, coated with copper first, and to this the silver adheres without difficulty. The surface has, however, to be most carefully freed from all grease or tarnish before being immersed in the decomposing trough. The solution of silver usually employed is made by dissolving cyanide of silver in a weak solution of cyanide of potassium.

Etching may also be done by means of the electric current. The surface of the copper plate is coated in the usual way with wax, and the design traced on it so as to remove the wax from the lines. It is then connected with the positive pole of the battery, and the copper is eaten away from the exposed places in a more even and regular way than it would be by an acid.

It may be mentioned here that some of these chemical effects may be produced to a limited extent by means of a current of frictional electricity. If we take a piece of blotting-paper, and, having moistened it with a solution of iodide of potassium and starch, lay on it a piece of wire connected with the prime conductor, and near to this another connected with the rubber or the ground, iodine will be evolved at the former, and its presence shown by a blue stain on the paper.

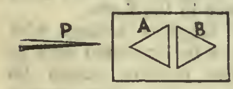

Fig. 67.

Another plan of showing these effects is to take two triangular pieces of paper (Fig. 67)—one, A, coloured blue by litmus, the other B, coloured with turmeric—and moisten both with a solution of sulphate of soda, having laid them on a piece of glass. Now hold A to a point, P, fixed in the conductor; in a little time it will turn red, thus indicating the presence of free acid, while B will turn brown from the alkali set free.

LESSONS IN GERMAN.—LXII.

§ 73.—AUXILIARIES OF THE SECOND CLASS.

(1.) The second class of auxiliaries embraces the following:—

Ich mag, I am allowed (may).
Ich will, I will (purpose).
Ich soll, I am obliged (shall).
Ich kann, I am able (can).
Ich darf, I am permitted; I dare.
Ich muß, I am obliged (must).
Ich lasse, I let.

(2.) These verbs are, for the most part, very irregular in conjugation, and serve simply the purpose of modifying other verbs with the ideas of *liberty, possibility*, or *necessity*, and the verbs thus modified are required to be in the infinitive mood; thus, er mag lachen, he *may* (has permission to) laugh; ich kann schreiben, I *can* (am able to) write; where lachen and schreiben are both in the infinitive, governed respectively by mag and kann.

(3.) In the perfect and pluperfect tenses, however, the past participle of these verbs is used only when the principal verb is not expressed. Its place is supplied, in such cases, by the infinitive, the translation, of course, being the same in either case; as:—

Ich habe ihn sehen können (instead of gekonnt), I have been able to see him.
Er hat warten müssen (instead of gemußt), he was obliged to wait.
Man hätte über ihn lachen mögen (instead of gemocht), one might have laughed at him.
Er hat dem Befehle nicht gehorchen wollen (instead of gewollt). he has not been willing to obey the command.
Ich habe sein Geheimniß wissen dürfen (instead of gedurft), I have been allowed to know his secret.
Sie hätten es thun sollen (instead of gesollt), they ought to have done it.
Sie haben ihn gehen lassen (instead of gelassen), they have suffered him to go.

For a full display of the forms of the verbs, and for further remarks on their uses, see the Section on the *Mixed* Conjugation (§ 83).

The verb lassen (*to let*) does not belong to the Mixed conjugation. This verb is used either in *permitting* or *commanding*; as, ich habe ihn gehen lassen, I have *allowed* him to go; ich habe ihn kommen lassen, I have *ordered* him to come; which two meanings are near akin. When used with a reciprocal pronoun, it has its equivalent in such phrases as *can, is to, ought to, may*; as, das läßt sich nicht thun, that cannot be done; literally, *does not allow itself* to be done. The infinitive active after lassen must often be translated passively.

§ 74.—CONJUGATION OF VERBS.

(1.) There are two conjugations of verbs. the *Old* and the *New*. The difference between them lies mainly in the mode of forming the imperfect tense and the perfect participle.

(2.) The verbs of the Old form are commonly denominated *Irregular Verbs*. But as nearly all the primitive verbs in the language are conjugated in this way, and few, except the derivative verbs (now the larger class), ever assume the other form, it is the custom of the best German grammarians to adopt the classification which we have given. This will occasion no confusion or inconvenience to those who prefer the common classification; since it is only necessary to remember that the *things* are the same, though the *names* have been changed.

(3.) In order to afford the ready means of comparing the *terminational* differences between the Old and New forms of conjugation, we subjoin the following tabular view of the *simple tenses and participles*, in which alone differences of this kind can exist.

(4.) In the compound tenses, the *auxiliary* alone being subjected to terminational variation, the mode of inflecting these tenses becomes of course perfectly uniform in all classes of verbs. Hence, to secure a complete acquaintance with the forms of the compound tenses, little more is necessary than a bare inspection of the paradigms.

§ 75.—TERMINATIONS OF THE SIMPLE TENSES.

Old Conjugation. *New Conjugation.*

		Old: Indicative.				Old: Subjunc.			New: Indicative.				New: Subjunctive.		
		Persons.	*Root.*	*Tense-Sign.*	*Pers.-Ending.*	*Root.*	*Tense-Sign.*	*Pers.-Ending.*	*Persons.*	*Root.*	*Tense-Sign.*	*Pers.-Ending.*	*Root.*	*Tense-Sign.*	*Pers.-Ending.*
Present.	*Sing.*	1	—	*wanting.*	e	—	*wanting.*	e	1	—	*wanting.*	e	—	*wanting.*	e
		2	—		eſt, ſt	—		eſt	2	—		eſt, ſt	—		eſt
		3	—		et, t	—		e	3	—		et, t	—		e
	Plur.	1	—		en, n	—		en	1	—		en, n	—		en
		2	—		et, t	—		et	2	—		et, t	—		et
		3	—		en, n	—		en	3	—		en, n	—		en
Imperfect.	*Sing.*	1	—	*wanting.*	—	—	*wanting.*	e	1	—	t or et	+ e	—	t or et	+ e
		2	—		eſt, ſt	—		eſt	2	—	t or et	+ eſt	—	t or et	+ eſt
		3	—		—	—		e	3	—	t or et	+ e	—	t or et	+ e
	Plur.	1	—		en	—		en	1	—	t or et	+ en	—	t or et	+ en
		2	—		et	—		et	2	—	t or et	+ et	—	t or et	+ et
		3	—		en	—		en	3	—	t or et	+ en	—	t or et	+ en

*

		IMPERATIVE.				INFINIT.		IMPERATIVE.				INFINITIVE.	
		Persons.	*Root.*	*Tense-Sign.*	*Pers.-Ending.*	*Root.*	*Ending.*	*Persons.*	*Root.*	*Tense-Sign.*	*Pers.-Ending*	*Root.*	*Ending.*
Present.	*Sing.*	1	—	*wanting.*	—			1	—	*wanting.*	—		
		2	—		e			2	—		e		
		3	—		e			3	—		e		
	Plur.	1	—		en	—	en	1	—		en	—	en
		2	—		et, t			2	—		et, t		
		3	—		en			3	—		en		

PARTICIPLES.		PARTICIPLES.	
Present.	*Perfect.*	*Present.*	*Perfest.*
-end	ge-en	-end	ge-et or t

Remark.—The sign + in the table above is used as in Arithmetic, *i.e.*, to indicate that the parts et + e are to be united; as, ete.

§ 76.—OBSERVATIONS ON THE PRECEDING TABLE.

(1.) Observe, in the table above, that the terminations in all places, except the imperfect of the New form, are to be added *directly* to the root. In the place excepted (*imperfect of the New form*), there comes between the root and the personal ending a sort of *tense-sign* (et or t), which is not necessary to verbs of the Old form; because in *them* the imperfect is made by means of a change in the radical vowel.

(2.) It may also be noticed that a characteristic difference in *form* between the indicative and the subjunctive (third person sing.), is that the former ends in et or t, the latter always in e; and that the *personal ending* in the first and third person sing. of the imperfect of the *Old form* is wholly omitted.

(3.) It may further be observed that the e in the terminations eſt and et of the indicative is retained or omitted just according to what is demanded by euphony. In the subjunctive, for the most part, the full termination is preserved.

(4.) For the same reason, also—that is, for the sake of euphony—when the root of a verb ends in el or er, the vowel e of any termination beginning with that letter is commonly omitted; as, hämmern (not hämmeren), to hammer; ſammeln (not ſammelen), to collect. Sometimes, however, the e of the *root* is rejected; as, ich ſammle (not ſammele), I collect.

§ 77.—VERBS OF THE OLD CONJUGATION.

(*Commonly called Irregular Verbs.*)

(1.) In the Old Conjugation, the imperfect tense and the perfect participle are distinguished from the infinitive chiefly by a change of the radical vowels. Thus, in some verbs, a different radical vowel is found in each of those three parts.

Infinitive.	*Imperfect.*	*Perfect Participle.*
Bitten, beg;	bat, begged;	gebeten, begged.
Helfen, help;	half, helped;	geholfen, helped.
Sinnen, reflect;	ſann, reflected;	geſonnen, reflected.
Trinken, drink	trank, drank;	getrunken, drunk.

When in the course of the changes noted in the text above, a long vowel or diphthong becomes *short*, the final consonant of the root is doubled; as—

Reiten, to ride;	ritt, rode;	geritten, ridden.
Leiden, to suffer;	litt, suffered;	gelitten, suffered.

In the case of Leiden, note also that d is changed into its cognate t. When, on the other hand, a short vowel is thus made *long*, the second of two radical consonants is omitted:—

Bitten, to beg;	bat, begged;	gebeten, begged.
Kommen, to come;	kam, came;	gekommen, come.

(2.) In some, the vowel or diphthong in the imperfect and the participle is the same, but is different from that in the infinitive; as—

Infinitive.	*Imperfect.*	*Perfect Participle.*
Glimmen, glimmer;	glomm, glimmered;	geglommen, glimmered.
Heben, lift;	hob, lifted;	gehoben, lifted.
Leiden, suffer;	litt, suffered;	gelitten, suffered.
Saugen, suck;	ſog, sucked;	geſogen, sucked.
Schieben, shove;	ſchob, shoved;	geſchoben, shoved.
Schreiben, write;	ſchrieb, wrote;	geſchrieben, written.

(3.) In others, the vowel or diphthong of the infinitive is changed in the imperfect, but resumed in the participle; as—

Infinitive.	*Imperfect.*	*Perfect Participle.*
Blaſen, blow (sound);	blies, blew;	geblaſen, blown.
Geben, give;	gab, gave;	gegeben, given.
Hangen, hang;	hing, hung;	gehangen, hung.
Kommen, come;	kam, came;	gekommen, come.
Laufen, run;	lief, ran;	gelaufen, run.
Schaffen, create;	ſchuf, created;	geſchaffen, created.

(4.) Besides the vowel changes indicated above, verbs of the ancient conjugation have the following characteristics:—

(*a.*) The perfect participle ends in en or n, and is thereby distinguished from that of the New Form ending in et or t; thus:—

OLD FORM.	NEW FORM.
Geholfen, helped; from Helfen.	Gelobt, praised; from Loben.
Gefallen, fallen; from Fallen.	Geliebt, loved; from Lieben.
Getragen, borne; from Tragen.	Gelabt, quickened; from Laben.
Geboten, bidden; from Bieten.	Getauſcht, exchanged; from Tauſchen.

(*b.*) Those having a in the *first* person singular of the present indicative, and in the participle, assume the Umlaut in the *second* and *third* persons; thus—

INDICATIVE.—*Present.*

S. Ich fange.	*P.* Wir fangen.	*S.* Ich ſchlage.	*P.* Wir ſchlagen.
Du fängſt.	Ihr fangt.	Du ſchlägſt.	Ihr ſchlagt.
Er fängt.	Sie fangen.	Er ſchlägt.	Sie ſchlagen.

(*c.*) Some verbs having e (long) in the *first* person singular of the present indicative, take, in the *second* and *third* person, ie; and some having e (short) take, in the same places, the vowel i (short); and in both instances the imperative (*second person singular*) adopts the vowel-form of the second person of the indicative; thus—

INDICATIVE.—*Present.*

S. Ich leſe, I read.	*P.* Wir leſen.	*S.* Ich helfe, I help.	*P.* Wir helfen.
Du lieſeſt.	Ihr leſt.	Du hilfſt.	Ihr helft.
Er lieſt.	Sie leſen.	Er hilft.	Sie helfen.

IMPERATIVE.—*Present.*

S. Lies du (for lieſe), read thou.	*S.* Hilf du (for hilfe), help thou.
Leſe er, let him read.	Helfe er, let him help.
P. Leſen wir, let us read.	*P.* Helfen wir, let us help.
Leſet ihr, read ye *or* you.	Helfet ihr, help ye *or* you.
Leſen ſie, let them read.	Helfen ſie, let them help.

The verbs that thus adopt the vowel-form of the second person of the indicative lose also the characteristic e final; giving, as above, lies, for lieſe; hilf, for hilfe, etc. The unaccented e final is, in other instances, also sometimes omitted.

(*d.*) In the imperfect subjunctive the radical vowel, if it be capable of it, assumes the Umlaut; thus—

INDICATIVE.—*Imperfect.*		SUBJUNCTIVE.—*Imperfect.*	
S. Ich ſprach.	*P.* Wir ſprachen.	*S.* Ich ſpräche.	*P.* Wir ſprächen.
Du ſprachſt.	Ihr ſpracht.	Du ſprächeſt.	Ihr ſprächet.
Er ſprach.	Sie ſprachen.	Er ſpräche.	Sie ſprächen.
S. Ich ſchlug.	*P.* Wir ſchlugen.	*S.* Ich ſchlüge.	*P.* Wir ſchlügen.
Du ſchlugſt.	Ihr ſchlugt.	Du ſchlügeſt.	Ihr ſchlüget.
Er ſchlug.	Sie ſchlugen.	Er ſchlüge.	Sie ſchlügen.

§ 78.—PARADIGM OF A VERB OF THE OLD FORM.

Schlagen, to strike, is thus conjugated:—

INDICATIVE MOOD.

PRESENT.	IMPERFECT.
Sing. Ich ſchlage, I strike.	*Sing.* Ich ſchlug, I struck.
Du ſchlägſt.	Du ſchlugſt.
Er ſchlägt.	Er ſchlug.
Plur. Wir ſchlagen.	*Plur.* Wir ſchlugen.
Ihr ſchlagt.	Ihr ſchlugt.
Sie ſchlagen.	Sie ſchlugen.

PERFECT.	PLUPERFECT.
Sing. Ich habe geſchlagen, I have struck.	*Sing.* Ich hatte geſchlagen, I had struck.
Du haſt geſchlagen.	Du hatteſt geſchlagen.
Er hat geſchlagen.	Er hatte geſchlagen
Plur. Wir haben geſchlagen.	*Plur.* Wir hatten geſchlagen.
Ihr habet geſchlagen.	Ihr hattet geſchlagen.
Sie haben geſchlagen.	Sie hatten geſchlagen.

FIRST FUTURE.

Sing. Ich werde schlagen, I shall strike.
Du wirst schlagen.
Er wird schlagen.
Plur. Wir werden schlagen.
Ihr werdet schlagen.
Sie werden schlagen.

SECOND FUTURE.

Sing. Ich werde geschlagen haben, I shall have struck.
Du wirst geschlagen haben.
Er wird geschlagen haben.
Plur. Wir werden geschlagen haben.
Ihr werdet geschlagen haben.
Sie werden geschlagen haben.

SUBJUNCTIVE MOOD.

PRESENT.

Sing. Ich schlage, I may strike.
Du schlagest.
Er schlage.
Plur. Wir schlagen.
Ihr schlaget.
Sie schlagen.

IMPERFECT.

Sing. Ich schlüge, I might strike.
Du schlügest.
Er schlüge.
Plur. Wir schlügen.
Ihr schlüget.
Sie schlügen.

PERFECT.

Sing. Ich habe geschlagen, I may have struck.
Du habest geschlagen.
Er habe geschlagen.
Plur. Wir haben geschlagen.
Ihr habet geschlagen.
Sie haben geschlagen.

PLUPERFECT.

Sing. Ich hätte geschlagen, I might have struck.
Du hättest geschlagen.
Er hätte geschlagen.
Plur. Wir hätten geschlagen.
Ihr hättet geschlagen.
Sie hätten geschlagen.

FIRST FUTURE.

Sing. Ich werde schlagen, (if) I shall strike.
Du werdest schlagen.
Er werde schlagen.
Plur. Wir werden schlagen.
Ihr werdet schlagen.
Sie werden schlagen.

SECOND FUTURE.

Sing. Ich werde geschlagen haben, (if) I shall have struck.
Du werdest geschlagen haben.
Er werde geschlagen haben.
Plur. Wir werden geschlagen haben.
Ihr werdet geschlagen haben.
Sie werden geschlagen haben.

CONDITIONAL MOOD.

FIRST FUTURE.

Sing. Ich würde schlagen, I should strike.
Du würdest schlagen.
Er würde schlagen.
Plur. Wir würden schlagen.
Ihr würdet schlagen.
Sie würden schlagen.

SECOND FUTURE.

Sing. Ich würde geschlagen haben, I should have struck.
Du würdest geschlagen haben.
Er würde geschlagen haben.
Plur. Wir würden geschlagen haben.
Ihr würdet geschlagen haben.
Sie würden geschlagen haben.

IMPERATIVE MOOD.

PRESENT.

Sing. Schlage (du), strike thou.
Schlage er, let him strike.
Plur. Schlagen wir, let us strike.
Schlaget (ihr), strike ye.
Schlagen sie, let them strike.

INFINITIVE MOOD.

PRESENT.	PERFECT.	FIRST FUTURE.
Schlagen, to strike.	Geschlagen haben, to have struck.	Schlagen werden, to be about to strike.

PARTICIPLE.

PRESENT.	PERFECT.
Schlagend, striking.	Geschlagen, struck.

KEY TO EXERCISES IN LESSONS IN GERMAN.

EXERCISE 170 (Vol. III., page 278).

1. Both friends were tired of disputing longer with each other. 2. The king and the empress, wearied with the long quarrel, at last made peace. 3. As the wind blew tolerably hard and without cessation, we already saw land after fourteen days. 4. A very cold wind is blowing to-day, and I am afraid that we shall have snow. 5. The wind has much abated since dinner-time; it does not blow so hard by far as it did this morning. 6. There was such a cold and cutting air blowing, that it chilled both his hands within five minutes. 7. Is my father still alive? 8. Yes, he is still living, but our young friend is no more. 9. It is well for him; he is gone where there is no more snow. 10. He, the sustainer of so many poor people, is no more. 11. On what does this poor family live? 12. What is talked of? 13. Of whom do they speak? 14. That is something which you do not understand. 15. What is the conversation about? 16. Of whom have you heard this? 17. From whom have you received this fine present? 18. The poacher shot at the gamekeeper, but the ball missed its aim; and before he could fire another shot, he himself fell, hit by the gamekeeper's shot. 19. The fortress was surrendered without a shot, and without a sword being drawn. 20. He shot several times in the garden to frighten away the birds. 21. The young Englishman passed by our door just now. 22. He passed by me without perceiving me. 23. This man has let the most favourable time of his life pass unemployed. 24. When Frederick the Great was greatly honouring and publicly praising a young officer after a battle, he answered, "Your Majesty embarrasses me by this honour." 25. Take this letter to the post, John, and get this gold watch repaired. 26. Have you already been to the minister, and have you attended punctually to my orders? 27. Yes, my lord, I have attended to them. 28. I have not taken a step out of the house to-day. 29. Although I have taken the first step towards a reconciliation, yet it is hard for him to take the second. 30. In his sixteenth year he paid his first visit to foreign countries. 31. This young scholar tries to keep pace with the elder one.

LESSONS IN LOGIC.—V.

FALLACIES.

A FALLACY is defined by Archbishop Whately as "any unsound mode of arguing, which appears to demand our conviction, and to be decisive of the question in hand, when in fairness it is not." The part of Logic which deals with the classification and detection of the different kinds of fallacies is naturally the most popular and interesting, as well because it seems less dry and barren than the consideration of abstract rules, as because it exhibits in a more palpable form the practical use of an art of Logic in teaching men to guard against some of the mistakes in reasoning into which they might otherwise fall.

Now it will upon reflection appear plain that an argument may be incorrect or unsound in either of two ways—viz., either in the manner in which the conclusion is made to result from the premises, or in the grounds upon which one or both of the premises are themselves laid down or assumed. We may either reason wrongly from right premises, or our premises may be false while our reasoning from them is correct. In either case our supposed argument will be fallacious, the fallacy lying, according to the language of logicians, in the former case in the *form*, and in the latter, in the *matter*, or, more technically still, *in dictione*, *i.e.*, in the words, in the one case, or *extra dictionem*, *i.e.*, outside the words, in the other.

In accordance with what has been previously said of the province of Logic, it does not profess to teach us to guard against errors and mistakes in the *matter* of our reasoning. This can only be done by a perfect knowledge of the particular science or branch of knowledge to which the premises of our argument relate; but when the premises are laid down, then the observance of the rules of Logic, as a test, will ensure that no error shall creep in between them and the conclusion.

The great division of fallacies, then, is into those in the form and those in the matter; into those in which the conclusion *does not* follow from the premises, and those in which it *does*. It is not, however, always possible accurately to determine to which of these two classes a fallacious argument should be referred. Thus in enthymemes it is often a matter of choice, whether the premiss left to be supplied should be taken to be one which is not true, or one which does not prove the conclusion. To take an example given by Archbishop Whately: if a man argues from the fact that a particular country is distressed, that it is under a tyranny, his suppressed premiss may be *either* "every distressed country is under a tyranny" (which is plainly false), or "every country under a tyranny is distressed" (which does not prove the conclusion, as the middle term will be undistributed in both premises). Now, if the former premiss be the one meant to be supplied, the fallacy is to be referred to those in form; if the latter, to those in the matter. This illustration shows how hard it is to attempt any classification of fallacies, to which some may not except. The outline of the classification which we shall adopt will be that of Archbishop Whately, and many of our examples will be taken from the same writer, whose chapter on Fallacies is probably the most valuable and interesting of his whole work.

We have seen that in every argument which professes to assume the syllogistic form, the conclusion either does or does not follow from the premises; and that, in the latter case, where the conclusion does not follow from the premises, the fault lies not in our imperfect knowledge of the subject-matter, but in the reasoning alone. Hence, as these fallacies are violations of the rules which Logic lays down as those to which all sound thinkers are bound to conform, we may call them *logical* fallacies.

The most plain and obvious *logical* fallacies are, of course, those which arise from the violation of some one of the syllogistic rules already given; and upon them it is unnecessary to dwell here at greater length. It may, however, be remarked, that several unsound arguments, not uncommonly to be met with, may be referred to this head. Thus, if a person argues that a certain proposition is false because it has been successfully demonstrated that the grounds or premises upon which it was supposed by his opponent to rest are false, such a person would be using an unsound argument, in which he would be guilty of an illicit process of the major term (which we have already explained)—*e.g.*, if the ground adduced to prove the existence of a God, was that it is universally believed, and an instance where no such belief prevailed was cited, then, if an attempt was made to argue that this *disproved* the existence of a God (instead of merely overthrowing the *single* proof which had been advanced), the fallacy might be represented thus: "Whatever is universally believed is true; the existence of a God is not universally believed; therefore it is not true." So also the fallacy of inferring the truth of the premises from the truth of the conclusion may be stated as follows: "What is universally believed is true; the existence of a God is true; therefore it is universally believed." This is obviously an instance of undistributed middle.

The middle, however, is often ambiguous, not from being undistributed, but from being used in a different *sense* in each premiss. This gives rise to a very large class of fallacies, to which no one name can be assigned which will comprehend all.

When the middle term is thus ambiguous in sense, as having *in itself*, from its own equivocal nature, two significations, we have what is called the *Fallacia equivocationis* of logicians: *e.g.*, "Light is contrary to darkness; feathers are light; therefore feathers are contrary to darkness"—in which example there are, strictly speaking, *four* terms. No one would be deceived in such a case as this one; but it must be remembered that the ambiguity will often be less patent and more likely to escape observation from the premises being placed at a considerable distance from each other in the course of a long argument.

In the fallacy which is mentioned by logicians under the title of *Fallacia amphiboliæ*, the ambiguity arises from an *amphibolous* sentence, *i.e.*, one which is capable of two meanings, not from the double sense of any of the words, but from its admitting of a double construction. "Pyrrhus the Romans shall, I say, subdue" (where the nominative to "subdue" may be either "Pyrrhus" or "the Romans,") is an instance of such a sentence; but the English language does not furnish so many of them as the Latin and others like it, and the fallacy is therefore not often to be met with in this shape. Ordinary language, however, is very elliptical, and thus terms not seldom become practically ambiguous, being differently applied on different occasions, although there is no real difference in the sense of the terms themselves: *e.g.*, "faith," which has in itself but one meaning, is employed by the votary of each different religion to denote his own peculiar form of belief. This may lead us without caution into arguments somewhat resembling the fallacy just mentioned.

An ambiguity arising from the context also gives rise to the fallacies of *Division* and *Composition*. In the fallacy of composition the middle term is used in the major premiss in a *distributive*, and in the minor in a *collective* sense: *e.g.*, "Two and three are odd and even; five is two and three; therefore five is odd and even," where it is plain that the middle term "two and three" is ambiguous, denoting, as it does, in the major premiss the two numbers *taken separately*, and in the minor, *taken together*. This fallacy is employed whenever, as is not unfrequently the case, a person, after establishing some truth *separately* concerning *each* member of a class, then infers the same to be true of the *whole collectively*. This is the same thing as contending that, because it is not improbable one may throw a six *in any one* out of a hundred throws, it is not improbable that one may throw a six in *each* of them, *i.e.*, a hundred times running; the absurdity of which is plain: but yet, hardly any fallacy is more common or more likely to deceive than this. The fallacy of division, on the other hand, occurs where the middle term is first taken collectively in the major premiss, and then distributively in the minor—*e.g.*, "two and three are five; two and three are two numbers; therefore five is two numbers." Here the middle term is in the major premiss, "two and three" *together*, and in the minor "two and three" taken *separately*. The ambiguity of the word "all," which means sometimes "every one separately," and sometimes "all together," not unfrequently gives rise to this fallacy of division.

There is also another kind of ambiguity occasioned by the context—viz., where the middle term is used in the major premiss to signify something considered simply in itself and as to its essence; and in the minor for the same thing, with some of its accidents taken into account along with it. The example commonly given of this, the *Fallacia Accidentis*, as it is called, is this: "What is bought in the market is eaten; raw meat is bought in the market; therefore raw meat is eaten." Now in this case the context shows that the middle in the major merely denotes the substance or essence of the thing bought, but that in the minor it is used for the same thing, with the accident of "being dressed" superadded. If the accident is understood with the middle in the major premiss instead of in the minor, logicians give the fallacy the somewhat lengthy Latin name of *Fallacia a dicto secundum quid ad dictum simpliciter*, *i.e.*, the fallacy of arguing from what is said with a certain accidental reference to the same thing said absolutely.

Under the head of ambiguous middle we may also class the *Fallacia Figuræ Dictionis*. "This," to quote from Archbishop Whately, "is built on the grammatical structure of language, from men's usually taking for granted that words belonging to each other, as the substantive, adjective, verb, etc., of the same root, have a precisely correspondent meaning, which is by no means universally the case. Such a fallacy could not indeed be even exhibited in strict logical form, which would preclude even the attempt at it, since it has two middle terms in sound as well as in sense: *e.g.*, "*Projectors* are unfit to be trusted; this man has formed a *project*; therefore he is unfit to be trusted:" here there is an assumption that he who forms a *project* must be a *projector*; whereas the bad sense that commonly attaches to the latter word is not at all implied in the former." There is a similar want of complete correspondence in the meaning of "presume" and "presuming," "art" and "artful," "design" and "designing," and many other words.

The last of the *logical* fallacies we shall notice separately is the *Fallacia Plurium Interrogationum*, or, "fallacy of several questions." This consists in asking two or more questions, really distinct, which *appear* to be but one, so as to entrap an opponent into giving but one answer, which, though only applicable to one of the questions, may be taken as an answer to the other or others. The way in which it must be defeated is by giving a separate answer to each question. A good instance is given by Archbishop Whately of its employment by a Parliamentary Committee in 1832, before which a witness was asked "how long the practice had *ceased* in Ireland of dividing the tithes into four portions;" two questions being thus combined:—1. Had this practice ever existed? 2. If so, how long had it been discontinued? Sometimes the ambiguity which gives rise to this fallacy lies not in the meaning but in the *distribution* of a term: *e.g.*, "Did this man act from such and such a motive?" which may mean, was it *one* of his motives? or, was it his *sole* motive. So also the question, "Has a state a right to enforce laws?" is ambiguous from the fact that "laws" may mean either "some laws," or "any laws, without exception," *i.e.*, may be understood as undistributed or not.

We now come to the consideration of *material* or *non-logical* fallacies, as they are sometimes called.

The first of these is termed *Ignoratio Elenchi*, because in it, instead of proving the contradictory of the proposition advanced by your opponent (which, in order to refute him successfully, you are bound to do, and which Aristotle called *Elenchus*), you prove some other proposition which, by more or less resembling it, is likely to be mistaken for it. In doing this, some one or more of the rules given by Logic for proving the contradictory of a given proposition will be violated.

This is a fallacy which is very common in argument or controversy; and the particular manner in which the conclusion is irrelevant—*i.e.*, fails to answer the purpose it is supposed to answer—varies with each particular case. Sometimes a particular will be proved when a universal is required; sometimes one with terms which are not the same in sense as those in the conclusion really given to be established. Suppose we are seeking to prove that a certain man was virtuous in his life and character (which makes it necessary to show that on the whole *all* his acts and deeds were virtuous), but we claim to have proved all that is required, when we show satisfactorily that *some* of his acts were of this character, leaving out of sight altogether many others of a very different aspect. This is an instance of *Ignoratio Elenchi.* So also if, when we ought to show a thing is just, instead of that we show that it is inexpedient, or *vice versâ;* or, if the right of private judgment in matters of religion be maintained, we imagine this disproved by the statement, however true, that it is impossible for every one to be right in his judgment, which in reality was never denied by our opponent. An instance of the employment of this fallacy through the instrumentality of an ambiguous term is often afforded by those who, in theological controversy, establish certain conclusions in reference to "faith," used in one sense, and then use these conclusions to meet arguments in which the word is used in a different sense.

This is really the fallacy involved in the error of shifting ground, as well as in that of combating *both* the premises of an opponent *alternately*, instead of dealing with one only at a time, and having done with it before proceeding to another.

Persons often seem to think that it is quite sufficient to show that there exist grave objections against the adoption of a particular plan, in order to force others to reject it. This is in reality the fallacy of *Ignoratio Elenchi;* it is proving that there are weighty objections against a particular course, when what is required to be proved is that there are *more* weighty and insuperable objections against its adoption than against its rejection.

It should be borne in mind that those who employ this fallacy very frequently suppress the conclusion they are really proving, in order that it may thus escape notice that they are not really proving the one required; and, as Archbishop Whately remarks, this is, "perhaps, the most common form of that confusion of thought to which those are liable who have been irregularly and unskilfully educated—who have collected, perhaps, a considerable amount of knowledge, without arrangement, and without cultivation of logical habits. Most of the erroneous views in morals, and in other subjects, which prevail among such persons, may be exhibited in the form of fallacies of irrelevant conclusion: *e.g.*, the question "whether it be allowable for a Christian to fight in defending himself from oppression and outrage," and "whether a Christian magistrate may employ physical coercion, and inflict secular punishment on evil-doers"—these are perpetually confounded with the questions "whether Christians are allowed to fight *as such; i.e.*, to fight for their religion against those who corrupt or reject the faith;" and "whether a Christian magistrate may employ coercion on behalf of Christianity, and inflict punishment on heretics as evil-doers."

The fallacy called *Petitio Principii* (begging the question), is used whenever that is assumed as granted which ought to have been proved. This is the account ordinarily given, although Archbishop Whately confines the name to those cases in which one of the premises is plainly the same as the conclusion, or is proved from it, or is such as the person to whom the argument is addressed would not know or admit, except as an argument from the conclusion: *e.g.*, where one argues in favour of the authenticity of a history from its recording certain facts which rest themselves for their reality merely on the evidence of the same history.

The form in which this fallacy most commonly occurs is in that which has been called "arguing in a circle"—a species of argument in which the ultimate conclusion is proved by a train of reasoning, which has one of its premises the same as this conclusion: *e.g.*, "Some mathematicians," according to Whately, "attempt to prove that every particle of matter gravitates equally. 'Why?' 'Because those bodies which contain more particles ever gravitate more strongly, *i.e.*, are heavier.' 'But (it may be urged) those which are heaviest are not always most bulky.' 'No, but still they contain more particles, though more closely condensed.' 'How do you know that?' 'Because they are heavier.' 'How does that prove it?' 'Because all particles of matter gravitating equally, that mass which is specifically the heavier must needs have the more of them in the same space.'"

It should be observed that the longer the chain of reasoning—*i.e.*, the wider the circle—the more likely it is that the fallacy will escape observation.

The fallacy of "*non causa pro causâ*" (literally, "taking as the cause that which is not such") is divided into two kinds, called respectively "*a non verâ pro verâ*" and "*a non tali pro tali*," which in reality are—the former, arguing from a false premiss as if it were true (*i.e.*, having, in logical language, the *expressed* premiss false), and the latter arguing from a case not parallel or similar, as if it were (*i.e.*, having the *suppressed* premiss false). In the one case there is *no* connection at all between the effect and the cause to which it is attributed; in the other, if there is any such connection at all, it is an *insufficient* one.

Instances of the fallacy of "*non causa pro causâ*" are very common, especially amongst the uneducated and vulgar, who are very liable to suppose, from seeing two events often or even sometimes conjoined, that there subsists some necessary connection between them, that the one must be the cause of the other. Most instances of popular superstition may, accordingly, be referred to this source. In this way it used to be generally thought that the appearance of a comet portended some great national calamity, merely because it so happened that on several occasions when comets were visible great disasters occurred in some portion of the world. Not that this erroneous mode of reasoning is one from which the educated and scientific can be supposed free. Nearly all writers upon political economy thought until very lately that money, in place of being merely a sign, was the cause of wealth in a country, and hence tried to restrict its flowing out in the natural course of trade; and there are some who even now think that labour is the chief cause of the value of some commodities, instead of being merely a sign of this. An instance not uncommonly given of "*a non tali pro tali*" is this: "What intoxicates should be forbidden; wine intoxicates; therefore wine should be forbidden;" where the minor premiss only being true of wine taken *in excess*, is in the conclusion treated as if it were true of wine taken in any quantity. This might also be exhibited as a fallacy "*a dicto secundum quid ad dictum simpliciter.*"

We have thus given a brief and incomplete outline of the kinds of fallacies most usually met with in argument with others, or most liable to deceive us in solitary reasoning; and we shall now illustrate the remarks made by some examples of the most celebrated fallacies on which the ancient logicians used to exercise their ingenuity.

Perhaps the most celebrated of all is that of "Achilles and the Tortoise." It runs thus:—"Suppose Achilles to run ten times faster than the tortoise; and while he remains in his place let the tortoise start and run through a certain portion (say a tenth) of the entire space to be traversed. Let Achilles then start to overtake the tortoise; he can never overtake it; for, while he runs through the tenth part of the course by which the tortoise had the start of him, the tortoise will have run further through a tenth of a space equivalent to that—*i.e.*, through $\frac{1}{100}$th part of the whole—and when Achilles has got through *this*, the tortoise will have got on in advance through $\frac{1}{10}$th part of this, *i.e.*, through $\frac{1}{1000}$th of the whole, and so on for ever, so that Achilles will never be able to overtake the tortoise, though he runs ten times as fast." The solution of this fallacy by Diogenes (*Solvitur ambulando*)—*i.e.*, that it is false—is hardly a satisfactory logical mode of escaping from the difficulty. No one ever doubted *that.* Nor is it much more satisfactory to allow, as Archbishop Whately does, that it cannot possibly be exhibited in a syllogistic form at all, which would virtually be a surrender of the proposition that the syllogism is a test by which we can always distinguish between sound and unsound reasoning. Mansel's is the best solution, which classes the fallacy as a *material* one. Let the whole space to be traversed be represented by A, and then the syllogism representing the reasoning will be this, "Any space equal to $\frac{A}{10} + \frac{A}{100} + \frac{A}{1000}$, etc., is infinite (being the sum of an infinite series). The space to be passed before Achilles overtakes the tortoise is equal to that sum; therefore it is infinite." In this the major premiss is simply *false.* The sum of an infinite series is not necessarily infinite; it may be, and in this case is finite. And this solves the whole mystery.

In our next lesson we shall give other similar examples.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER I.—INTRODUCTORY.

THE word "commerce" is probably derived from two others, "*commutatio mercium*," and signifies primarily the exchange of commodities for commodities. In a general sense it is used to designate interchange of property between individuals or nations, and in the following pages is mostly so employed. The divisions of the subject are as various as the interests concerned are manifold. A German writer says: "How shall we describe in detail the connection of the various relations of commerce? Instead of a lengthy exposition, let us give a single proof, taken from recent facts. While the evening sun of the momentous 3rd of July, 1866, was still shining on the bloody battle-field of Königgrätz, with all its horrors, the telegraph brought new orders from London, Paris, and other large places in the west of Europe, to the German factories, and in consequence of these, fresh remunerative employment was given on the following morning to the workmen, after they had been long out of work. Owing to the breaking up of the telegraph lines, the destruction of the railways, and the suspension of postal communication, people in Prussia, Saxony, Thuringia, and Bavaria, at a much shorter distance from the field of battle, did not learn until several days later how great an event history had to record upon her tablets; but that the war had taken a decisive turn, and how in all probability it had occurred, the manufacturer perceived on the very evening of the day of battle from the orders that came to him from far distant places."

There was a time, perhaps, when every man ministered to his own wants, as there may still be parts of the world where the inhabitants have little or no social intercourse. Under such conditions commerce could hardly exist. Nor could its range be great when slaves were the agricultural labourers and the chief artisans, slave-owners the only men of property, and slave-traders the principal merchants. With the advent of freedom and the growth of municipalities commerce first became general.

Its tendency in our own day, whatever may have been the case in past ages, is to equalise amongst millions the blessings provided by Nature; to diffuse as widely as possible an abundance of the necessaries and comforts of life at the least cost of hnman toil or suffering; and thus, ultimately, to remove that scarcity to which can be traced a large amonnt of crime and misery. Throngh its instrumentality additional value is given to commodities, by their conveyance from localities of profuse or easy production, to others selected for their consumption; thongh until the means of distribution be adequate, snpplies must continue irregular and costly.

Successful commercial transactions require powers of foresight and combination. The merchant has not only to supply the present wants of a locality, but also to anticipate future wants. Still further, he must have jnst conceptions of the functions of credit—a gigantic power for good, if well used, bnt, if abnsed, entailing the gravest evils—panics, waste of wealth, and destitution.

From the foregoing it will be evident that the history of commerce, with which is interwoven the development of mercantile associations, guilds, companies, and trade-unions, the principles and practice of colonial policy, as well as much of our legislation, is a subject of the highest importance. Yet the duty of its culture has been hitherto neglected or misunderstood amongst us—ignored, almost without exception, in our colleges and courses of public instruction. England, the most commercial country in the world, has allowed the neighbonring states of Holland and Germany to outstrip her in attention to commercial literature, and in adequate provision for its study. The consequences have been serions; for, as the possession of knowledge always tends to the application of knowledge, so ignorance entails the loss of opportunities.

Pnblic opinion appears to be at length aronsed to a sense of this neglect, and to the means for its removal; if so, we may hope that in proportion to the spread of information on points of economic science and experience there will be less of "wilful waste and woeful want," and that even decennial commercial crises may become things of the past.

In a history of commerce, the destructive agencies that have disturbed society, and the aggrandisement of states by plnnder, are dwelt upon only so far as they militate against the principles which have led mankind to produce, distribute, consume, replace, and accumulate wealth with a view to happiness. With the like aim are investigated the phenomena of class legislation, and the suicidal policy of those sovereigns who have forbidden the diffusion of the rudiments of useful knowledge among their people. One consequence of such unenlightened government has been that "the labour of the world has for the most part been performed by ignorant men—by the bondmen and bondwomen of the Jews, by the Helots of Sparta, by the captives that passed under the Roman yoke, by the villeins, serfs, and slaves of mediæval and modern times."

But it will be found that though the downfall of a people may have been accelerated by the ambition or incapacity of rnlers, yet the germs of decay are usually to be traced to the sloth, self-indulgence, venality, and disregard of economic virtues, exhibited long before, among all classes of the community. Where these vices prevail to any great extent, no nation can enjoy continned prosperity. Now, as in the days of old, nations are impoverished or flourishing, in the ratio of their obedience to the great moral laws.

CHAPTER II.

FIRST PERIOD: FROM THE EARLIEST TIMES TO THE FALL OF THE WESTERN ROMAN EMPIRE, A.D. 476.

Primitive Land Traffic—River Traffic—Maritime Coasting Trade.

1. *Primitive Land Traffic.*—Before gold became a medium of exchange, production was restricted to those commodities the exchange of which for others might generally be reckoned upon. With the use of the precious metals as a common measure of value, industry and interchange were greatly facilitated. Enlarged trade required the whole time and energies of a class of men to negotiate between the prodncers of different nations. A class of merchants thus arose, whose business it was to travel from place to place, observing where commodities were to be spared, and where they were wanted, and devising means for a transfer of the surplus of one country to supply the deficiency of another.

In its infancy, trade was carried on overland. Man did not at first trust to the unknown waters even of rivers, but confined himself to narrow routes between the various states. The dangers which beset a solitary journey led to the practice of travelling at fixed seasons and in large companies. Thus was obtained mutual protection, and at the same time the enjoyment of social intercourse. The earliest caravan trade had its centre in Egypt, and dated from a period antecedent to the records of history. The geographical position of this country made it a convenient meeting-place, or medium of communication, between Africa and Asia. All evidence points to a connection between the ancient Egyptians and those Semitic races which extended from the Levant to the plain of Shinar, and from the high lands of Armenia to Yemen. The fertile valley of the Nile was the cradle of the social polity, the arts, and the sciences of Phœnicia and of Europe. Equally obscure as to its origin and the conditions under which it was carried on was the caravan trade of Bactria, now Bokhara, the country beyond the mountainous border of North-west India. This was the most remote region to which the Western caravans penetrated, and here, as an emporium, the prodncts of the unknown eastern regions of Asia were brought to be exchanged for the merchandise of the West. The district over which overland traffic extended thus coincided with the geographical range of the camel—an animal whose association with the caravan trade from the earliest times has entitled it to the name of the "ship of the desert." The route of a caravan westward, heavily laden with silks and precious stones, ivory, pearls, and spices, was by way of Herat in Afghanistan, and Ecbatana in Persia. Besides these cities, the halting-places were valleys and plains fertilised by water, and by the refreshed and grateful travellers of old described as paradises upon earth.

In India, elephants were used. The merchants travelled alone, caravans not being common.

2. *River Traffic.*—Traders in time acquired sufficient confidence to entrust themselves and their wares to the easier transit of rivers, wherever facilities for such means of communication existed. The Nile must have been thns utilised

at a very early period. Its course downwards to the sea was well known; and Meröe, on the confines of Egypt and Ethiopia, one of the most renowned cities of the ancient world, owed its importance to its position on the Nile. The Suez Canal, one of the greatest engineering works of our own day, restores, and partly follows, the line of an older canal, the date of the construction of which cannot now be fixed, which connected the river and the head of the Red Sea. The river commerce of the Tigris and Euphrates, furnishing an easier mode of reaching India, was of still greater importance than that of the Nile. The Indus and Ganges, as well as the grand river system of China, were, in all probability, similarly employed, but our information relative to them is scanty. Better known to us, from the Roman and Greek historians, is the use made, at a later period, of the Rhone, the Rhine, the Po, the Danube, the Don, and the Volga. These winding watercourses were the pathways of the earliest travellers. River commerce, thus far, was combined with that carried on by means of the caravans. It received a great impetus when men learnt to venture along the coast, and ultimately upon the bosom of the sea. Important, however, as river trade was in this first period of commercial history, it bears no comparison with that of times like our own.

3. *Maritime Coasting Trade.*—Maritime commerce was the natural sequence of that along the courses of rivers. The harbours and mouths of rivers on the sea-coast presented such advantages for ships, that cities arose upon their shores, and the conveyance of goods was carried on partly by water and partly by land. This division of traffic led to a corresponding distinction between the persons who were thus engaged. The interchange of commodities between distant nations was conducted by several sets of hands. The original producers, in caravans, or as individual dealers, conveyed their wares overland to the river depôt or seaport, where they exchanged them for other commodities brought by the traders of the maritime nations, who, as agents or factors, consigned their freights again, at the end of the voyage, for inland distribution. Rendered fearless by increase of knowledge, merchants discovered that they could sail upon the Persian Gulf with as much safety as upon the Tigris and Euphrates, and that, without losing sight of the land, they could reach the coast of India. Taking advantage of the monsoons, voyages foreshadowing ocean commerce soon became organised into a system of departures and returns, according to seasons, as perfect as that regulating the caravans. The Arabian and Indian seas appear to have been the scenes of the first trade of this character. At a later date the Mediterranean Sea was the chief seat of the carrying trade, and the nations possessing it were described as having in their hands the commerce of the world. One of the first nations to obtain a universal traffic was the Phœnician, whose mercantile supremacy at one time extended from India to the countries north and south of the Pillars of Hercules, two rocky masses flanking what are now called the Straits of Gibraltar. Many of the great commercial centres on the shores of the Mediterranean grew out of colonies planted by this enterprising and adventurous people. Nevertheless, ocean commerce, as we understand it, was unknown and impossible to the ancients. The Mediterranean was to them literally the middle of the earth. The limitless sea beyond was filled by their imagination with vague and impassable terrors. In Ptolemy's Geography, the earth is said to be bounded by ice at 63° N. lat. and by fire at the equinoctial on the south. The commercial zone lay between the Tropic of Cancer and 40° N. lat., but afterwards expanded to 45° N. and 10° S. lat. Ocean traffic began with the invention of the mariner's compass, about 1300, but its first fruits were not reaped by Bartholomew Diaz, Vasco de Gama, and Columbus, until 1492. With these general facts and principles in our minds, we are now prepared to trace, in the order of time, the development of commerce to its present dimensions.

EARLY CARAVAN TRADE.—1. HALT OF AN EASTERN CARAVAN.

EARLY CARAVAN TRADE.—2. EASTERN CARAVAN ENTERING THE GATE OF AN ANCIENT CITY.

PAINTING IN WATER-COLOURS.—IV.

After our pupils have accustomed themselves in some degree to handling the brush, and, from the use of sepia, have gained fresh experience in discriminating and representing the tones arising from the innumerable and ever-varying effects caused by light and shade, we now recommend them to apply to colour the principles we have endeavoured to explain. Here we reach a point where many of our difficulties begin. It is not an easy task to lay down rules by which we are to be guided in conducting a picture through all its stages of progress, and enumerate and specify its colours, tones, and tints, for if it were possible to give a recipe for painting one picture, it is more than probable that it would not be found equally applicable to another. When we reflect that there is no restriction to the changes which are continually passing over the same object, and add to this, in many cases, the multiplied varieties of that object, it will be readily acknowledged that the attempt to write special rules for all cases, or even for a few, would be a failure; consequently, we must again make our starting-point from first principles, and endeavour to unite them with much that is generally practical, that our pupils may be led to make their own deductions, and thus carry their experience beyond the point where specific rules have little advantage.

There are but three primitive colours—red, blue, and yellow; all others are but proportionate combinations of these three: for example, red and blue mixed make purple, blue and yellow make green, and red and yellow make orange. These, again, which are called secondary colours, may be respectively united and further neutralised; and this art of neutralising and combining in accordance with the colour of the object to be imitated, and the apparent change of that colour as it yields to the light, or is acted upon by reflection from another adjacent colour, is the object which the student desires to accomplish. But our difficulties are greatly diminished by having the colour-box supplied with modifications of these colours under distinct names. Independently of the many different reds, blues, and yellows, from which we derive so much assistance on account of their diversity—as one red in some cases is preferable to another, and one blue to another—we have in addition to these a great variety of browns, which furnish numerous tints of the greatest service, and still further when we combine them with one or other of the primitive colours. Let the pupil unite blue with burnt sienna, or with brown pink, or with sepia, and he will find that he produces greens much more sombre and deeper in tone than the composition of blue with any of the yellows. The latter are more serviceable in the lights, the former in the shadows; but this will engage our attention again in some practical application.

Fig. 5.—TREATMENT OF FOREGROUND, MIDDLE, AND EXTREME DISTANCE.

We shall very frequently have occasion to use the terms *warm* and *cool* in reference to colour, therefore it is necessary to explain them, and show how these changes are effected. The *warm* tones are obtained by adding a greater proportion of red or yellow, whilst the *cool* ones are produced by an increase of blue; but even these, the primitive colours, have their gradations of tone. Light red, which is nothing more than burnt yellow ochre, is warmer than some of the lakes. Of the yellows, cadmium yellow is more intense than gamboge, and it will be seen that when each of these yellows is separately mixed with blue to produce green, the latter will make a much cooler green than the former. All these combinations, and many more of like character, will from an important study for the pupil, and it will be his policy to make himself fully acquainted with them, for, as he proceeds, experience will teach him that the more he is familiar with the capabilities of colour, or, in other words, what his colours are able to produce, he will the more readily comprehend, and be better able to imitate, the innumerable degrees of tone and tint as they appear to him in Nature. Similarly, greys and all neutral tones may be made warmer or cooler as the occasion requires. This is one of the most important studies of the painter. His greatest difficulties with regard to colour will arise in the use of greys, and in harmonising neutral tones. There is no limit to their gradations, and in proportion as they are understood and applied, so will the ability of the painter and the merit of his work be estimated. Nobody has yet painted them all; and when we say one artist is greater than another in the use of colour, it is principally on account of his greater comprehension of the use of greys, and his power of adapting them to the colours he uses, so that, by skilful management, the greys may enhance the purity and brilliancy of the positive colours according as the character of the subject upon which he employs them requires it. We will give one example where the same grey placed by the sides of extreme warm and cool colours will appear from the connection to be so widely different that it would scarcely be thought to be the same tint, and it will show how colours influence one another. We ask our pupils to try the following experiment:—Take three saucers, and in one mix a rather strong tint of Prussian blue, in another cadmium yellow and crimson lake, in the third prepare a grey tint, composed of cobalt and a little light red; then take two pieces of paper, and cover the upper part of one with the Prussian blue, and the upper part of the other with the cadmium yellow and lake. When dry, continue from the edge of each colour a wash of the grey; it will be seen that the latter in juxtaposition with the cool colour will appear to be warm, and the same in alliance with the warm colour will appear to be cold, and the two colours respectively will seem to be made more blue or yellow, that is, more intense than if painted alone. If Indian ink be used instead of grey, the contrast is even more striking. Here, then, is the first principle upon which is founded the theory of the use of grey in union with the primary colours in order to increase their brilliancy by the contrast.

The subject we have chosen for our lesson (Fig. 5), *evening* or *sunset*, is not an elaborate one, nor do we intend to go beyond the leading principles to be observed in painting it. It will require very few colours: crimson lake, burnt sienna, yellow ochre, cadmium yellow, gamboge, brown pink, sepia, cobalt, and indigo. That is, we will restrict ourselves to these colours, for with them the theory of light and shade, the contrasts of warm and cold colours in their arrangement and general effects, can be sufficiently explained, and leave for private study all minor details in relation to colour that arise from various accidental circumstances, which are found to differ in every subject, though every subject contains them more or less. If our pupils can accompany us only to the extent we can possibly attempt to lead them with merely written instructions, we shall have so far assisted them that they may afterwards pursue their course, depending upon their own observations from Nature, bearing in mind that we have endeavoured to impress upon them that warm colours will appear more so when contrasted by cold ones, and that light will appear brighter in contrast with dark, provided that the semi-tones are judiciously managed. Thus by contrast, not necessarily violent, brilliancy and force are increased. (See the remarks upon shadows in Vol. I., p. 362, in "Lessons in Drawing," No. XII.)

We will now proceed with our subject, and commence with an old caution respecting the outline—let it be made perceptible, and no more. We must begin with the sky. Turn the drawing upside down, and let it be inclined so that what is really the bottom of the picture is now from its position the most elevated, as the positions of the letter A and B explain. Mix in a saucer a less than middle tint of cadmium yellow. This powerful yellow will be the most suitable for our purpose. Begin with a wash of this tint from the edge A A as far as B B, to the upper line of the hills, afterwards increase its strength a little, and then let it become a graduated tint from E E through the rest of the sky. It is always safe for a beginner not to make his tints too strong, as they can be repeated if necessary. When dry, turn the picture back into its proper position, still preserving the inclination; and commence from D D with a wash composed of cobalt blue and a little lake. This must also be graduated, and cease at about E E. It must be observed that the blue tint must be a light one, for although the previous yellow mixture has been decreasing in depth to the top of the picture, the blue tint must not be carried down to the same extent, as it would neutralise or destroy the purity of the yellow, and again, when passing over the yellow with the blue it must be done carefully, with one wash, for the oftener the brush passes across an under colour, the danger of washing it up is increased. Cover the mountains with the blue tint with which the upper part of the sky was painted, and when dry repeat it again, excepting those parts which catch the light on the summits; wash off the *edge* (remember, the edge only) at the base, clean the brush, and take the cadmium tint of the sky and paint the water. The whole of the foreground may be passed over with a light mixture of burnt sienna and yellow ochre. The shadows in the foreground must be made with cobalt blue, lake, and a little sepia. Let the blue and lake be in greater proportion than the sepia, because this purple grey upon the warm ground previously painted with burnt sienna and ochre will be sufficiently neutralised with only a small addition of sepia. The broad shadows of the dark tree may be passed over with the same grey. If, as the picture proceeds, it is discovered that the sky is too low in tone, mix a light tint of cadmium yellow and lake, and pass it over the whole of the sky, from the top to the edges of the hills. Should it be found when dry that the last wash has accidentally gone beyond the edge of the hills so as to produce a heavy margin, wet the parts with a clean brush, press a piece of blotting-paper upon them, and rub the parts very gently with a folded silk handkerchief. If carefully done, the original ground will be restored without any injury. This last tint may most likely be required over the water also; in this case, break it off into the lights in the foreground. If the last wash upon the sky has proved satisfactory, add to the same tint a little more lake, and with a light hand touch in the clouds. As they ascend into the upper part of the sky, add some of the grey tint to the last, and paint the darker clouds. Before painting the trees, do something more to the foreground. Mix a little indigo with gamboge and yellow ochre, and paint *the lights only* of the grass and herbage, etc., close to the edges of the shadows before painted. Indigo and brown pink will be useful to define the character of the foreground by giving a little more decision to the forms of the leaves and weeds, without destroying the cool shadows that must be in contrast and give strength to the warm lights. The dark tree may be painted first with brown pink only, preserving the openings to the sky; afterwards it must be made out with indigo and brown pink. These two colours combined compose a rich dark green, that can be made either warmer or cooler according to the proportion of indigo or brown pink added to it. Keep the ground of the shadows cool, upon which make out with the dark warm green all particulars approaching the light. The smaller tree on the left partakes of the colour of the sky and dark tree united. We have introduced the white sail of a boat under the hills to assist the colour of the distance. To do this, draw the form of the sail with a wet brush, take up the superfluous water with blotting-paper, and then rub the part with india-rubber. The hull of the boat must be of the grey distance. The edges of the shore, and the sides of the stones which are away from the light, are painted with the grey tint, some parts darker, others lighter. These general directions may be closely followed whilst repeating the practice of this lesson a few times. Then the pupil will begin to see how colours can assist or weaken one another, so that by degrees he will be induced to apply them to a much greater extent than can be explained in these pages, with less fear of any serious failure.

LESSONS IN FRENCH.—LXXIX.

§ 98.—Respective Place of the Pronouns when two occur with one Verb.

(1.) When two pronouns occur, one direct object, and the other indirect object, governed by à understood, the pronoun indirect object, if not in the third person singular or plural, must precede the pronoun direct object:—

Il **me** le donnera.	*He will give it to me.*
Il **te** le prêtera.	*He will lend it to thee.*

Ils **nous** les montreront.	*They will show them to us.*
Vous **nous** le direz.	*You will say it to us.*
Quand je puis obliger, ma joie est assez grande; Pour n'attendre jamais que l'on **me** le commande. BOURSAULT.	*When I can oblige, my joy is great enough for me never to wait until they command me (i.e., they command it to me).*
Je **vous** le dis encore, vous n'aurez l'estime des hommes que par une solide vertu. MME. DE MAINTENON.	*I repeat it to you; you can obtain the esteem of men only by real virtue.*

(2.) When the pronoun indirect object is in the third person singular or plural, it must then be placed after the direct object:—

On **le lui** donnera.	*They will give it to him.*
Vous **le lui** prêterez.	*You will lend it to him.*
Nous ne **le leur** prêterons pas.	*We will not lend it to them.*
Vous **le leur** écrirez.	*You will write it to them.*
Le plus sûr appui de l'homme c'est Dieu, et vous voulez **le lui** ravir. BOISTE.	*The surest support of man is God, and you wish to deprive him of it.*

(3.) *Remark:* The reflective pronoun **se**, used as indirect object, is an exception to the above rule, as it takes precedence of the direct object:—

Si les hommes pensent mal les uns des autres, du moins ils ne **se le** disent pas. ANONYMOUS.	*If men think ill of each other, at least they do not say it to each other.*

(4.) The Rules (1.) and (2.), also the Exception (3.), apply to the imperative used negatively:—

Ne **nous le** donnez pas [Rule (1.)].	*Do not give it to us.*
Ne **le leur** prêtez pas [Rule (2.)].	*Do not lend it to them.*
Du sang de tant de rois c'est l'unique héritage; Ne **me** l'enviez pas, laissez-moi mon partage. VOLTAIRE.	*Of the blood of so many kings, it is my only inheritance; do not envy it (to me), leave me my portion.*

(5.) When the imperative used affirmatively has two pronouns as objects, the pronoun direct object precedes the indirect object:—

Envoyez-**le-moi**.	*Send it to me.*
Donnez-**le-nous**.	*Give it to us.*
Montrez-**le-moi**, ce mortel privilégié. BALLANCHE.	*Show him to me, that privileged mortal.*
Mets-**le-toi** dans l'esprit; qui fait mal, trouve mal. ANONYMOUS.	*Put this into thy mind: he who does evil, finds evil.*

(6.) *Remark:* The rules given for the place of personal pronouns accompanying a verb in the imperative do not apply to its third persons, in regard to which the general rules given hold good:—

Qu'on **se le** dise.	*Let people say it to each other.*
Qu'il ne **me** l'envoie pas.	*Let him not send it to me.*
Qu'elle **le lui** donne.	*Let her give it to him.*

§ 99.—Rule on the Place of Pronouns Indirect Objects referring to Persons.

When a verb has for direct object a personal pronoun of the first or second person, and for indirect object, governed by **à**, a personal pronoun of the first, second, or third, *all referring to persons*, the personal pronoun direct object is placed as usual before the verb, but the preposition **à** is expressed and the pronoun indirect object is placed after it:—

Le roi m'envoie **à vous**.	*The king has sent me to you.*
Ils vous ont confié **à moi**.	*They have entrusted you to me.*
Il nous a recommandés **à eux**.	*He has recommended us to them.*
Il vous présentera **à elle**.	*He will introduce you to her.*

§ 100.—Rule on the respective use of Lui, Elle, etc., and En and Y.

(1.) The personal pronouns **lui, elle, eux, elles**, used as indirect objects of verbs and preceded by a preposition, can only relate to persons, and not to things. The expressions *of* or *from it; of* or *from them*, when relating to things, should be rendered by **en** [§ 40, (17.)]:—

J'en parle; **j'en** donne.	*I speak of it, of them; I give some.*
J'aime trop la valeur pour **en** être jaloux. LA HARPE.	*I prize valour too highly to be jealous of it.*
Celui qui est dans la prospérité doit craindre **d'en** abuser. FÉNELON.	*He who is in prosperity should fear to abuse it.*

(2.) The relative pronoun **y** [§ 40, (18.), § 108], is used in French in relation to things, sometimes to persons, as indirect object (dative), and is expressed in English by *at* or *to him, to her, to it;* or *to them; thereto, therein,* etc.:—

J'y songerai, *I will think of it.*	Faites-**y** attention, *Pay attention to it.*
C'est lorsque nous sommes éloignés de notre pays, que nous sentons surtout l'instinct qui nous **y** attache. CHÂTEAUBRIAND.	*It is when we are far from our country that we feel, above all, the instinct which attaches us to it.*
Tous nos jours vont à la mort, le dernier **y** arrive. MONTAIGNE.	*All our days travel towards death, the last one arrives at it (reaches it).*
Les choses de la terre ne valent pas qu'on **s'y** attache. NICOLE.	*The things of the earth are not worth our attachment to them.*

NOTE.—The pronoun **en** can only be used with verbs which require the preposition **de**; and the pronoun **y** with verbs which require the preposition **à**.

§ 101.—Place of En and Y.

(1.) The place of **en** and **y** is the same as that prescribed by Rule (1.), § 97, for the personal pronouns. They are also subject to Exception (2.) and Remark (3.) of the same §. See examples above.

(2.) **En** and **y** are always placed after the other pronouns objects:—

Il **nous en** a parlé.	*He has spoken to us of it.*
Il **lui en** a dit quelque chose.	*He has told him something of it.*
Parlez-**lui-en**.	*Speak to him of it.*
Ne **nous en** parlez pas.	*Do not speak to us of it.*
Je **l'y** ai renvoyé.	*I have referred him to it.*
Renvoyez-**nous-y**.	*Refer, or send us back to it.*
Ne **nous y** renvoyez pas.	*Do not refer us to it.*

(3.) When **en** and **y** are in the same clause, **en** is *always* placed after **y**:—

Envoyez-**y-en**.	*Send some there.*
N'y en envoyez pas.	*Do not send any there.*
Il **y en** a porté plusieurs.	*He has carried several of them there.*

§ 102.—Repetition of the Pronouns used as Objects.

These pronouns must, in French, be repeated before every verb:—

Ah! mon enfant, que je voudrais bien **vous** voir un peu, **vous** entendre, **vous** embrasser, **vous** voir passer. MME. DE SÉVIGNÉ.	*Ah! my child, how I should like to see you for a short time, to hear you, embrace you, see you pass.*
Je veux **le** voir, **le** prier, **le** presser, **l'**importuner, **le** fléchir. BESCHERELLE.	*I will see him, entreat him, press him, importune him, touch his heart.*

§ 103.—The Possessive Pronoun.

(1.) The possessive pronoun, in French, is always preceded by the article [§ 35, (2.), (3.)], which, as well as the pronoun itself, agrees in gender with the noun to which it refers; but it may differ from it in number [§ 36, (1.)]:—

L'ambition ni la fumée ne touchent point un cœur comme **le mien.** J. J. ROUSSEAU.	*Neither ambition nor smoke have power on such a heart as mine.*
Au lieu de déplorer la mort des autres, je veux apprendre de vous à rendre **la mienne** sainte. BOSSUET.	*Instead of bewailing the death of others, I wish to learn from you how to render my own holy.*
Ma maison est haute, cependant **les leurs** sont encore plus hautes.	*My house is high, yet theirs are higher still.*

(2.) The pronouns **le nôtre, le vôtre** [§ 35, (3.)], etc., unlike the adjectives **notre, votre,** etc., always take the circumflex accent:—

La musique des anciens Grecs était très différente de **la nôtre.** VOLTAIRE.	*The music of the ancient Greeks was very different from ours.*

(3.) When the English possessive pronouns, *mine, thine,* etc., come after the verb *to be,* they are often rendered into French by the indirect pronouns **à moi, à toi**:—

Ce livre est **à moi.**	*That book is mine.*
Ces plumes sont-elles **à vous?**	*Are these pens yours?*

§ 104.—THE DEMONSTRATIVE PRONOUN.

(1.) The demonstrative pronouns [§ 37] can never be placed before nouns. They merely represent them:—

La meilleure leçon est **celle** des exemples. LA HARPE.	*The best lesson is that of examples.*
N'oublie jamais les bienfaits que tu as reçus; oublie promptement **ceux** que tu as accordés. BOISTE.	*Never forget the benefits which thou hast received; forget quickly those which thou hast conferred.*

(2.) The pronouns **celui, celle, ceux, celles,** as has been said [§ 38, (2.)], are often used absolutely, not only in the nominative, but also in the objective and in the oblique cases. They have then the sense of *he who, him whom, of whom; that which, of which,* etc.:—

Celui qui compte dix amis, n'en a pas un. MALESHERBES.	*He who reckons ten friends has not one.*
On ne saurait forcer **celui** qui ne veut pas.	*We cannot compel him who will not.*
L'harmonie la plus douce est la voix de **celle** qu'on aime. LA BRUYÈRE.	*The sweetest harmony is the voice of her whom we love.*

(3.) The French use **celui, celle, ceux, celles,** indifferently for *this, that, these, those.* When they institute a contrast or a comparison, they add the adverbs* **ci (ici)** and **là** to the pronouns [§ 38, (3.)]:—

Corneille nous assujettit à ses caractères et à ses idées; Racine se conforme aux nôtres. **Celui-là** peint les hommes comme ils devraient être, **celui-ci** les peint tels qu'ils sont. LA BRUYÈRE.	*Corneille subjects us to his characters and to his ideas; Racine conforms himself to ours. That one (the former) paints men as they should be, this one (the latter) paints them as they are.*

(4.) **Celui-ci, celle-ci, ceux-ci, celles-ci, celui-là,** etc., may be used absolutely in French in the sense of *this one, that one,* etc.:—

On la vit, toutes les semaines, essuyer les larmes de **celui-ci,** pourvoir aux besoins de **celui-là.** FLÉCHIER.	*Every week, she was seen wiping the tears of this one, providing for the wants of that one.*

* The same adverbs produce the same difference in meaning with the demonstrative adjectives **ce, cet,** etc. They are not placed immediately after those adjectives, but after the nouns which they determine: **cet homme-ci,** *this man;* **cet homme-là,** *that man.*

(5.) **Ceci** and **cela** are always used absolutely, and have no plural. They serve to point out things only. They can, of course, never be placed before a noun [§ 37, (5.)]:—

Tant que le jour est long, il gronde entre ses dents, Fais **ceci,** fais **cela,** va, viens, monte, descends. REGNARD.	*The livelong day he mutters between his teeth, do this, do that, go, come, go up, come down.*
Je suis un peu surpris de tout **ceci.** MASSILLON.	*I am a little surprised at all this.*
Vous n'avez pu désavouer **cela.** PASCAL.	*You have not been able to disavow that.*

LESSONS IN ALGEBRA.—XXXV.

ADFECTED QUADRATIC EQUATIONS (*continued*).

WE now furnish our students with a set of problems in Adfected Quadratic Equations for practice.

EXERCISE 66.

1. To find two numbers whose difference shall be 12, and the sum of their squares 360.
2. Two persons draw prizes in a lottery, the difference of which is £120, and the greater is to the less as the less to 10. What are the prizes?
3. What two numbers are those whose sum is 6, and the sum of their cubes 72?
4. Divide the number 56 into two such parts, that their product shall be 640.
5. A gentleman bought a number of pieces of cloth for 675 crowns, which he sold again at 48 crowns per piece, and gained by the bargain as much as one piece cost him. What was the number of pieces?
6. A and B started together for a place 150 miles distant. A's hourly progress was 3 miles more than B's, and he arrived at his journey's end 8 hours and 20 minutes before B. What was the hourly progress of each?
7. The difference of two numbers is 6; and if 47 be added to twice the square of the less, it will be equal to the square of the greater. What are the numbers?
8. A and B distributed £1,140 each among a certain number of persons. A relieved 40 persons more than B, and B gave to each individual £5 more than A. How many were relieved by A and B?
9. Find two numbers whose sum is 10, and the sum of their squares 58.
10. Several gentlemen made a purchase together for £175. Two of them having withdrawn, the bill was paid by the others, each furnishing £10 more than would have been his equal share if the bill had been paid by the whole company. What was the number in the company at first?
11. A merchant bought several yards of cloth for £60, out of which he reserved 15 yards, and sold the remainder for £54, gaining two shillings a yard. How many yards did he buy, and at what price?
12. A person bought two cubical stacks of hay for £15, each of which cost as many shillings per solid yard as there were yards in a side of the other, and the greater stood on more ground than the less by 7 square yards. Find the price of each stack.
13. A gentleman bought two pieces of cloth, the finer of which cost four shillings a yard more than the other. The finer piece cost £18; but the coarser one, which was two yards longer than the finer, cost only £16. How many yards were there in each piece; and what was the price of a yard of each?
14. A merchant bought 54 gallons of Madeira wine, and a certain quantity of Teneriffe. For the former he gave half as many shillings by the gallon as there were gallons of Teneriffe, and for the latter four shillings less by the gallon. He sold the mixture at ten shillings by the gallon, and lost £28 16s. by his bargain. Required the price of the Madeira, and the number of gallons of Teneriffe.
15. A person being asked his age replied, "If you add the square root of it to half of it, and subtract 12, the remainder will be nothing." What was his age?
16. Two casks of wine were purchased for 58 crowns, one of which contained 5 gallons more than the other, and the price by the gallon was 2 crowns less than one-third of the number of

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gallons in the smaller cask. Required the number of gallons in each, and the price by the gallon.

17. If the square of a certain number be taken from 40, and the square root of this difference be increased by 10, and the sum be multiplied by 2, and the product divided by the number itself, the quotient will be 4. What is the number?

18. A person bought a certain number of oxen for 80 guineas. If he had received 4 more oxen for the same money, he would have paid one guinea less for each. Find the number of oxen.

19. It is required to divide 24 into two such parts that their product shall be equal to 35 times their difference.

20. The sum of two numbers is 60, and their product is to the sum of their squares as 2 to 5. What are the numbers?

21. Divide 146 into two such parts, that the difference of their square roots may be 6.

22. What two numbers are those whose difference is 16 and their product 36?

23. Find two fractions whose sum shall be $\frac{3}{8}$, and the sum of their reciprocals 6 times as much.

24. Required to find two numbers whose difference is 15, and half of their product is equal to $\frac{2}{3}$ of the cube of the less number.

25. A company incurred a bill of £8 8s. One of them absconded before it was paid, and in consequence those who remained had to pay four shillings apiece more than their just share. How many were there in the company?

26. A gentleman bequeathed £7 4s. to his grandchildren; but before the money was distributed two more were added to their number, and consequently the former received one shilling apiece less than they otherwise would have done. How many grandchildren did he leave?

27. The length added to the breadth of a rectangular room makes 42 feet, and the room contains 432 square feet. Required the length and breadth.

28. A says to B, "The product of our years is 120; and if I were 3 years younger, and you were 2 years older, the product of our ages would still be 120." How old was each?

29. Should the square of a certain number be taken from 89, and the square root of their difference be increased by 12, and the sum multiplied by 4, and the product divided by the number itself, the quotient will be $8\frac{1}{2}$. What is the number?

30. A mason laid 105 rods of wall, and on reflection found that if he had laid 2 rods less per day, he would have been 6 days longer in accomplishing the job. How many rods did he build per day?

31. The length of a gentleman's garden exceeded its breadth by 5 rods. It cost him 3 crowns per rod to fence it; and the whole number of crowns which the fence cost was equal to the number of square rods in the garden. What were its length and breadth?

32. What number is that, which being added to its square root will make 156?

33. The circumference of a grass plot is 48 yards, and its area is equal to 35 times the difference of its length and breadth. What are its length and breadth?

34. A gentleman purchased a building plot, and in the centre of it erected a house 54 feet long and 36 feet wide, which covered just one-half his land. This arrangement left him a flower-border of uniform width all round his house. What was the width of his border, what the length and breadth of his plot, and how much land did he buy?

35. A general wished to arrange his army, which consisted of 20,886 men, in a solid body, so that each rank should exceed each file by 59 men. How many must he place in rank and file?

36. A man has a painting 18 inches long, and 12 inches wide, which he orders the cabinet-maker to put into a frame of uniform width, and to have the area of the frame equal to that of the painting. Of what width will the frame be?

37. A man having to walk 54 miles, finds that if he increases his speed half a mile per hour, he will perform his task $1\frac{1}{2}$ hours sooner than if he walked at his usual rate. Find that rate.

38. A merchant sold a quantity of goods for £39, and gained as much per cent. as the goods cost him. How much did he pay for the goods?

39. Suppose in a garden, 400 feet long and 300 feet broad, there is a walk 10 feet wide all round the garden, equidistant from and parallel to the wall, and that it divides the garden into two equal parts: that is, the area betwixt the wall and walk is the same as the area within the walk. Required the breadth of the space between the wall and the walk.

40. A and B started from two cities 247 miles apart, and travelled the same road till they met. A's progress was 1 mile per day less than B's, and the number of days before they met was greater by 3 than the number of miles B went per day. How many miles did each travel?

41. Two persons, A and B, invest £2,000 in business. A's money remained in trade 17 months, and he received £1,710 for his share of the profit and stock; B's money was in trade 12 months, and he received £1,040 for his share of the profit and stock. What was each partner's stock?

42. A merchant bought a piece of cloth for 162 florins; the number of shillings which he paid per yard was $\frac{2}{3}$ of the number of yards. Required the length of the cloth, and the price per yard.

43. There was a cask containing 20 gallons of wine; a quantity of this was drawn off and put into another cask of equal size, and then this last was filled with water; and afterwards the first cask was filled with the mixture from the second. It appears that if $6\frac{2}{3}$ gallons are now drawn from the first and put into the second, there will be equal quantities of wine in each cask. How much wine was first drawn off?

44. A man bought 80 lbs. of pepper and 100 lbs. of ginger for £65, at such prices that he obtained 60 lbs. more of ginger for £20 than he did of pepper for £10. What did he pay per pound for each?

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XXXIV.

Exercise 64.

1. $\dfrac{\pm\sqrt{d^2+4ah}-d}{2a}$.
2. 3 or $-4\frac{2}{3}$.
3. 9 or 6.
4. 8 or -4.
5. $(\sqrt{4b^2+a}+2b)^2$.
6. $(\pm\sqrt{h-n+4}-2)^2$.
7. $(\pm\sqrt{16+a+b}-4)^2$.

Exercise 65.

1. 7 or -4.
2. 12 or $-\frac{3}{4}$.
3. 4 or $-\frac{7}{4}$.
4. 4 or -1.
5. 4 or [illegible].
6. 12 or 6.
7. 21 or 5.
8. 1 or -28.
9. 4 or 1.
10. 49 or $40\frac{1}{3}$.
11. 4 or $(-7)^{\frac{2}{3}}$.
12. 64 or $(-\frac{27}{3})^{\frac{2}{3}}$.
13. 4 or -1.
14. 1 or $1 \pm 2\sqrt{15}$.
15. 4 or 1.
16. 4, -3, or $\dfrac{1\pm\sqrt{-43}}{2}$
17. 9, 4, or $\dfrac{-3\mp\sqrt{-7}}{2}$
18. $\sqrt{\left(\dfrac{m\pm\sqrt{m^2+4p}}{2}\right)}$
19. ± 2, -8, or $-\frac{1}{4}$.
20. $\dfrac{b}{2}\pm\sqrt{\dfrac{4a^3-b^3}{12b}}$.
21. 4 or $7\frac{1}{9}$.
22. 243 or $-28^{\frac{3}{5}}$.
23. 4 or -25.
24. $9a$ or $-a$.
25. 9 or -12.
26. 2 or -3.
27. 2 or [illegible].
28. 3 or [illegible].
29. 9 or $(-5)^{\frac{2}{3}}+5$.
30. 10 or -2.

LESSONS IN LATIN.—LII.

GOVERNMENT BY VERBS.

A VERB may govern a noun; for example—

Amo filium, *I love a son.*

Here the noun *filium* is dependent on the verb *amo*; by the force of the verb *amo*, the nominative form, *filius*, is changed into *filium*, the accusative form, or the form of the object.

With the noun, one pronoun or more may be connected; also one adjective or more; in which case the pronoun and the adjective will be in the same gender, number, and case as the noun, presenting an instance of concord or agreement; as—

Amo filium meum minorem natu, *I love my younger son.*

Instead of a noun, the object of a verb may be a pronoun; as—

Amo te, *I love thee.*

All verbs do not govern nouns. In general, the verbs which govern nouns are transitive verbs in the active voice. Intransitive verbs, inasmuch as their action does not pass over to an object, do not govern nouns.

In the examples just given, the nouns, etc., are in the accusative case. Verbs govern nouns in other cases. The noun, when governed by a verb, is said to be the object of the verb. The object of a verb may be a noun, a noun and adjective or participle, or a pronoun. The object of a verb thus explained may be in either of these cases, namely, the genitive, the dative, the accusative, the ablative. Here you see in the Latin a great divergence from the English, in which the object is always in the accusative or the objective (so called from its being the case of the object) case. I subjoin instances of each of these governments:—

VERBS WITH THEIR GOVERNMENTS.

1. *The Object in the Genitive.*—Miserere mei, *pity me.*
2. *The Object in the Dative.*—Medetur OCULIS, *he cures the eyes.*
3. *The Object in the Accusative.*—Docet PUEROS, *he teaches boys.*
4. *The Object in the Ablative.*—Fungitur MUNERE, *he performs (his) duty.*

Some verbs have in the same sentence two governments; as in this example:—

Docet PUEROS MUSICAM, *he teaches the boys music.*

A verb may also have two objects in unlike cases; as—

Dat librum puero, *he gives a book to the boy.*

Both *librum* and *puero* depend on *dat*, and consequently *dat* is said to govern them. The general rule may be given in these terms—

Transitive verbs in the active voice have two governments, the near and the remote; the near is the accusative, the remote is the dative.

The same verb may govern two different cases; as—

Sapiens eget nullâ RE, *the wise man wants nothing.*
Ægrotus eget medicinæ, *the sick man wants medicine.*

The verb *eget* takes, in one sentence, the ablative; in another, the genitive. These diversities of form generally involve some diversity of signification. Egeo signifies *to be without, not to have;* also *to need, to require.* In the first sense *egeo* takes an ablative: the ancient wise man could be without nothing, for he possessed all things, inasmuch as he wanted (wished for) nothing. The sick man, on the contrary, has occasion for medicine, inasmuch as he is sick.

The two meanings are so much alike that they are sometimes exchanged the one for the other; thus we may find *medicinâ* in the ablative, and the genitive employed when the ablative might have been expected.

Having given a general view of the government of verbs, I shall take up each case in succession; and first,

VERBS WHICH GOVERN THE GENITIVE.

Verbs which denote an active or quiescent state of the feelings require their object to be in the genitive case; such as *misereor, miseresco;* as—

EORUM MISERERI oportet, *it is proper to pity them.*

Instead of a verb, you may have an adjective with *est;* as—

Est PATIENS laboris, *he is enduring of (he endures) labour.*

Certain impersonal verbs take a genitive together with an accusative for their object; as—

Piget ME STULTITIÆ, *I am ashamed of my folly.*

This, literally rendered, is, *it shames me of my folly*, showing a compound object to the verb *piget.*

A neuter pronoun, corresponding in relation with the noun in the genitive, stands in the accusative; as—

ID ne pudet te? *art thou not ashamed of that?*

Verbs which signify to remember and to forget, also to remind and to admonish, take their object in the genitive. Such words are memini, *I remember;* reminiscor, *I call to mind;* recordor, *I recollect;* obliviscor, *I forget;* moneo, *I put thee in mind;* admoneo, *I admonish;* commoneo, *I advise;* commonefacio, *I warn;* as—

Animus MEMINIT PRÆTERITORUM, *the mind remembers past things.*

Similar in construction is the phrase "venit mihi in mentem alicujus rei," literally, *it comes to me into the mind of something*, that is, *something occurs to me, is suggested to me.* We also read "venit res in mentem," *the thing comes to my mind.*

With verbs of remembering and forgetting, the accusative is found instead of the genitive; as—

CINNAM MEMINI, Syllam vidi, *I remember Cinna, I saw Sylla.*

This is specially the case if the object is a pronoun in the neuter gender. Recordor, *I call to mind,* requires an accusative. *Recordor* may also have after it the preposition *de*, with its case.

Instead of the simple verb, we may have its equivalent in an adjective, and the copula *est.* Thus, instead of *he forgets*, we may say, *he is forgetful.* Consequently, a number of adjectives denoting states of mind are followed by the genitive; as, prudens (for providens), *foreseeing, prudent;* gnarus, *knowing;* peritus, *skilful;* conscius (*knowing with*), *conscious, aware of;* rudis, *destitute of, untrained;* memor, *mindful.*

Here we may place the phrase certiorem facere, *to inform*, which has a genitive object; as—

Certiorem me fecit tui CONSILII, *he informed me of thy plan.*

Some adjectives are denominated verbal, inasmuch as they are derived from verbs, and have a verbal meaning; thus, edax, from edo, *I eat*, signifies *eating.* Verbal adjectives in ax, as, capax, edax, ferax, rapax, tenax, govern a genitive case; as, tenax propositi, *firm to (his) purpose.* Certain participles, also, when used as adjectives, take a genitive—as, amans patriæ; appetens gloriæ; diligens veritatis; metuens futuri; sitiens sanguinis. The participle differs from the adjective in this, that while the participle denotes a single act, the adjective denotes an habitual state. When, then, these participles are used as participles, they require the government of the verbs to which they belong. *Sitiens*, employed as an adjective, has a genitive; but when used as a participle, it governs an accusative like its verb; as—

Tiberius sitiens SANGUINEM, Sejanum interfici jussit.
Tiberius, thirsting for blood, commanded Sejanus to be put to death.

Verbs which denote fulness, abundance, or want, take their object in the genitive case. Adjectives of similar import govern a genitive case; as—

Adolescentem suæ TEMERITATIS implet.
He fills the youth with his own rashness.

This is an instance of a verb with a double object, an accusative of the person, and a genitive of the thing.

The verb potiri, *to make yourself master of*, takes the genitive in the phrase rerum potiri, *to seize the helm of government, to obtain power over;* though generally potiri requires the ablative.

Adjectives, too, denoting such a state of mind as is implied in having power, possessing ability, or the reverse, take a genitive after them. Hence arises combinations which the student may be glad to see translated—as, virtutis compos, *endued with virtue;* mentis impos, *weak of (in) mind;* sui potens, *master of himself;* exsors culpæ, *free from blame;* rationis particeps, *sharing in the possession of reason;* rationis expers (ex and pars), *having no part, no share*, that is, *devoid of reason.*

The adjective *proprius*, denoting that which belongs or is peculiar to a person, takes a noun after it in the genitive case; as in this example:—

VIRI PROPRIA est fortitudo, *courage is a property of man.*

So *proprium* in the neuter is employed to designate the special property of an object; as—

Id est vitium SENECTUTIS PROPRIUM, *this is the special fault of old age.*

By an ellipsis of *proprius* you may explain what is commonly called the genitive of possession or quality; as—

Hic liber FRATRIS mei est, *this book is my brother's.*

VIRORUM FORTIUM est dolorem pati, *to bear grief is the part of brave men.*
Vir est SUMMÆ PIETATIS, *he is a man of the greatest piety.*

The quality is sometimes put in the ablative; as—

Aristoteles vir erat SUMMO INGENIO.
Aristoteles was a man of the greatest ability.

Allied with the usage of *proprium* is the phrase *nostrum est, vestrum est, meum est,* etc.; as—

NOSTRUM EST parentes amare.
It is our duty to love our parents.

From the idea of partaking or sharing in anything seems to have arisen the use of the genitive with the adjectives reus, *accused of;* manifestus, *proved guilty* (Scotch, *proven*); noxius, *criminal, liable to punishment;* compertus, *detected;* as—

Manifestus est RERUM CAPITALIUM.
He was clearly convicted of a capital crime.

And hence is explained the genitive used with verbs which signify to accuse, acquit, condemn. With such verbs, the crime is in the genitive, and the person accused or acquitted is in the accusative; as—

Ne quis ante ACTARUM RERUM accusaretur.
Let no one be accused of former deeds.

In such cases it may be supposed that causâ, *on account of*, was originally employed, and is now understood, as the grammatical phrase is; if so, then this is an example of elliptical construction. Many peculiarities in all languages have arisen from ellipsis, or the omission of a word or words.

The penalty to which a convicted person was condemned may be in the genitive or in the ablative; for example—

1. *Genitive.*—Damnavit eos CAPITIS, *he condemned them to death.*
2. *Ablative.*—Damnavit hostem TERTIÂ PARTE agri, *he condemned the enemy (to lose) the third part,* etc.

As the penalty, so the price is put in the genitive or the ablative. If the exact sum paid for an object is stated, it must be in the ablative case. If any indefinite word is employed, that word is put in the genitive; as—

QUANTI emisti librum? CENTUM ASSIBUS.
For how much did you buy the book? a hundred asses.

In a similar manner the genitive is used after verbs which denote to value, esteem, or regard; as—

Divitiæ a sapienti viro MINIMI putantur.
Riches are little thought of by a wise man.

This genitive bears the name of the genitive of price. In agreement with it stand several neuter adjectives, used substantively, in the genitive case: for example, magni, *at a great price*, or *greatly*; pluris, *more*, *for more*; maximi, *at a very great price*, *very dear*; so plurimi; also parvi, minoris, minimi; quanti? *how much?* tanti, *so much*; tanti quanti, *so much as*; tantidem, *for the same sum*; quantivis, *for whatever you please*; nihili, *of no value*; flocci (floccus, *a lock of wool*), as in flocci facere, *not to care a straw for*; nauci (naucum, *a trifle*), as in homo non nauci, *a worthless fellow*; pili (pilus, *a hair*), as in non facit pili cohortem, *he does not value the cohort a bit*; pensi (pensum, *a task*), as in pensi habere, *to care for*; assis (as, *a small Roman coin*), as in non assis facere, *not to care a farthing for.*

Nearly connected with the genitive of price is the use of the genitive with *interest* and *refert*; as—

Hoc vehementer INTEREST REIPUBLICÆ.
This greatly concerns the Commonwealth.

Refert is made up of the ablative *re* and *fert*; hence arises the genitive; for example, illorum re fert, *it bears on the concern of them*—that is, *it concerns them.* And so we are enabled to explain the fact that the possessive pronouns (mea, tua, sua, nostra) are with *refert* employed in the ablative case; thus, re meâ fert; re tuâ fert, etc. These phrases, however, appear without the *re*, or rather, the *re* appears as a part of the verb. Taking the forms as they actually appear—for example, refert nostrâ, refert vestrâ, etc.—we must construe the possessives as if they were personal pronouns; accordingly, refert meâ must be rendered *it concerns me.*

KEY TO EXERCISES IN LESSONS IN LATIN.—LI.

EXERCISE 182.—LATIN-ENGLISH.

1. No evil is more oppressive and troublesome than envy. 2. What embossed plate, what coverlets, what paintings do you think there are in his house? 3. As the mind is more noble than the body, so virtue is preferable to strength and external beauty. 4. How preferable is an honourable death to a base life! 5. How few philosophers are with you! 6. The tribunes put forward a law (to the effect) that one of the two consuls should be chosen from the people. 7. Of their benefits some are of that kind that they extend to all the citizens, some that they affect individuals. 8. You have an abundance of wealth. 9. Terror and fraud abound. 10. You have preserved me rather from love than honour. 11. He pretended to be in haste on account of business. 12. All of them received a military honour on account of their valour. 13. That one day on which I returned to my native land was to me as good as an immortality.

EXERCISE 183.—ENGLISH-LATIN.

1. Regis mulier pulchra est. 2. Regis mulier est pulchrior quam ducis mulier. 3. Uter est sapientior? 4. Sapientissimus mortalium est Socrates. 5. Quid panis est tibi? 6. Eo dementiæ est progressus ut omnes eum predicent stultum. 7. Belli causâ venerunt milites. 8. Ducis honori præmium cuique militum est datum. 9. Librorum abunde mihi est. 10. Hic unus liber librorum omnium mihi est instar.

EXERCISE 184.—LATIN-ENGLISH.

1. He had one chaplet on his head, another round his neck. 2. Crassus smiled once in his life. 3. Pausanias took many Persian noblemen, and among them some relations of the king's. 4. Among the good qualities of Epaminondas it is related that he danced well. 5. He spoke till night, and even during the night, lights being brought. 6. I put off serious things till to-morrow. 7. The number of the enemy increases every day. 8. The whole of Gaul is divided into three parts. 9. It is in my mind. 10. It occurs to me. 11. He kept the legions in arms. 12. Wisdom is often under a mean coat. 13. The image of myself, greater than the reality, will go down to the shades. 14. He enslaved the captives. 15. They went under the walls. 16. He was taught the art of war under his instructor, Hannibal. 17. They quitted the city at the coming of the Romans. 18. At these words they fell at the feet of Marcellus. 19. Cranes sleep with their head under their wing. 20. The consul, dashing his spurs into his horse, rides up to the cohorts under the enemy's walls. 21. There shone an image of the sun above the tent of Darius. 22. They burned the houses and themselves in them. 23. He reposed on the greensward. 24. The Tiber overflowed its banks. 25. They spoke of his vileness during supper. 26. No one of those who had been sent on such a business returned. 27. I will write to you on that matter. 28. It moves before and behind. 29. Behind me was Ægina; before, Megara. 30. He ordered him to enter before, not behind. 31. If fortune wills it, you who are now a rhetorician, will become a consul. 32. The enemies sent ambassadors to Cæsar concerning peace. 33. Robbers rise by night in order to cut throats. 34. He moves the camp at the fourth watch. 35. Darius led an army from Asia into Europe. 36. He snatched the colony out of the enemy's hands. 37. While corn was so scarce and dear, of a sudden there came so great a cheapness of provisions. 38. I waited from day to day. 39. Man consists of a mind, and of a perishable and infirm body. 40. Our ancestors left to us the republic very much enlarged, it being very small in their time. 41. Bad men estimate friendships and enmities not from their intrinsic worth, but their advantage. 42. Hercules drove a herd before him. 43. I cannot see the sun on account of the multitude of weapons. 44. Cæsar led out his forces in front of the camp. 45. This is not only not for me, but rather against me. 46. Cato with me stands in the place of many thousands. 47. To him he manifested gratitude in acknowledgment of his deserts. 48. The Helvetii, considering their numbers and their warlike glory, thought their territories confined. 49. They would have acted more conveniently if those things which they lay before you respecting me, they had rather said before me while I was present. 50. He orders the others, together with their guards, to go into the temple of Concord. 51. He himself wrote with great care and diligence. 52. He here carried on many things without Alcibiades. 53. Pompey obtained the highest honours without any ancestral advantages. 54. The water in the stream had swollen as high as the breast. 55. The ancients, so far as words are concerned, discoursed concerning the republic. 56. What spot over the whole sea has during these years had so strong a guard? 57. We know that this man's thefts and crimes have been very great and very disgraceful, not only in Sicily, but in Achaia, Asia Cilicia, Pamphylia—in a word, before the eyes of the whole world. 58. Here are the remaining legions from Italy. 59. The entire book on the existence of the gods has been read by me. 60. A bloody battle was fought at Zama. 61. From the battle a messenger came to thee. 62. The severities of the nobles against the people, and of the people against the nobles, were shocking. 63. Examine that book which treats of the mind. 64. The first oration delivered by Cicero against Catiline is beautiful and effective.

EXERCISE 185.—ENGLISH-LATIN.

1. Plures horas locutus est Cæsar. 2. Totum diem sol lucet. 3. In Angliâ est. 4. In Angliam it. 5. Flagitia tua coram omnibus sunt populis. 6. Ex Italiâ venerunt hæ legiones. 7. Prœlium ad urbem commissum sanguinem erat. 8. Librum de legibus scripsi. 9. De republicâ librum scripsit Cicero. 10 Apud Aristotelem vera lego multa. 11. Rus redeundi nulla nobis est spes. 12. Heri ad decimam horam scripsi. 13. Maximus est meus erga te amor. 14. Apud Homerum sunt nonnulla quæ culpæ sunt obnoxia (*reprehensione digna sunt*). 15. Ad fontem constitit dux. 16. Prope muram castra ponet Cæsar. 17. Penes malos est civitas. 18. Inter stabulum et domum fons est. 19. Canis est extra stabulum. 20. Adversum murum milites impetum facient. 21. Apud te ero circiter meridiem. 22. Per me tibi licet ire. 23. In capite habeo coronam. 24. Quotidie sapientior meliorque fis. 25. Sub doctore meo multa didici. 26. Subter terram eunt animæ. 27. In cœlum ascendunt animæ. 28. De nequitiâ ejus colloquitur civitas. 29. Literas ad te mittam. 30. Ad me misit mater nuncium. 31. Inter hos libros nullus est tibi destinatus. 32. Pecus præ se agit pastor. 33. Hæc statua est de ære, illa de argento.

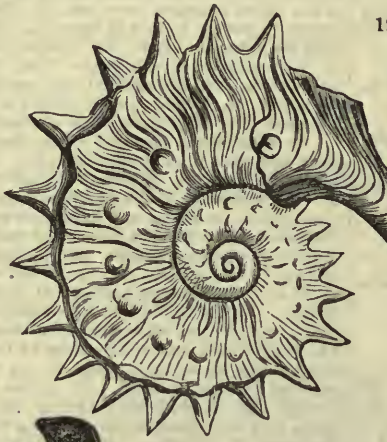
LESSONS IN GEOLOGY.—XXIII.

THE JURASSIC FORMATION—OOLITE.

To the Oolite is attached a peculiar interest since William Smith, "the father of English Geology," lent his sagacious mind to tabulate its subdivisions first.

It runs in a band, varying from thirty to ninety miles in breadth, from the Yorkshire coast, a little south of the Tees, to Lyme Regis in Dorsetshire. When we cross this belt, passing from the south-east to the north-west, we find it consists of three series of low hills separated by considerable valleys. The three hills are the three divisions of the system—the Upper, Middle, and Lower Oolite; whilst the clays of the formation are to be found in the valleys, a fact which points to the reason of the existence of the hills and dales. The following is a table of the members of the system:—

Upper Oolite.	Purbeck beds.
	Portland stone.
	Kimmeridge clay.
Middle Oolite.	Coral rag.
	Oxford clay.
	Kelloway rock.
Lower Oolite.	Cornbrash and Forest marble.
	Great oolite.
	Stonesfield slate.
	Fuller's earth.
	Inferior oolite.



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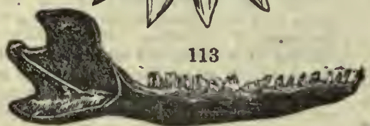

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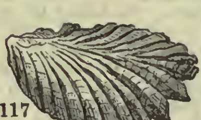

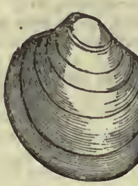

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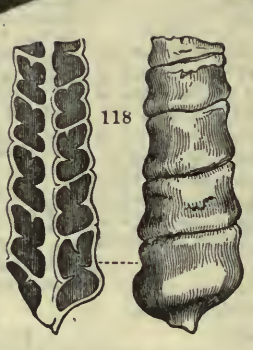

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THE LOWER OOLITE.

Superincumbent upon the Lias in the south and west of England are certain yellow sands: these are the sands of the *Inferior Oolite.* They evidently bear a close connection with a calcareous freestone, for they pass into this rock, or give place to it. The sand and the freestone form the inferior oolite, and together have but small thickness.

The *Terebratula fimbria*, *Rhynconella spinosa*, and the *Pholadomya fidicula* are its characteristic fossils. There are thirty-nine species of cephalopoda known in the inferior oolite; but, what is extremely remarkable, only one of the *Belemnites*, the *B. giganteus*, survived the period; and this is the more strange, for the great oolite is also a calcareous deposit, and would give us the idea that the same circumstances existed during its deposition as those under which the inferior oolite was formed. The thin layer of fuller's earth, which is only of local occurrence, cannot represent any violent change; hence it is difficult to account for the extinction of thirty-eight species of cephalopoda.

Fuller's earth is a thin argillaceous deposit which occurs near Bath, but is wanting in the north of England, and separates the inferior from the great, or Bath oolite. The most plentiful of its fossils is a small oyster, *Ostrea acuminata.*

The *Stonesfield slate* in Oxfordshire is a slightly oolitic, shelly limestone, but as it passes northwards into Northamptonshire it gives evidence of a more decidedly marine deposit, assuming more of a sandstone character. In Oxfordshire, as at Colleyweston near Peterborough, the Stonesfield slate is rich in organic remains. Several insects have been discovered, and the wing-covers of beetles, beautifully preserved, indicating a close proximity to the land. But by far the most celebrated fossils yielded by the Stonesfield slate are the jaws of certain small mammiferous quadrupeds, which at least indicate the existence of three distinct genera, the *Amphitherium*, *Phascolotherium*, and *Stereognathus* (Fig. 113). The fact that the jaw-bone is in one piece indicates that it did not belong to a fish or to a reptile. The number of teeth, their double fangs, and the complicated crowns of the molars, besides the peculiar structure of the hinge of the jaw, all tend to show that the creature was a mammal.

It was noticed that the lowest process or projection at the hinge end of the jaw was bent inwards. Now the marsupial quadrupeds, which are the stepping-stone between creatures who bring forth their young alive and those who propagate their species by eggs, have this peculiarity of the jaw-bone; hence the mammals of the Stonesfield slate were pronounced to be marsupials; but this cannot be affirmed, for the bend of the process is not great, and there are certain placental mammals whose lower jaw exhibits a certain inflection of the process.

The flora of the era was extensive, as may be gathered from the fact that at Brora, in Sunderlandshire, there is the thickest stratum of coal found in any English secondary rock. It has been mined for a long period, the bed being three and a-half feet thick.

The *Great* or *Bath Oolite*, in point of thickness and of utility, is the most important of the series. It mainly consists of a stratified calcareous mass, which varies in thickness from 130 to 200 feet. It affords an excellent building stone. St. Paul's Cathedral is built of stone quarried from it, from Burford, in Oxfordshire; near Bath, the stone has a finer grain.

The great oolite contains so many corals, that some parts of it deserve the name of coralline limestone. The *Eunomia radiata* is very plentiful, and appears to have grown like the brain coral of our time, probably centuries being required by the polypes to construct the masses, which are found several feet in diameter.

The *crinoids* or stone-lilies are also abundant. At Bradford, near Bath, an interesting section is exposed where the upper crust of the great oolite is covered with quite a forest of crinoids.

While the colony was busy in the labour of its life, the clear water of the sea became suddenly turbid with mud, the deposit quickly entombed the crinoids, and to-day the Bradford clay preserves many of them *in situ*, others broken off and lying horizontally embedded in the clay.

The *cornbrash*, which is the topmost member of the lower oolite, is a loose rubbly limestone; in some places, however, it becomes solid, and is then quarried for building, as at Malmesbury, yet its general character is brashy and disintegrated; owing to the fact that it is particularly favourable to the production of good corn-growing soil when it comes to the surface, it has been named "cornbrash." It is by no means a thick deposit, large areas not being more than six inches thick; neither is it very fossiliferous, but it passes downwards into an argillaceous limestone—

The *Forest Marble*, which abounds in marine fossils. The sandstone slabs of this bed are frequently ripple-marked, and mixed with the broken débris of shells, pieces of wood, etc., plainly indicating that once there the waters of the sea were met by the land. This stratum owes its name to the fact that in Whichwood Forest, in Oxfordshire, it yields a marble.

THE MIDDLE OOLITE.

The lowest member of the middle oolite is the *Kelloway rock*, an arenaceous limestone usually classed with the Oxford clay; for in the south-west of England, especially near Kelloway, in Wiltshire, the clay encloses lenticular masses of the rock, which are very fossiliferous. But as it passes north its dimensions increase, until at Scarborough it becomes thirty feet thick.

The *Oxford clay* is a vast deposit, its greatest depth being estimated at 700 feet. It is destitute of corals, but ammonites and belemnites are found in any quantities. The plesiosaurus and ichthyosaurus also appear, and a species of crocodile, the *Steneosaurus*, not unlike those which now bask upon the mudbanks of the Ganges.

The fossil wood so frequently found in the clay appears sometimes silicified and sometimes converted into an imperfect jet; it is remarkable that these two distinct conditions should have been caused at the same time, and apparently under the same circumstances. Crystals of sulphate of lime are also common. Many of the ammonites have on each side of the opening of the mouth a long projection, as *Ammonites Jason* (Fig. 114).

The *Coral rag* is the uppermost member of the middle oolite. As its name imports, it is generally a loose, rubbly limestone, often almost entirely composed of aggregations of madrepores. The two most common—indeed, the prevailing—corals are the *Thecosmilia annularis* (Fig. 115) and the *Thamnastræa* (Fig. 116). With these corals are found, in great quantities, an oyster, the *Ostrea gregarea* (Fig. 117). One of the Jura limestones of this period, from its numerous fossils of the *Nerinæa*, has been called the Nerinean limestone. Fig. 118 is the *Nerinæa Goodhallii*, which is found on the top of the coral rag.

THE UPPER OOLITE.

Resting on the coral rag is the *Kimmeridge clay*, the lowest representative of the upper oolite. It consists of beds of blue slaty or greyish and yellow clay, containing selenite (sulphate of lime). Near Kimmeridge the beds become so highly bituminous that they produce fuel, which is burnt under the name of Kim coal.

The *Ostrea deltoidea* (Fig. 119), the *Gryphæa virgula* (Fig. 120), and the *Cardium striatulum* (Fig. 121), are three characteristic fossils of this deposit.

PORTLAND STONE AND SAND.

To the Kimmeridge clay succeeds, in the south of England, a bed of sand upon which lie calcareous rocks of various consistencies; from those in the islands of Purbeck and Portland some of our best building stone is quarried.

In Wiltshire and Dorsetshire many of the beds contain layers of septaria, like the flints of the chalk formation. The Solenhofen beds in Bavaria belong to the upper oolite, from which the lithographic stone is procured. The beautifully fine grain of this limestone renders it perfect for the preservation of fossils. In 1862 a skeleton of a bird, the *Archæopteryx macrura*, was discovered; some of the feathers even being exhibited. Several species of flying lizards, *Pterodactylis* (Fig. 122), were first found

IDEAL FLORA AND FAUNA OF THE OOLITE.

1, Pterodactyle; 2, Kaidacarpum; 3, Williamsonia; 4, Pinites; 5, Mantellia.

in these beds; these curious creatures are restored in our sketch of a forest of the period.

The *Purbeck beds* are more or less fresh-water formations. The upper division, some fifty feet in thickness, is purely fresh-water, as declared by the fossils *Paludina, Limnæa, Planorbis, Cyclas, Unio.*

The middle Purbeck is partly fresh-water and partly marine, but is noted for a certain thin bed of marl, only a few inches thick, near its base, in which have been discovered the remains of many species of mammalia. From an area of not 500 square yards have been taken the skeletons of some fourteen species. The *Plagiaulax* is one of the most prominent, an insectivorous mammal. This discovery was a decided hint that it is dangerous to draw any general conclusion concerning the land life of the globe, for here we have, in a small space, far more evidence of mammalian life than all the previous strata put together have furnished.

FOSSILS WHICH CHARACTERISE THE LOWER OOLITE.

Plants.—Bucklandia squamosa; Halymenites ramulosus; Sphenopteris cysteoides.

Protozoa.—Spongia cymosa, etc.

Corals.—Isastræa Conybeari; Millepora pyriformis.

Brachiopoda.—Rhynconella concinna; Terebratula globata, fimbria, cardium; Discina granulata.

Conchifera.—Lima gibbosa, rigidula, impressa; Trigonia angulata, duplicata; Gervillia lævigata; Avicula costata; Gryphæa minuta, gigantea; Iuoceramus; Ostræa rugulosa; Pecten retiferus, vagans; Astarte orbicularis; Corbula depressa; Cypricardia; Modiola compressa; Trigonia cuspidata; Nucula variabilis.

Gasteropoda.—Pleurotomaria fasciata; Nerita costata; Alaria armata; Eulima communis; Fusus coronatus; Natica; Trochus ornatissimus.

Cephalopoda.—Ammonites corrugatus, Sowerbyi, subcontractus, etc.; Belemnites abbreviatus, giganteus, fusiformis; Nautilus dispansus.

Echinodermata.—Echinus germiuans; Clypcus Agassizii; Pentacrinus Millcri.

Annelida.—Serpula grandis, etc.

Insecta.—Coccinella Wittsii.

Fish.—Hybodus crassus; Strophodus magnus; Acrodus leiodus; Lepidotus tuberculatus; Asteracanthus acutus.

Reptiles.—Cetiosaurus lougus; Megalosaurus Bucklandi; Pterodactylus Bucklaudi.

Mammalia.—Amphitherium Prcvostii: Phascolotherium Bucklandi; Stereognathus ooliticus.

FOSSILS WHICH CHARACTERISE THE MIDDLE OOLITE.

Plants.—Carpolithes couicus.

Sponges.—Manon foliaceum; Spongia floriceps.

Corals.—Calamophyllia Sokesii; Isastræa explanata; Thamnastræa rotata.

Brachiopoda.—Discina latissima; Lingula ovalis; Rhynconella lacunosa; Terebratula insignis.

Conchifera.—Avicula expansa, ovalis; Gryphæa bilobata, mima; Ostræa inæqualis, deltoidea; Prima granulata; Corbis ovalis; Nucula elliptica; Pecten articulatus; Astarte extensa; Pholas compressa.

Gasteropoda.—Alaria composita; Pleurotomaria depressa; Bulla elongata; Natica nodulata; Turbo funiculatus; Turritella muricata.

Cephalopoda.—Ammonites annularis, bifrons, Duncani, Jason, cordatus, etc.; Belemnites anomalus, gracilis, abbreviatus; Nautilus hexagouus.

Echinodermata.—Amphiura Prattii; Astropecten rectus; Echinus gyratus, cidaris, corouata, spinosa.

Annelida.—Serpula vertebralis.

Crustacea.—Glyphæa scabrosa.

Fish.—Lepidotus macrocheirus; Strophodus; Hybodus obtusus.

CHARACTERISTIC FOSSILS OF THE UPPER OOLITE.

Plants.—Chara Purbeckensis; Cyadeoidea microphylla; Zamiostrobus Fittoni.

Corals.—Isastræa oblonga.

Brachiopoda.—Rhyncouella inconstans, varians; Terebratula impressa.

Conchifera.—Ostræa læviuscula; Pecten distriatus; Astarte liueata, cuueata; Mytilus pectinatus; Modiola pallida; Trigouia incurva; Cucullæa oblonga.

Gasteropoda.—Patella latissima; Pleurotomaria reticulata, rugata; Natica elegaus; Limnea; Paludina; Planorbis; Ostrca.

Cephalapoda.—Ammonites auceps, triphiatus, macrocephabus.

Echinodermata.—Cidaris spinosa; Echiuus perlatus; Pygurus pentagonalis.

Crustacea.—Glyphæa rostrata.

Fish.—Asteracanthus ornatissimus; Hybodus acutus; Strophodus reticularis; Lepidotus minor.

Reptiles.—Ichthyosaurus trigonus; Plesiosaurus affinis; Chelone planiceps; Nothetes destructor.

Mammalia.—Spalacotherium Brodiei; Plagiaulax; Tricodon.

LESSONS IN SPANISH.—XIV.

IRREGULAR VERBS.

THE irregular verbs in Spanish are such as do not conform exactly in their manner of conjugation to the model verbs (*amar, comer, vivir*). The deviations of each irregular verb are in most cases but slight, yet important to be known, as most of the irregular verbs are in general use.

There are thirty-nine of the different irregular verbs: seven of the first conjugation, seventeen of the second, and fifteen of the third. Many of these differ but very slightly from each other. All the irregular verbs are conjugated like some one of these thirty-nine forms. Four of these—viz., *haber, ser, estar*, and *tener*—have already been conjugated.

Those verbs which undergo slight changes in the verb-roots or verb-endings of certain tenses or persons of tenses, are not on that account deemed irregular, since these changes take place solely to preserve *regularity* and uniformity of sound, which would be dissimilar in some cases if these changes did not take place. Both regular and irregular verbs undergo such changes when required by the rules of pronunciation.

Remark.—In the following conjugations of the irregular verbs, those persons of the moods and tenses only which deviate from the regular conjugation are given. Thus, in the first verb, *andar*, no tense of the indicative mood except the perfect definite is given, because this verb is conjugated regularly in the other tenses of this mood. The student is therefore to remember that all moods, tenses, and persons not included in the conjugation are regular. We have, however, in all cases given the participle and gerund, whether formed regularly or not.

IRREGULAR VERBS OF THE FIRST CONJUGATION.

1. The irregular verb *andar*, to walk, is thus conjugated:—

INF. *Past Participle.* Audado.—*Gerund.* Audaudo.

IND. *Perfect Definite.* Anduve, anduviste, anduvo; auduvimos, anduvísteis; anduvieron.

SUB. *Imperfect.* Anduviera *or* anduviese, anduvieras *or* anduvieses, anduviera *or* auduviese; anduviéremos *or* auduviésemos, anduviérais *or* anduviéseis, anduvieran *or* anduvieseu.—*First Future.* Auduviere, anduvieres, auduvicre; anduviéremos, anduviéreis, auduvicren.

2. The irregular verb *contar*, to relate, is thus conjugated:—

INF. *Past Participle.* Contado.—*Gerund.* Contaudo.

IND. *Present.* Cuento, cueutas, cuenta; ——, ——, cuentan.

IMP. Cuente, cuenta, cuente; ——, ——, cueuten.

SUB. *Present.* Cueute, cueutes, cueute; ——, ——, cuenten.

This verb changes *o* of the verb-root into *ue*, in the three persons singular and third person plural of the present indicative, imperative, and present subjunctive.

3. The irregular verb *dar*, to give, is thus conjugated:—

INF. *Past Participle.* Dado.—*Gerund.* Dando.

IND. *Present.* Doy (*no other Persons irregular*).—*Perfect Definite.* Dí, diste, dió; dimos, dísteis, dieron.

SUB. *Imperfect.* Diera *or* diese, dicras *or* dieses, diera *or* diese; diéramos *or* diésemos, diérais *or* diéseis, dieran *or* diesen.—*First Future.* Diere, dieres, diere; diéremos, diéreis, dieren.

4. The irregular verb *jugar*, to play, is thus conjugated:—

INF. *Past Participle.* Jugado.—*Gerund.* Jugando.

IND. *Present.* Juego, juegas, juega; ——, ——, juegan.

IMP. Jueguc, juega, juegue; ——, ——, jueguen.

SUB. *Present.* Juegue, juegues, juegue; ——, ——, jueguen.

This verb takes *e* before *g* of the verb-root in the three persons singular and third person plural of the present indicative, the imperative, and present subjunctive.

5. The irregular verb *tentar*, to try, to tempt, is thus conjugated:—

INF. *Past Participle.* Tentado.—*Gerund.* Tentando.

IND. *Present.* Tiento, tientas, tienta; ——, ——, tientan.

IMP. Tiente, tienta, tiente; ——, ——, tieuten.

SUB. *Present.* Tieute, tientes, tiente; ——, ——, tientcn.

This verb takes *i* before *e* of the verb-root in the same persons and tenses as are irregular in the preceding verb.

6. The irregular verb *errar*, to err, is thus conjugated:—

INF. *Past Participle.* Errado.—*Gerund.* Errando.

IND. *Present.* Yerro, yerras, yerra; ——, ——, yerran.

IMP. Yerre, yerra, yerre; ——, ——, yerren.

SUB. *Present.* Yerre, yerres, yerre; ——, ——, yerren.

This verb is irregular in the same persons and tenses as *tentar*, and takes *y* before *e* of the verb-root in all the irregular persons.

IRREGULAR VERBS OF THE SECOND CONJUGATION.

7. The irregular verb *caber*, to be contained, to have room, is thus conjugated :—

INF. *Past Participle.* Cabido.—*Gerund.* Cabiendo.

IND. *Present.* Quepo (*no other Persons irregular*).—*Perfect Definite.* Cupe, cupiste, cupo; cupimos, cupisteis, cupieron.—*First Future.* Cabré cabrás, cabrá; cabremos, cabréis, cabrán.

IMP. Quepa, ——, quepa; quepamos, ——, quepan.

SUB. *Present.* Quepa, quepas, quepa; quepamos, quepáis, quepan. —*Imperfect.* Cupiera, cabria, *or* cupiese; cupieras, cabrias, *or* cupieses; cupiera, cabría, *or* cupiese. Cupiéramos, cabríamos, *or* cupiésemos; cupiérais, cabríais, *or* cupiéseis; cupieran, cabrían, *or* cupiesen.—*First Future.* Cupiere, cupieres, cupiérei; cupiéremos, cupiércis, cupieren.

8. The irregular verb *caer*, to fall, is thus conjugated :—

INF. *Past Participle.* Caido.—*Gerund.* Cayendo.

IND. *Present.* Caigo (*no other Persons irregular*).

IMP. Caiga, ——, caiga; caigamos, ——, caigan.

SUB. *Present.* Caiga, caigas, caiga; caigamos, caigáis, caigan.

This verb takes *ig* after the verb-root in the first person singular of the present indicative, in the first and third persons singular and plural of the imperative, and in all the persons of the present subjunctive.

9. The irregular verb *hacer*, to make, to do, is thus conjugated :—

INF. *Past Participle.* Hecho.—*Gerund.* Haciendo.

IND. *Present.* Hago (*no other Persons irregular*).—*Perfect Definite.* Hice, hiciste, hizo; hicimos, hicisteis, hicieron.—*First Future.* Haré, harás, hará; haremos, haréis, harán.

IMP. Haga, haz, haga; hagamos, ——, hagan.

SUB. *Present.* Haga, hagas, haga; hagamos, hagáis, hagan.—*Imperfect.* Hiciera, haría, *or* hiciese; hicieras, harias, *or* hicieses; hiciera, haría, *or* hiciese. Hiciéramos, haríamos, *or* hiciésemos; hiciérais, haríais, *or* hiciéseis; hicieran, harían, *or* hiciesen.—*First Future.* Hiciere, hicieres, hiciere; hiciéremos, hiciéreis, hicieren.

Satisfacer, one of the compounds of the verb *hacer*, has in the second person singular of the imperative mood both *satisfaz* and *satisface*.

10. The irregular verb *mover*, to move, is thus conjugated :—

INF. *Past Participle.* Movido.—*Gerund.* Moviendo.

IND. *Present.* Muevo, mueves, mueve; ——, ——, mueven.

IMP. Mueva, mueve, mueva; ——, ——, muevan.

SUB. *Present.* Mueva, muevas, mueva; ——, ——, muevan.

This verb changes *o* of the verb-root into *ue* in the three persons singular and third person plural of the present indicative, the imperative, and present subjunctive.

11. The irregular verb *oler*, to smell, is thus conjugated :—

INF. *Past Participle.* Olida.—*Gerund.* Oliendo.

IND. *Present.* Huelo, hueles, huele; ——, ——, huelen.

IMP. Huela, huele, huela; ——, ——, huelan.

SUB. *Present.* Huela, huelas, huela; ——, ——, huelan.

This verb changes as the preceding, and also takes *h* at the beginning of the irregular persons.

12. The irregular verb *parecer*, to seem, is thus conjugated :—

INF. *Past Participle.* Parecido.—*Gerund.* Pareciendo.

IND. *Present.* Parezco (*no other Persons irregular*).

IMP. Parezca, ——, parezca; parezcamos, ——, parezcan.

SUB. *Present.* Parezca, parezcas, parezca; parezcamos, parezcáis, parezcan.

This verb, and all others ending in *acer*, *ecer*, and *ocer* (except *hacer* and *cocer*, and, of course, their compounds), take *z* before *c* of the verb-root, when the verb-ending begins with *a* or *o*. This can only occur in the first person singular of the present indicative, the first and third persons singular and plural of the imperative, and all the persons of the present subjunctive.

13. The irregular verb *poder*, to be able, is thus conjugated :—

INF. *Past Participle.* Podido.—*Gerund.* Pudiendo.

IND. *Present.* Puedo, puedes, puede; ——, ——, pueden.—*Perfect Definite.* Pude, pudiste, pudo; pudimos, pudísteis, pudieron.—*First Future.* Podré, podrás, podrá; podremos, podréis, podrán.

SUB. *Present.* Pueda, puedas, pueda; ——, ——, puedan.—*Imperfect.* Pudiera, podría, *or* pudiese; pudieras, podrías, *or* pudieses; pudiera, podría, *or* pudiese. Pudiéramos, podríamos, *or* pudiésemos; pudiérais, podríais, *or* pudiéseis; pudieran, podrian, *or* pudiesen.—*First Future.* Pudiere, pudieres, pudiere; pudiéremos, pudiéreis, pudieren.

14. The irregular verb *poner*, to place, to put, is thus conjugated :—

INF. *Past Participle.* Puesto.—*Gerund.* Poniendo.

IND. *Present.* Pongo (*no other Persons irregular*).—*Perfect Definite.* Puse, pusiste, puso; pusimos, pusísteis, pusieron.—*First Future.* Pondré, pondrás, pondrá; pondremos, pondréis, pondrán.

IMP. Ponga, pon, ponga; pongamos, ——, pongan.

SUB. *Present.* Ponga, pongas, ponga; pongamos, pongáis, pongan.—*Imperfect.* Pusiera, pondría, *or* pusiese; pusieras, pondrías, *or* pusieses; pusiera, pondría, *or* pusiese. Pusiéramos, pondríamos, *or* pusiésemos; pusiérais, pondrías, *or* pusiéseis; pusieran, pondrían, *or* pusiesen.—*First Future.* Pusiere, pusieres, pusiere; pusiéremos, pusiéreis, pusieren.

15. The irregular verb *querer*, to be willing, to wish, is thus conjugated :—

INF. *Past Participle.* Querido.—*Gerund.* Queriendo.

IND. *Present.* Quiero, quieres, quiere; ——, ——, quieren.—*Perfect Definite.* Quise, quisiste, quiso; quisimos, quisísteis, quisieron.—*First Future.* Querré, querrás, querrá; querremos, querréis, querrán.

IMP. Quiera, quiere, quiera; ——, ——, quieran.

SUB. *Present.* Quiera, quieras, quiera; ——, ——, quieran.—*Imperfect.* Quisiera, querría, *or* quisiese; quisieras, querrías, *or* quisieses; quisiera, querría, *or* quisiese. Quisiéramos, querríamos, *or* quisiésemos; quisiérais, querríais, *or* quisiéseis; quisieran, querrían, *or* quisiesen.—*First Future.* Quisiere, quisieres, quisiere; quisiérémos, quisiéreis, quisieren.

16. The irregular verb *saber*, to know, is thus conjugated :—

INF. *Past Participle.* Sabido.—*Gerund.* Sabiendo.

IND. *Present.* Sé (*no other Persons irregular*).—*Perfect Definite.* Supe, supiste, supo; supimos, supísteis, supieron.—*First Future.* Sabré, sabrás, sabrá; sabremos, sabréis, sabrán.

IMP. Sepa, ——, sepa; sepamos, ——, sepan.

SUB. *Present.* Sepa, sepas, sepa; sepamos, sepais, sepan.—*Imperfect.* Supiera, sabría, *or* supiese; supieras, sabrías, *or* supieses; súpiera, sabría, *or* supiese. Supiéramos, sabríamos, *or* supiésemos; supiérais, sabríais, *or* supiéseis; supieran, sabrian, *or* supiesen.—*First Future.* Supiere, supieres, supiere; supiéremos, supiéreis, supieren.

17. The irregular verb *tender*, to tend, to extend, is thus conjugated :—

INF. *Past Participle.* Tendido.—*Gerund.* Tendiendo.

IND. *Present.* Tiendo, tiendes, tiende; ——, ——, tienden.

IMP. Tienda, tiende, tienda; ——, ——, tiendan.

SUB. *Present.* Tienda, tiendas, tienda; ——, ——, tiendan.

18. The irregular verb *traer*, to bring, to carry, is thus conjugated :—

INF. *Past Participle.* Traido.—*Gerund.* Trayendo.

IND. *Present.* Traigo (*no other Persons irregular*).—*Perfect Definite.* Traje, trajiste, trajo; trajimos, trajisteis, trajeron.

IMP. Traiga, ——, traiga; traigamos, ——, traigan.

SUB. *Present.* Traiga, traigas, traiga; traigamos, traigáis, traigan. —*Imperfect.* Trajera *or* trajese, trajeras *or* trajeses, trajera *or* trajese; trajéramos *or* trajésemos, trajérais *or* trajeseis, trajeran *or* trajesen.—*First Future.* Trajere, trajeres, trajere; trajéremos, trajéreis, trajeren.

KEY TO EXERCISES IN LESSONS IN SPANISH.—XIII.

EXERCISE 32.

1. How do you find yourself? 2. The lawyers conduct themselves badly. 3. Ye behave yourselves badly. 4. The carpenter finds himself contented. 5. Peter praises himself. 6. The general armed himself. 7. They saved themselves. 8. I hid myself. 9. We hid ourselves. 10. Oh that I might find myself with her! 11. Thy friends will assemble themselves in London. 12. Praise ye yourselves. 13. Let us arm ourselves. 14. Arm yourself. 15. I rejoice much. 16. The winter draws near. 17. You jest. 18. Peter complains. 19. Of whom do they complain? 20. I always rise at six o'clock. 21. Would you not retire from the country? 22. They rejoice. 23. Rejoice ye. 24. Let them rejoice. 25. Do not complain. 26. Let us not meddle in the affairs of the judge.

EXERCISE 33.

1. Pedro se porta bien. 2. Te portas bien. 3. Ellas se juntaron en Madrid. 4. Te amas. 5. La muger se escondió. 6. Se alaban mis hermanos. 7. Me alabó. 8. Nos amamos. 9. Se han portado mal 10. ¡Ojala se portasen bien! 11. Escondete. 12. Salvaos. 13. Alabese vmd. 14. Te burlas. 15. Se acerca la primavera. 16. Se quejan. 17. Te alegras. 18. Se ha levantado. 19. ¿Me he metido nunca en sus asuntos? 20. Me retiraré.

EXERCISE 34.

1. This woman is called Mary. 2. It is believed. 3. This wine is sold at three shillings a bottle. 4. You are deceived. 5. What books are used in that school? 6. The bottles will be filled with water. 7. All the city will be filled with smoke. 8. Here French is spoken. 9. The doors will be opened. 10. The houses are burned. 11. Here books are sold. 12. The prophecies are fulfilled. 13. This man is called Peter.

EXERCISE 35.

1. Aqui se habla el Frances. 2. Llamad, y se os aburá. 3. Se dobla el clamor. 4. ¿Se usan plumas de oro? 5. Las botellas se llenarán de vino. 6. La casa se llenará de humo. 7. Se abrirán las puertas. 8. Se cumple la profecia. 9. Las casas se quemaron. 10. Se abrió el libro. 11. Este vino se vende á dos pesos la botella. 12. Se continuara la carta. 13. Se abrieron todas las puertas.

EXERCISE 36.

1. The father loves his sons. 2. The physician heals the sick. 3. We pardon our debtors. 4. God loves those who are good. 5. She fears the American. 6. The judge pardoned the man who robbed Peter's father. 7. My manservant slew his father. 8. I pardoned all my debtors. 9. Peter loves me like a brother. 10. We will visit the president to-night. 11. I will reward him who honours me.

EXERCISE 37.

1. Honoramos al juez. 2. Este juez no teme á Dios. 3. Yo perdono á mis deudores. 4. Llamaron á los pintores. 5. El medico sanará á muchos enfermos. 6. Robaron á la muger á quien recompensamos. 7. Honrad á vuestros padres. 8. Te amo como á un padre. 9. Las señoras recompensarán á sus criadas.

LESSONS IN ENGLISH LITERATURE.—XVI.

THE CIVIL WAR AND THE COMMONWEALTH: POETRY.

THE period of the Civil War and the Commonwealth produced many poets; but, excepting always Milton, whom we shall have to treat of separately, they were neither very great individually, nor did they, like the second-rate poets and dramatists of the preceding generation, belong to a great school, writing under the influence of its principles and following its traditions. The period at which we have now arrived produced a class of poets distinguished rather by learning and subtlety than by truth or poetic feeling. To those poets Johnson gave the name of the metaphysical poets. The name is not very happily chosen, but it has been generally adopted by later writers; and Johnson's description of the characteristics of this class of writers, though a little exaggerated, is, if applied to the more extravagant examples of the class, in the main just:—"The metaphysical poets were men of learning, and to show their learning was their whole endeavour; but, unluckily resolving to show it in rhyme, instead of writing poetry, they only wrote verses, and very often such verses as stood the trial of the finger better than of the ear; for the modulation was so imperfect that they were only to be found verses by counting the syllables. If the father of criticism has rightly denominated poetry τέχνη μιμητική, an imitative art; those writers will, without great wrong, lose the name of poets; for they cannot be said to have imitated anything. They neither copied nature nor life; neither painted the forms of matter, nor represented the operations of intellect. . . . Their thoughts are often new, but seldom natural; they are not obvious, but neither are they just; and the reader, far from wondering that he missed them, wonders more frequently by what perverseness of industry they were ever found. . . . The most heterogeneous ideas are yoked by violence together; nature and art are ransacked for illustrations, comparisons, and allusions; their learning instructs, and their subtlety surprises; but the reader commonly thinks his improvement dearly bought, and though he sometimes admires, is seldom pleased. . . . From this account of their compositions it will be readily inferred that they were not successful in representing or moving the affections. . . . Nor was the sublime more within their reach than the pathetic. . . . Those writers who lay on the watch for novelty could have little hope of greatness, for great things cannot have escaped former observation. Their attempts were always analytic; they broke every image into fragments; and could no more represent, by their slender conceits and laboured particularities, the prospects of nature or the scenes of life, than he who dissects a sunbeam with a prism can exhibit the wide effulgence of a summer noon."

The origin of this school of poetry in England is traced back by Johnson to Donne, whom we have already mentioned as a satirist among the poets of the Elizabethan age. The principal representative of the class in the following age was Cowley.

Abraham Cowley was born in London in 1618, his parents belonging to the tradesman class. He received his education at Westminster School and at Cambridge. From a very early age he gave proof of extraordinary intellectual vigour and great literary ability, and laid the foundation of the high reputation which he enjoyed among his contemporaries. Throughout the civil contests and the Commonwealth, Cowley warmly espoused the side of the king, and was for many years employed in responsible posts at home and abroad by the royal family. After the Restoration he, like many other faithful adherents of royalty, failed to obtain the reward of his devotion; and he died in retirement and disappointment in 1667. Of poets whose fame while living has been anything like so great as Cowley's, there is probably hardly any whose poems posterity has so completely forgotten as his. He was the author of a great number of short poems upon the most various subjects, and of very various degrees of merit, but all tainted more or less by the vices pointed out by Johnson in the passage we have quoted. The works of Cowley most admired by his contemporaries were his "Pindaric Odes," of which some are free translations of the odes of Pindar, others original odes composed in a style which was once thought scarcely inferior to Pindar. But to a modern reader it is very difficult to detect their merit. "The Davideis" is an epic poem, intended to have extended to twelve books, but of which only four were completed, upon the life of David. It is said to have been written by Cowley when a very young man. There are few poems in the language so wholly wearisome, so destitute of life and interest, and so perpetually offending against every principle of good taste. As a prose writer, Cowley is far more pleasing than as a poet; his essays upon various subjects of taste and criticism fully deserve the high reputation they have always enjoyed.

Among the minor poets of that age, there is probably none whose works have retained their popularity to the same degree as those of George Herbert. Where Cowley and even Waller have one reader, Herbert has hundreds. This lasting popularity he owes at least as much to the purity and beauty of his life and character, as to his genius. Herbert was born in 1593; he was educated at Trinity College, Cambridge, and resided for some years at the University, where he filled the office of public orator, and was highly distinguished for learning and eloquence. But it was as a country clergyman, in the rectory of Bemerton, in Wilts, that he chiefly displayed those virtues which have secured him to so high a degree the reverence of successive generations of English churchmen. His poems are short religious pieces, and the principal series of them is one published after his death, under the title of "The Temple." They partake strongly of the prevailing faults of the day, affected conceits, and misplaced ingenuity. But the spirit of profound piety, of ardent but chastened religious emotion which breathes through these poems, has given them a vitality which all their faults has not been able to destroy. Herbert died in 1633.

Somewhat similar in character to the poetry of Herbert is that of Richard Crashaw, a poet born a few years later than Herbert. Crashaw was educated at Oxford, but he soon became a Roman Catholic, and died at an early age an ecclesiastic in the Roman Catholic Church.

Francis Quarles is one of the writers most completely ruined by the prevailing taste of his day; his writings are to modern readers almost unbearable, from their affectation and want of simplicity. A series of "Divine Emblems" is the best known of his works.

A poet of far superior quality to Quarles was George Wither. He was born towards the close of the reign of Elizabeth, and lived till several years after the Restoration. In all the contests of the stormy period in which his lot was cast Wither took an active part, and experienced the alternations of success and persecution which befell all such men. He was a staunch Puritan, and fought in the parliamentary army. As a poet, Wither possessed many qualities of a very high order. When he writes at his best, his language is admirably terse and vigorous, his verse very melodious, and his observation both of external nature and of human nature close and delicate. But a great part of his poems are spoiled by the prevailing faults of his day, puerile conceits and ingenious extravagances both of thought and expression. There are some or his poems, however, which have wholly escaped the taint. What can be more simple and manly than the well-known song, from which space allows us to quote only two stanzas:—

"Shall I, wasting in despair,
Die because a woman's fair?
Or my cheeks make pale with care,
'Cause another's rosy are?
Be she fairer than the day,
Or the flowery meads in May—
If she be not so to me,
What care I how fair she be?

"Great or good, or kind or fair,
I shall ne'er the more despair.
If she love me, this believe,
I will die ere she shall grieve.
If she slight me when I woo,
I can scorn and let her go;
For if she be not for me,
What care I for whom she be?"

Robert Herrick was born before the close of the sixteenth century, and lived till some years after the Restoration. He was by profession a clergyman, and rector of a country parish; but in taste and sympathies he was a wit and man of the world. While showing strongly the faults of his age—sensuousness even to indecency, subtlety, and want of simplicity—Herrick's poems also show in a peculiar degree the highest excellences of the period. For refinement of sentiment and grace of expression his songs are unsurpassed.

The peculiar beauties of the minor poetry of this period, though by no means wanting in some of those whom we have already mentioned, especially in Wither and Herrick, are chiefly to be found in the cavalier poets. These writers are all poets of romance rather than of passion. There is an air of lightness, almost of unreality, about their tenderest expressions; and they show a sensuousness of tone by no means in harmony with the sterner taste either of their Puritan contemporaries, or of more modern times; nor are they free from the tendency to morbid subtlety of thought and expression. But their lyrics have a grace, refinement, and delicacy of finish which no other school of English song-writers has ever reached, and which is irresistibly attractive. The principal representatives of this class are Suckling and Lovelace.

Sir John Suckling, who was born early in the reign of James I., and died in the midst of the conflicts of the next reign, was a cavalier, an ardent and devoted royalist. His poems are all short, almost all of them on subjects of love and gallantry. Many of them are marred by an over-sensuous warmth of tone, occasionally amounting to positive indecency; but the best of them exhibit in a very high degree that delicacy of fancy and neatness of expression which are among the highest graces that such poetry can possess. The following lines from one of his best-known poems—that in which, under the guise and in the assumed style of a rustic, he describes a fashionable wedding—are a fair specimen of his style:—

"The maid, and hereby hangs a tale—
For such a maid no Whitsun ale
Could ever yet produce:
No grape that's hardly ripe could be
So round, so plump, so soft as she,
Nor half so full of juice.

"Her finger was so small, the ring
Would not stay on which they did bring,
It was too wide a peck.
And, to say truth (for out it must),
It looked like the great collar (just)
About our young colt's neck.

"Her feet, beneath her petticoat,
Like little mice stole in and out,
As if they feared the light.
But, oh! she dances such a way!
No sun upon an Easter day
Is half so fine a sight."

Of all the song-writers of this period, perhaps the first place is due to Sir Richard Lovelace. He lived through the whole of the stormy period which included the Civil War and the Commonwealth. He was a soldier and a zealous loyalist, and fought on the king's side throughout the war; and in proportion as the king's cause declined the fortunes of Lovelace suffered with it. He was reduced to poverty, was frequently imprisoned, and died at last in extreme distress, just too soon to see the tide of fortune turn, and the triumph of his party in the Restoration. Love and loyalty are his favourite themes, and his songs have an exquisite grace and tenderness. The following poem, "To Althea from Prison," is one of the most beautiful lyrics in our language:—

"When Love, with unconfinéd wings,
Hovers within my gates,
And my divine Althea brings
To whisper at the grates;
When I lie tangled in her hair,
And fettered to her eye,
The birds that wanton in the air
Know no such liberty.

"When flowing cups run swiftly round,
With no allaying Thames,
Our careless heads with roses crowned,
Our hearts with loyal flames;
When thirsty grief in wine we steep,
When healths and draughts go free—
Fishes that tipple in the deep
Know no such liberty.

"When, like committed linnets, I
With shriller throat shall sing
The sweetness, mercy, majesty,
And glories of my king;
When I shall voice aloud how good
He is, how great should be,
Enlargéd winds, that curl the flood,
Know no such liberty.

"Stone walls do not a prison make,
Nor iron bars a cage;
Minds innocent and quiet take
That for an hermitage.
If I have freedom in my love,
And in my soul am free,
Angels alone, that soar above,
Enjoy such liberty."

And not less perfect is his little poem, "To Lucasta on Going to the Wars:"—

"Tell me not, sweet, I am unkind,
That from the nunnery
Of thy chaste breast and quiet mind,
To war and arms I fly.

"True a new mistress now I chase,
The first foe in the field;
And with a firmer faith embrace
A sword, a horse, a shield.

"Yet this inconstancy is such
As you too shall adore;
I could not love thee, dear, so much,
Loved I not honour more."

To the same class of cavalier poets belongs Cleveland, a poet who, in his own day, enjoyed a higher reputation than either Suckling or Lovelace, though posterity has reversed this judgment. His chief powers were as a satirist.

Two poets in particular, Waller and Denham, are exempted by Johnson from the catalogue of metaphysical poets. They, he says, "sought another way to fame, by improving the harmony of our numbers;" and though, in the case of Waller, most modern critics might hesitate before acquitting him absolutely of the charge intended to be conveyed by the epithet metaphysical, there can be no doubt that both the poets named contributed largely to the improvement of English versification.

Edmund Waller was born in 1603, and lived till 1687. During this period he filled a prominent place in public affairs. By birth he was a country gentleman, and at an early age he inherited an ample fortune. He entered Parliament early, and his wit and eloquence soon acquired for him a popularity which he never lost; though, by his selfish and unscrupulous conduct, he forfeited the respect of all parties. As a near relation of Hampden and Cromwell, his family connections were on the side of the Parliament; but his sympathies, so far as he had any, seem to have been rather with the opposite party. On one occasion he suffered banishment and a pecuniary fine for being party to a foolish and somewhat discreditable plot in favour of the king, and might have incurred a heavier penalty, had he not escaped by a cowardly betrayal of his friends. He was, in fact, an unprincipled and time-serving politician, a bad specimen of what in the next generation would have been called a trimmer; and he panegyrised with equal zeal Charles I., Cromwell, and Charles II. As a poet, a wit, and a man of letters, he enjoyed an unrivalled fame in his own day; but his works are little read now, and deservedly so. His verses never jar upon the ear, and his ideas but rarely offend the taste; but he very seldom rises above the tamest mediocrity. The simplest and least ambitious among Waller's poems are to a modern reader the most pleasing. The following very graceful song to a rose is a very favourable specimen of his manner:—

"Go, lovely rose!
Tell her that wastes her time and me,
That now she knows,
When I resemble her to thee,
How sweet and fair she seems to be.

"Tell her that's young,
And shuns to have her graces spied,
That hadst thou sprung
In deserts where no men abide,
Thou must have uncommended died.

"Small is the worth
Of beauty from the light retired:
Bid her come forth,
Suffer herself to be desired,
And not blush so to be admired.

"Then die! that she,
The common fate of all things rare,
May read in thee:
How small a space of time they share,
That are so wondrous sweet and fair."

Sir John Denham, whom Johnson, as we have seen, coupled with Waller as an improver of our numbers, was not a very voluminous writer. His best as well as most celebrated poem is "Cooper's Hill." It is the earliest of a class of poems which have since become extremely common—poems in honour of particular localities. The subject, "Cooper's Hill," is a spot of that name close to the Thames. Denham, in a manner varied, but always pleasing, describes the beauties of the place, and expresses the thoughts and recollections which it suggests. His style and versification are always melodious, and he sometimes rises to a high degree of elevation and dignity. One of the finest passages in the poem is that in which, after an eloquent description of the beauties and benefits of the Thames, and its character as a stream, he closes with the lines which have been so often quoted and commended from the days of Dryden downwards:—

> "Oh, could I flow like thee, and make thy stream
> My great example, as it is my theme!
> Though deep, yet clear; though gentle, yet not dull;
> Strong without rage, without o'erflowing full."

Two other poets, from among a large number of obscurer names, demand mention, though we can only mention them. William Browne was the author of a series of pastoral poems of much merit, published under the name of "Britannia's Pastorals." Sir William Davenant enjoyed great fame as a dramatist and a poet. His chief poem is a long narrative poem of heroic achievements, "Gondibert." In its author's day this poem was very popular, as we know from the frequent allusions to it in contemporary writings. But it is now completely forgotten.

LESSONS IN GERMAN.—LXIII.

§ 78 (*continued*).—(1.) ALPHABETICAL LIST OF VERBS OF THE OLD FORM.

(*Commonly called Irregular Verbs.*)

NOTE that in the following list many *compound* forms are not set down. In such case, the student has only to look for the verb in its *simple* form.

INFINITIVE.	INDICATIVE. *Present.*	INDICATIVE. *Imp.*	SUBJUNC. *Imp.*	IMPERAT.	PARTICIP.
Backen, ([1]) to bake	ich backe, du bäckst, er bäckt	ich buk	ich büke	backe	gebacken
Befehlen, to command	ich befehle, du befiehlst, er befiehlt, ꝛc.	ich befahl	ich beföhle	befiehl	befohlen
Befleißen (sich) to apply one's self	ich befleiße, ꝛc.	ich befliß	ich beflisse	befleiße	beflissen
Beginnen, ([2]) to begin	ich beginne, ꝛc.	ich begann	ich begänne	beginne	begonnen
Beißen, to bite	ich beiße, ꝛc.	ich biß	ich bisse	beiße	gebissen
Beklemmen, ([3]) to pinch, press (by anxiety)	ich beklemme, ꝛc.	ich beklomm	ich beklemmte	beklemme	beklommen (beklemmt)
Bergen, to conceal	ich berge, du birgst, er birgt	ich barg	ich bärge	birg	geborgen
Bersten, to burst	ich berste, ꝛc.	ich borst or barst	ich bärste	berste or birst	geborsten
Betrügen, to deceive	ich betrüge, ꝛc.	ich betrog	ich betröge	betrüge	betrogen
Bewegen, ([4]) to induce	ich bewege, ꝛc.	ich bewog	ich bewöge	bewege	bewogen
Biegen, to bend	ich biege, ꝛc.	ich bog	ich böge	biege	gebogen
Bieten, ([5]) to offer, to bid	ich biete, ꝛc.	ich bot	ich böte	biete	geboten
Binden, to bind	ich binde, ꝛc.	ich band	ich bände	binde	gebunden
Bitten, to entreat, to beg	ich bitte, ꝛc.	ich bat	ich bäte	bitte	gebeten
Blasen, to blow	ich blase, du bläsest, er bläst	ich blies	ich bliese	blase	geblasen

([1]) Regular when active; as, er backte Brod; das Brod buk. ([2]) In the imperfect subjunctive begönne is also used. ([3]) Beklemmt is not frequently used, and is employed only in the sense of compressed. ([4]) Irregular when it means, to induce; regular when it means, to move a *body* or affect the *sensibilities.* ([5]) Beutst and beut, in the present, are poetical.

INFINITIVE.	INDICATIVE. *Present.*	INDICATIVE. *Imp.*	SUBJUNC. *Imp.*	IMPERAT.	PARTICIP.
Bleiben, to remain	ich bleibe, ꝛc.	ich blieb	ich bliebe	bleibe	geblieben
Braten, to roast	ich brate, du bratest or brätst, er bratet or brät	ich briet	ich briete	brate	gebraten
Brechen, to break	ich breche, du brichst, er bricht	ich brach	ich bräche	brich	gebrochen
Brennen, to burn	ich brenne, ꝛc.	ich brannte	ich brennte	brenne	gebrannt
Bringen, to bring	ich bringe, ꝛc.	ich brachte	ich brächte	bringe	gebracht
Denken, to think	ich denke, ꝛc.	ich dachte	ich dächte	denke	gedacht
Dingen, ([6]) to bargain	ich dinge, ꝛc.	ich dung	ich dünge	dinge	gedungen
Dreschen, to thrash	ich dresche, du drischest, er drischt	ich drosch	ich dräsche or drösche	drisch	gedroschen
Dringen, ([7]) to press, to urge	ich dringe, ꝛc.	ich drang	ich dränge	dringe	gedrungen
Dürfen, to be allowed	ich darf, du darfst, er darf, ꝛc.	ich durfte	ich dürfte	dürfe	gedurft
Empfangen, to receive	ich empfange, du empfängst, er empfängt	ich empfing	ich empfinge	empfange	empfangen
Empfehlen, to recommend	ich empfehle, du empfiehlst, er empfiehlt	ich empfahl	ich empföhle	empfiehl	empfohlen
Erbleichen, ([8]) to turn pale	ich erbleiche, ꝛc.	ich erblich	ich erbliche	erbleiche	erblichen
Erkiesen, Erküren, to select, to choose	ich erkühre (erküre), ꝛc.	ich erkor (erkohr)	ich erkühre (erküre)	erkühre (erküre)	erkohren (erkoren)
Erlöschen, ([9]) to extinguish	ich erlösche, du erlischest, er erlischt, ꝛc.	ich erlosch	ich erlöschte	erlösche	erloschen
Erschallen, to resound	ich erschalle, ꝛc.	ich erscholl	ich erschölle	erschalle	erschollen
Erschrecken, ([10]) to be frightened	ich erschrecke, du erschrickst, er erschrickt	ich erschrak	ich erschräke	erschrick	erschrocken
Erwägen, ([11]) to consider	ich erwäge, ꝛc.	ich erwog	ich erwöge	erwäge	erwogen
Essen, to eat	ich esse, du issest, er ißt	ich aß	ich äße	iß	gegessen
Fahren, ([12]) to drive in a carriage	ich fahre, du fährst, er fährt	ich fuhr	ich führe	fahre	gefahren
Fallen, to fall	ich falle, du fällst, er fällt	ich fiel	ich fiele	falle	gefallen
Fangen, ([13]) to catch	ich fange, du fängst, er fängt	ich fing	ich finge	fange	gefangen
Fechten, to fight	ich fechte, du fechtest or fichtst, er fechtet or ficht	ich focht	ich föchte	fechte (ficht)	gefochten

([6]) Dingte is sometimes used in the imperfect, in the sense of hire. ([7]) For drang, drung was formerly in use. ([8]) Derived from bleichen, to whiten as in the sun, which is regular. ([9]) Like verlöschen and auslöschen, irregular only when intransitive. Löschen is always transitive and regular. ([10]) Irregular always as an intransitive verb, but regular when transitive. ([11]) More frequently used as a regular verb. ([12]) All the compounds of fahren are irregular except willfahren. ([13]) The forms fieng and fienge are obsolete.

INFINITIVE.	INDICATIVE. Present.	INDICATIVE. Imp.	SUBJUNC. Imp.	IMPERAT.	PARTICIP.
Finden, to find	ich finde, ꝛc.	ich fand	ich fände	finde	gefunden
Flechten, to twist	ich flechte, du flechtest or flichtst, er flechtet or flicht	ich flocht	ich flöchte	flechte (flicht)	geflochten
Fliegen, (14) to fly	ich fliege, du fliegst, er fliegt	ich flog	ich flöge	fliege	geflogen
Fliehen, (15) to flee	ich fliehe, ꝛc.	ich floh	ich flöhe	fliehe	geflohen
Fließen, (16) to flow	ich fließe, ꝛc.	ich floß	ich flösse	fließe	geflossen
Fressen, to devour	ich fresse, du frissest, er frißt	ich fraß	ich fräße	friß	gefressen
Frieren, to freeze	ich friere, ꝛc.	ich fror	ich fröre	friere	gefroren
Gähren, (17) to ferment	ich gähre, ꝛc.	ich gohr	ich göhre	gähre	gegohren
Gebären, to bring forth	ich gebäre, du gebärst (gebierst), er gebärt (gebiert)	ich gebar	ich gebäre (geböre)	gebäre (gebier)	geboren
Geben,(18) to give	ich gebe, du gibst, er gibt	ich gab	ich gäbe	gib	gegeben
Gedeihen,(19) to prosper	ich gedeihe, ꝛc.	ich gedieh	ich gediehe	gedeihe	gediehen
Gehen,(20) to go	ich gehe, ꝛc.	ich ging	ich ginge	gehe	gegangen
Gelingen, to succeed	es gelingt	es gelang	es gelänge	gelinge	gelungen
Gelten,(21) to be worth, valid	ich gelte, du giltst, er gilt	ich galt	ich gälte	gilt	gegolten
Genesen, to recover	ich genese, ꝛc.	ich genaß	ich genäse	genese	genesen
Genießen,(22) to enjoy	ich genieße, ꝛc.	ich genoß	ich genösse	genieße	genossen
Geschehen, to happen	es geschieht, ꝛc.	es geschah	es geschähe	geschehe	geschehen
Gewinnen, to gain, to win	ich gewinne, ꝛc.	ich gewann	ich gewänne (gewönne)	gewinne	gewonnen
Gießen, (23) to pour	ich gieße, ꝛc.	ich goß	ich gösse	gieße	gegossen
Gleichen, to resemble	ich gleiche, ꝛc.	ich glich	ich gliche	gleiche	geglichen
Gleiten, (24) to glide	ich gleite, ꝛc.	ich glitt	ich glitte	gleite	geglitten
Glimmen,(25) to sparkle	ich glimme, ꝛc.	ich glomm	ich glömme	glimme	geglommen
Graben, to dig	ich grabe, du gräbst, er gräbt	ich grub	ich grübe	grabe	gegraben
Greifen, to seize	ich greife, ꝛc.	ich griff	ich griffe	greife	gegriffen
Haben,(26) to have	ich habe, du hast, er hat	ich hatte	ich hätte	habe	gehabt
Halten, to hold	ich halte, du hältst, er hält	ich hielt	ich hielte	halte	gehalten

(14) Fleugst and fleugt in the present, and fleug in the imperative, are forms used only in poetry. (15) Fleuchst, fleucht, and fleuch, poetical. (16) Fleußest, fleußt, and fleuß, poetical. (17) Sometimes regular, gährte. (18) Some writers prefer giebst, giebt, gieb, to gibst, gibt, gib. (19) Gediegen is but a strengthened adjective form of the past participle. (20) Gieng for ging is antiquated. (21) Formerly golt, gölte, were used in the imperfect indicative and subjunctive. (22) Geneußest, geneußt, and imperative geneuß, poetical; seldom used. (23) Geußest, geußt, and imperative geuß. See genießen. (24) Geleiten and begleiten are not derived from gleiten, but from leiten, and are therefore regular. (25) Now more frequently regular. (26) Handhaben is regular.

INFINITIVE.	INDICATIVE. Present.	INDICATIVE. Imp.	SUBJUNC. Imp.	IMPERAT.	PARTICIP.
Hangen, to hang	ich hange, du hängst, er hängt	ich hing	ich hinge	hange	gehangen
Hauen,(27) to hew	ich haue, ꝛc.	ich hieb	ich hiebe	haue	gehauen
Heben, to heave, lift	ich hebe, ꝛc.	ich hob or hub	ich höbe	hebe	gehoben
Heißen, to be named	ich heiße, ꝛc.	ich hieß	ich hieße	heiße	geheißen
Helfen, to help	ich helfe, du hilfst, er hilft	ich half	ich hülfe or hälfe	hilf	geholfen
Keifen,(28) to chide	ich keife, ꝛc.	ich kiff	ich kiffe	keife	gekiffen
Kennen, to know	ich kenne, ꝛc.	ich kannte	ich kennte	kenne	gekannt
Klimmen,(29) to climb	ich klimme, ꝛc.	ich klomm	ich klömme	klimme	geklommen
Klingen, to sound	ich klinge, ꝛc.	ich klang	ich klänge	klinge	geklungen
Kneifen, to pinch	ich kneife, ꝛc.	ich kniff	ich kniffe	kneife	gekniffen
Kommen, to come	ich komme, du kommst, er kommt; or du kömmst, er kömmt	ich kam	ich käme	komm	gekommen
Können, to be able	ich kann, du kannst, er kann	ich konnte	ich könnte	könne	gekonnt
Kriechen, (30) to creep	ich krieche, ꝛc.	ich kroch	ich kröche	krieche	gekrochen

LESSONS IN ASTRONOMY.—XVII.

THE TRANSIT INSTRUMENT (*continued*)—THE EQUATORIAL.

HAVING described in our last lesson the construction of the transit instrument, we have now to learn the mode of taking observations by means of it. To one side of the axis there is affixed a large circle, not shown in the engraving. This circle is accurately divided into degrees and fractions of a degree, and in some of the best instruments—as, for instance, that at Greenwich Observatory—several apertures are pierced through the pillar, and microscopes are placed in these so as to read very exactly the degree of the circle under them. When several readings are thus taken at different parts of the circle, errors arising from imperfect graduation or other causes are almost eliminated; and though in ordinary observations these are not of great moment, they materially impair more delicate ones.

As the axis of the instrument is due east and west, the tube will of course point to a great circle passing through the north pole.

If a star were situated exactly at this point we could easily direct the tube to it, and arrange the graduated circle so that it should then read 0°: as, however, the Pole star is not thus placed, we must observe carefully its position when it crosses the meridian above the pole, and again when it makes its lower transit. The true place of the pole is, of course, midway between these points, and the circle is adjusted accordingly.

If now we observe any star when it is on the meridian, we shall be able at once to measure its distance from the pole, and, by calculation, from the zenith. We have therefore one measure to fix its position; but, as we have seen, two are requisite to fix it definitely, since there may be a whole ring of stars at the same distance from the pole. The second measure is, however, easily obtained. In the observatory there is a clock made to indicate *sidereal time*—that is, the interval which elapses between two successive passages of the same star across the meridian is divided into twenty-four hours, and the clock is made to show these hours. It is then so adjusted as

(27) Haute (regular) is used when *cutting wood, carving stone*, etc., are meant. (28) This verb is sometimes used as a regular verb. (29) Sometimes regular, klimmte. (30) Kreuchst, kreucht, kreuch obsolete. Only poetically used.

to indicate 0h. 0m. 0s. when the first point of Aries is on the meridian, and has of course passed round the twenty-four hours when that point returns to the meridian.

Now right ascension is also measured from the first point in Aries, and hence we shall find that the clock will show us the right ascension of any star. In one hour the Earth has revolved through 15°, or $\frac{1}{24}$th of 360°, and any star on the meridian then must have 15°, or 1 hour of right ascension; similarly, every 4 minutes of sidereal time indicates 1°.

We see, then, that we can by a single observation with this instrument fix the place of any star. The graduated circle will give us its polar distance, and deducting this from 90° we have its declination; while by noting the time by the clock we at once learn its right ascension. Thus, if a star crossed the meridian at 13h. 13m. 30s., and its distance from the pole was 35°, we should at once know its declination was 55° N., and its right ascension 13h. 13m. 30s., or 198° 22½′. By observations of this kind the places of all the stars have been noted, and catalogues compiled giving their positions. In the eye-piece of the telescope there are usually five or seven equidistant and parallel wires, and by noting the time of the star passing over each, and taking the mean, we obtain the true time more exactly than by one observation taken singly.

The only other kind of mounting for a telescope we can explain now is that known as the *equatorial*. With any ordinary stand—as, for instance, that for the altazimuth instrument—two motions are requisite to keep a star in the field of view; both the observer's hands are therefore constantly occupied with the handles intended to impart a slow motion to the telescope, since, owing to the rapid rotation of the Earth on its axis, the star would in a very few minutes pass out of the field of view if these adjustments were neglected.

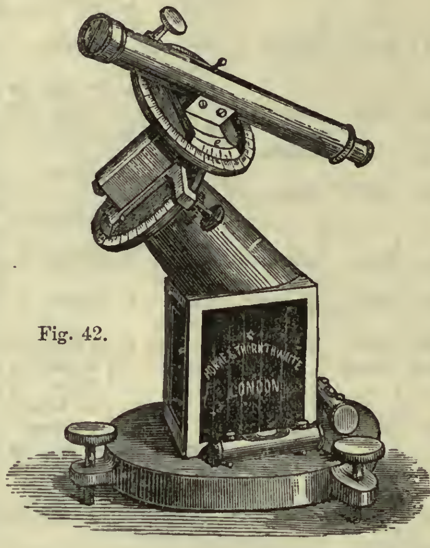

Fig. 42.

All the heavenly bodies, however, appear to revolve round the pole; hence if we mount our telescope so that its axis shall point towards the pole, one motion will be sufficient to enable us to follow a star and keep it in view.

One of the modes in which a telescope may be thus equatorially mounted is shown in Fig. 41. This is known as the English equatorial. The axis, instead of being vertical, is inclined to the horizon at such an angle that it points to the pole; the inclination, therefore, has to vary with the latitude of the place. An instrument of this kind is, however, usually made a fixture, and then the lower end of the axis turns in a bearing set in a block of masonry, A, while a strong support, B, bent over at the upper part, carries the other end.

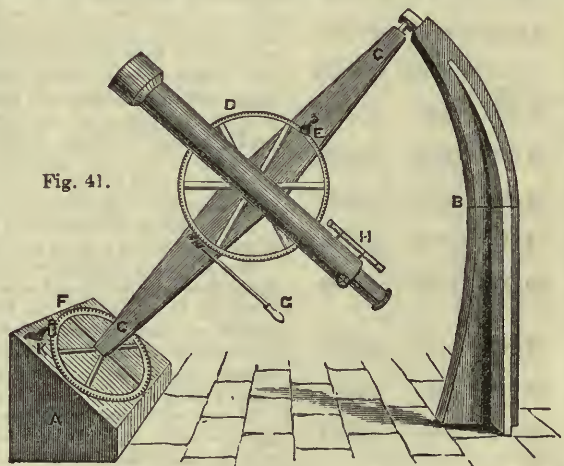

Fig. 41.

The telescope is attached to a pivot which turns in the polar axis, and is carefully adjusted so as to be at right angles to it. The telescope thus moves in a plane parallel to the axis, and sweeps along a meridian. A graduated circle, D, is attached to it, and read off by means of a microscope or a vernier at E. The edge of this circle is cut into teeth, which catch in an endless screw on the rod G, and in this way a slow motion may be imparted to the telescope. By pressing the handle G downwards, the screw is removed from the teeth, and the telescope then moves freely to allow of a coarse adjustment or rapid motion.

A similarly divided circle, F, is affixed to the lower end of the axis C C, and serves to give the right ascension of any object, the graduations on it reading from I. to XXIV. hours. A slow-motion handle is usually affixed to this, similar to that shown at G.

When the telescope is directed to any celestial object, the circle D may be clamped, as the star can be kept in the field by merely turning the circle F. In the best instruments a driving-clock, regulated to keep sidereal time, is added, and this causes the circle F to revolve in exactly 24 hours. All difficulty in adjusting the telescope is thus removed, as it constantly remains directed to the object without any alteration. It is by an arrangement of this kind that photographs of the heavenly bodies are taken.

The mode of using the equatorial requires a little explanation. The circle F is so adjusted as to read 0° when the telescope is directed to the meridian, and a sidereal clock is required to note the time of making the observation. Now, suppose that we want to note the position of any star, we get it exactly in the centre of the field, for which purpose fine cross-wires are usually placed in the eye-piece. We then note the exact time, and read off the two circles. Suppose, for example, that the time is 10h. 45m., and the reading of the declination circle is 37° 20′, and that of the other 3h. 40m.; the star then had passed the meridian 3 hours and 40 minutes at the moment of making the observation; it was on it, therefore, at 7h. 5m., and this is its right ascension, while its declination is 37° 20′, and thus we know exactly its position.

One great advantage which the equatorial possesses over the transit instrument arises from the fact that with it observations may be made in any part of the heavens, while with the other a star can only be observed when on the meridian.

A different mode of mounting an equatorial is represented in Fig. 42. This instrument, which is called the "star-finder," is mounted on the German, or Fraunhofer's system, which is that more usually adopted. The advantages it possesses over the English form are that stars near the pole may be observed with it, which the axis in the other prevents; and further, that only one support is required, and thus there is far less difficulty in fixing it accurately. The instrument shown here is portable, but in observatories the larger instruments mounted on the German plan are usually fixed to stone pedestals.

To nearly all telescopes of high power, a small one is usually affixed to serve as a *finder*, H (Fig. 41). The power of this is but small, but it takes in a large field, the centre of which is marked by means of cross-wires, and it is so adjusted that when the star is thus in the centre of its field, it is also in the centre of the field of the large instrument. In all powerful instruments the extent of sky seen at one time is very small, and therefore considerable difficulty would be experienced in finding any required star were it not for the finder.

There are many other instruments used by the astronomer, as the mural circle, the zenith-sector, etc., but we must not stay to notice them here. They consist for the most part of telescopes mounted in a peculiar way for some special purpose.

LESSONS IN BOTANY.—XLVIII.

SECTION CXXIII.—FUNGI (*concluded*).

Dr. Badham, the author from whom we have so frequently quoted, says: "For the single mushroom that we eat, how many hundreds there be that retaliate and prey upon us in return. To enumerate but a few, and those of the microscopic kinds—the *Mucor Mucedo*, that spawns upon our dried preserves; the *Ascophora Mucedo*, that makes our bread mouldy; the *Uredo Segetum*, that burns Ceres out of her own corn-fields; the *Uredo Rubigo*, whose rust is still more destructive; and the *Puccinia Graminis*, whose voracity sets corn-laws and farmers at defiance, are all funguses." The main body of those fungi which make war on man are microscopic; yet so strong and indefeasible are they in their multitudes and their pertinacity, that man has, in most instances, no power to withstand their forces.

To the list given above, we must add many more. There is the ergot (*Claviceps purpurea*), a species which infests grasses and corn. When developed in the latter, it produces the most dreadful disease in those who unfortunately partake of the infected grain. It is chiefly found in rye, but happily not very frequently met with in this country. This little fungus, though so dangerous in its effects when eaten, is nevertheless valuable for its medicinal uses. It is a little, cylindrical, horn-shaped body; purple-black without, and white or purplish in side.

Whether the injury to human life of which we have spoken is caused by the fungus itself, or by the decomposed and corrupted state of the corn to which it belongs, is still a matter of question amongst the learned, and one on which we can form no judgment.

The fungi which chiefly affect the cereal produce of our land are the *Uredines* and *Pucciniæ*. The former genus takes its name from *uro*, a Latin word, signifying "I burn," or "scorch," the discolorations and spots on the plants infested by these fungi having been formerly attributed to blasts or injuries caused by the atmosphere or the heavenly bodies. There are two species of this genus that are almost equally dreaded by the farmer; one called the Smut (*Uredo Segetum*), the other, the Bunt (*Uredo* or *Urtilago Caries*).

The former of these takes its rise within the glumes of the flowers, and grows with such rapidity as speedily to fill the interior space and burst through the epidermis, when it appears like a profuse black dust, which, if microscopically examined, is found to consist of minute, perfectly spherical sporules. Withering says of this species: "It consists of very minute, egg-shaped, stemless capsules, at first white, but the thin white soon bursting, it pours out a quantity of brown-black powder, mixed with wool-like fibres."

The other species, *Uredo Caries* (Fig. 311), is very common in wheat, and exceedingly injurious, as it not only destroys the ear on which it grows, but every grain with which the infected individuals come in contact. It is included within the germ of the wheat, and the spores, which are exactly spherical, are longer than those of the above-named species (*Uredo Segetum*), and quite black. When crushed they emit a most fetid odour, which is communicated to the whole sample of wheat with which the bunty grains are associated. Mr. Berkeley says of all the corn-infecting fungi: "The growth of these parasites depends so much on accidental circumstances, that it is impossible for the most experienced cultivators to guard against it entirely; but the evil is greatly lessened by careful choice of seed, and by steeping it in solutions of different substances, which destroy the vegetative power of the sporidia of these parasites," etc.

311. THE BUNT (UREDO CARIES). 312. WHEAT STRAW, NATURAL SIZE, INFECTED WITH PUCCINIA GRAMINIS; *a*, THE FUNGI MAGNIFIED IN CLUSTER. 313. SEPARATE FUNGI OF PUCCINIA GRAMINIS, HIGHLY MAGNIFIED. 314. SECTION OF INFECTED STRAW, HIGHLY MAGNIFIED. 315. PUCCINIA ROSÆ; *a*, NATURAL SIZE ON LEAF; *b*, SAME, MAGNIFIED; *c*, SEPARATE FUNGI, HIGHLY MAGNIFIED. 316. PUCCINIA RUBI; *a*, NATURAL SIZE; *b*, TUFTS, MAGNIFIED; *c*, SEPARATE FUNGI, MAGNIFIED. 317. ASPERGILLUS PENICILLATUS. 318. MUCOR MUCEDO. 319. MUCOR STERCOREA. 320. XYLOMA CONCAVUM. 321. NEMASPORA CARPINI. 322. PHACIDIUM CORONATUM; *a*, FUNGUS, MAGNIFIED. 323. DOTHIDEA TYPHINA. 324. SPHÆRIA REPTANS. 325. SPHÆRIA TUBERCULOSA. 326. SPHÆRIA ROSELLA.

The other genus, *Puccinia*, is of as evil a nature as the *Uredines*. The disease termed the *mildew* in wheat is produced by one of these (*Puccinia Graminis*, Figs. 312—314), a fungus so diminutive that a single *stoma* (or pore in a stem or leaf), invisible to the eye, will permit the extrusion of from twenty to forty; and each of these exquisitely minute plants will bring forth at least a hundred spores of seeds. The seeds are not much heavier than air; and it may easily be conceived that even a single stem of wheat or grass, when beset with these mischievous parasites, will not be long in infecting all the corn, not only in the field where the injured wheat grows, but in all those adjacent to it.

The first appearance of this blight is usually in the spring, or early in the summer, when it arises in the form of orange-coloured streaks, which afterwards assume a deep chocolate-brown. The tufts of this fungus are dense and often confluent, forming long parallel lines (Fig. 314). The spores are contained in a tubercular, double-celled case, and are black; this case is supported by a filiform peduncle or stem, as seen in Fig. 313.

But it is not on our corn-fields only that a plague of fungi rests; these little *Pucciniæ* attack the leaves of plum and other fruit trees, devour the fluids of our bean plants, and scatter themselves in destructive armies over our raspberry bushes and our rose beds (Figs. 315 and 316). There are some forty or more species which spread themselves in all directions on the leaves and stems of our plants and flowers, nor ever cease their ravages until they have destroyed the vitality of whatever part they touch.

But we must now, in this our concluding lesson on the science of Botany, turn to another class of fungi—those which beset our dainties under the name of *mould*. The following affords an interesting account of this production:—"If, during the warm weather, we put aside a bit of bread, or a slice of apple, pear, melon, or a turnip or potato-peeling, if nothing better is at hand, we shall find in a few days that all those substances will have assumed a mouldy appearance. Take a little of this mould gently off on the point of a penknife, and subject it to the microscope; you see in the moulded bread a grove of tall stalks, each with a round head slightly flattened—in short, a mushroom in miniature. This is the *Mucor Mucedo* (Fig. 318), the fungus of the bread-mould. While fresh and young, they are of a beautiful milk-white colour; gradually they assume a yellowish tinge. The stalks are so transparent as, under a good magnifying power, to show the cellular structure inside; the bulb also now exhibits, under a thin bark or skin, a number of minute, circular bodies, all arranged in a compact form: these are the spores or seeds. After a day or two more, the fungi begin to ripen, and assume a brownish tint; the bulbs blacken, the skin bursts, and innumerable spores are scattered about, many floating away in the air. This forest of mould, like larger ones, is liable to accidents. You may see in one corner, for instance, that the bit of bread forming the soil has cracked; thus a fungus has been loosened at the root, and it falls down, we may suppose, with a crash, though we still desiderate instruments to magnify and make audible the sound. Nevertheless, the effects of the fall are visible in the breaking down of neighbouring stems, and in the premature scattering of the seed. You may see, too, sometimes the scattered seeds collect upon one or two plants, and, enveloping them, entirely destroy their vitality, and thus cause old, rotten-looking stumps."

But it must not be understood that the mouldiness which we find on our eatables is always a crop of the same species of fungus, or even of different species of the same genus. It is not so. The kinds which infest the apple and the pear are different, and those which "rot and then fatten on" our grapes, plums, and raspberries, are all different from each other. Then there are other kinds which float in our fermented liquors; whilst others, again, are found within the nutshell; and even within the innermost cavities of the walnut. Some, "like leeches, stick to the bulbs of plants, and suck them dry;" whilst others, not content with a vegetable diet, lay hold of the hoofs of horses and the horns of cattle; nay, under certain diseased conditions, even the lungs and other organs of human beings are beset by these all-destructive little beings. Even in health it is a rare thing to find a mouth where the interstices of the teeth are not more or less the habitats of these vegetables.

Fungi not only prey on objects which are members of other families than their own, but they unscrupulously devour each other.

Many of the *Pileati* have parasitic fungi, which attach themselves solely to them, never attacking any other species. One sort settles itself on dried *Agarics;* another only on moist, decaying ones; whilst a third devours only the flesh of a particular *Boletus.*

Dr. Badham, writing of these, says, "Few minute objects are more beautiful than these mucedinous *fungi fungorum.* A common one besets the back of some of the *Russulæ* in decay, spreading over it, especially if the weather be moist, like thin flocks of light wool, presenting on the second day a bluish tint on the surface. Under a powerful magnifier, myriads of little glass-like stalks are brought into view, which bifurcate again and again, each ultimate head ending in a semilucent head, or button, at first blue, and afterwards black; which, when it comes to burst, scatters the spores, which are then (under the microscope) seen adhering to the sides of the delicate filamentary stalks, like so many minute limpets. There is a very beautiful fungus called the pencilled mould (*Aspergillus penicillatus,* Fig. 317), which clusters its pretty beaded tassels on the dried plants in our herbariums. This little plant consists of a stem and a cluster of sporules at the top, not unlike a brush with a handle. *Aspergillus* is the name of the brush with which the holy water is sprinkled in Roman Catholic churches, and from this resemblance the genus takes its name. *Nemaspora Carpini* (Fig. 321) is another curious species. This infests the dead wood of the hornbeam, its singular black spores escaping from their flat cases, and thrusting themselves upwards in the form of tendrils. Then there are the many species of *Sphæria,* which raise their little button-like forms on the branches of trees, and stud them over with sphere-like gems, some yellow, others scarlet, brown, black, orange, white, crimson, and a hundred other tints of richest dye." Sometimes these wonderfully varied little fungi are sessile on the substance they have selected for their habitat, as in Figs. 324, 325, and 326; in others they are raised on stalks. Some have smooth visible orifices, through which the spores escape; in others these openings are hairy; and in some species they are not visible at all.

Besides frequenting living plants, and closely besetting their leaves and branches, fungi of this genus are found abundantly on the bark of dead branches, and even on the wood where the bark has been removed. They frequent, also, the flock of *Agarics;* and one species, the nest-like Sphæria, is found in the little hollows of bean-roots; whilst others cluster on apples that are lying on the ground, the stems of reeds, or even on the naked earth. There are some species which take up their abode on, and obtain their sustenance from dead larvæ, pupæ, and spiders' eggs; whilst one, *Cordiceps Robertsii,* grows upon living caterpillars, causing their death. So numerous are the species which rank under this genus, that 201 are catalogued by Berkeley.

Racodium cellare, the mouse-skin byssus, is the fungus which festoons and covers the walls of our wine-cellars. For specimens, Badham refers us to the "London Docks, *passim,* where he pays his unwelcome visits, and is in even worse odour than the excisemen." Loudon tells us that it takes its name from a word "used among the Greeks" for a worthless, worn-out, ragged garment, which has been applied to the present genus in allusion to the dirty, interwoven, cloth-like substance with which it clothes whatever it grows on. *Racodium cellare* is the black substance which overruns the bottles of the wine-merchant, and which often hangs in long thick festoons from the sides and roof of his wine-cellars.

There is a very curious species of fungus which is found over-spreading the thing on which it grows like froth. Withering, on the authority of Stackhouse, thus describes it:—"Its first appearance is like custard spilt upon the grass or leaves. This soon becomes frothy, and then contracts around the blades of grass or leaves in the form of little tubercles united together. On examining it in its different stages under the microscope, it first appeared like a cluster of bubbles, irregularly shaped, and melting into one another. In the second stage it appeared imbricated, or tiled, with open cells, the edges of the cells beautifully waved. A blackish powdery matter, on the surface of the cells, now gives the plant a greyish cast. In the third stage, the wavy imbrication disappears, and the plant settles with minute tubercles united together. Some of these are closed; but many of them appear as if torn open, and out of the cavity emerge little downy strings, with irregular-shaped terminations, and other similar irregular bodies on the same strings, like the heads of some of the genus *Mucor.*"

We have seen that some of the fungus tribe are capable of being turned to important uses as a nutritious and wholesome article of diet, and that others have medicinal properties which render them highly valuable. One kind is employed in making ink.

another is used in the place of leather, whilst several kinds are serviceable in dyeing. Besides these and other individual uses, the tribe throughout seems to have a special commission to assist in the work of scavengers, by aiding the multitudinous host of grubs, insects and other devourers, in removing decayed matter (both animal and vegetable), which, if left to putrefy, would in many instances become destructive both to the comfort and health of man.

LESSONS IN GREEK.—XLIII.

STRENGTHENED STEMS (*continued*).

V. *Verbs whose Pure Stem is strengthened by a reduplication at the beginning.*

This reduplication consists in the repetition of the first consonant of the stem in union with the connecting vowel ι. Only in a few verbs does the reduplication remain in the formation of the tenses. To this class belong—

γιγνομαι (instead of γιγενομαι), *I become* (ΓΕΝ), aor. εγενομην (ΓΕΝΕ-), perf. γεγενημαι, *I have become*, or γεγονα with a present meaning, as *I am* (but γεγονως χρονος, *time past*), fut. γενησομαι.

πιπτω (instead of πιπετω), *I fall*, imper. πιπτε (ΠΕΤ-), fut. πεσοῦμαι, aor. 2 επεσον, perf. πεπτωκα.

Here also belong several of the fourth class, as γιγνωσκω.

VI. *Verbs whose Pure Stem receives an* ε *in the Present and Imperfect.*

1. γαμεω, *I marry* (used of the man), perf. γεγαμηκα; but fut. γαμῶ, aor. 1 εγημα, mid. γαμουμαι, *I am married* (of the woman—in Lat. *nubo*), aor. εγημαμην, perf. pass. γεγαμημαι (Lat. *in matrimonium ducor*), aor. εγαμηθην, etc.
2. δοκεω, *I appear* (in Lat. *videor*), *I think*, fut. δοξω, aor. 1 εδοξα, perf. pass. δεδογμαι (Lat. *visus sum*), aor. p. εδοχθην.
3. ξυρεω, *I shear, cut the hair*, mid. ξυρομαι, aor. εξυραμην, but perf. εξυρημαι.
4. ωθεω, *I push*, impf. εωθουν, fut. ωσω and ωθησω, aor. 1 εωσα and ωσα, perf. εωκα, mid. fut. ωσομαι, aor. εωσαμην, perf. εωσμαι, aor. pass. εωσθην.

VII. *Verbs which in the Present and Imperfect have the Pure Stem, but in the other Tenses have a Stem with* ε *as the Characteristic. (The* ε *passes into* η*; except* αχθομαι *and* μαχομαι.)

1. αλεξω, *I ward off*, fut. αλεξησω (the active is unusual in prose), mid. *I ward off from myself, I defend myself, I punish*, fut. αλεξησομαι, aor. ηλεξαμην (from ΑΛΕΚ).
2. αχθομαι, *I am vexed*, fut. αχθεσομαι, aor. ηχθεσθην, fut. pass. αχθεσθησομαι, of the same import as αχθεσομαι.
3. βοσκω, *I feed, pasture* (intrans.), fut. βοσκησω, aor. 1 εβοσκησα; mid. with pass. aor. (εβοσκηθην), *I feed*.
4. βουλομαι, *I am willing* (2 pers. βουλει), fut. βουλησομαι, perf. βεβουλημαι, aor. εβουληθην and ηβουληθην.
5. δεω, *I lack, want* (commonly as the impers., δεῖ, *there is want, there is a necessity*), subj. δεῃ, part. δεον, inf. δεῖν; imperf. εδει, opt. δεοι, fut. δεησει, aor. 1 εδεησε, perf. δεδεηκε; mid. δεομαι, *I need*, fut. δεησομαι, aor. εδεηθην, perf. δεδεημαι.
6. εθελω and θελω, *I am willing, wish*, imperf. ηθελον and εθελον, fut. εθελησω and θελησω, aor. 1 ηθελησα and εθελησα, perf. only ηθεληκα.
7. ειλω, *I press, I drive, enclose*, fut. ειλησω, perf. mid. or pass. ειλημαι, aor. pass. ειληθην.
8. ΕΡΟΜΑΙ, *I ask*, aor. ηρομην, *I asked*, subj. ερωμαι, opt. εροιμην, imper. εροῦ, ερεσθαι, ερομενος, fut. ερησομαι; the other tenses are supplied by ερωτᾶν.
9. ερρω, *I go forth*, fut. ερρησω, aor. 1 ηρρησα, perf. ηρρηκα.
10. εὑδω (commonly καθευδω), *I sleep*, fut. καθευδησω, aor. 1 εκαθευδησα, perf. wanting.
11. εχω, *I have, hold*, imperf. ειχον, aor. 2 εσχον, inf. σχειν, imper. σχες, παρασχες (μι), subj. σχω, -ῃς, παρασχω, παρασχῃς, etc.; opt. σχοιην (μι), but in composition παρασχοιμι; part. σχων; fut. ἑξω and σχησω, perf. εσχηκα, aor. mid. εσχομην; subj. σχωμαι, opt. σχοιμην, imper. σχοῦ, παρασχοῦ, inf. σχεσθαι, παρασχεσθαι, part. σχομενος, fut. ἑξομαι, and σχησομαι, perf. mid. or pass. εσχημαι, aor. pass. εσχεθην.
12. ἑψω, *I cook*, fut. ἑψομαι, aor. ἡψησα, aor. pass. ἡψηθην, perf. mid. or pass. ἡψημαι.
13. καθιζω, *I seat, I set, I seat myself*, imperf. εκαθιζον, old Attic καθῖζον, fut. καθιῶ, aor. 1 εκαθῖσα, old Attic καθῖσα, perf. κεκαθῖκα; mid. *I seat myself, I sit*, fut. καθιζησομαι, aor. εκαθισαμην, *I seated myself, I sat down*; but καθεζομαι, *I seat myself, I sit*, imperf. εκαθεζομην, fut. καθεδοῦμαι.
14. μαχομαι, *I fight, contend*, fut. μαχοῦμαι (instead of μαχεσομαι), aor. εμαχεσαμην, perf. μεμαχημαι.
15. μελλω, *I think to, I am about to, I loiter;* imperf. εμελλον and ημελλον, fut. μελλησω, aor. 1 εμελλησα.
16. μελει μοι τινος (Lat. *curæ mihi est aliquid*), *I care for* (the first person, μελω, is rare), fut. μελησει, aor. 1 εμελησε, perf. μεμεληκε, 2 perf. μεμηλε; mid. μελομαι (commonly επιμελομαι, and very often also επιμελοῦμαι, *I care for*), fut. επιμελησομαι, aor. επεμεληθην, perf. επιμεμελημαι.
17. μυζω, *I suck*, fut. μυζησω, etc.
18. οζω, *I smell*, fut. οζησω, aor. 1 ωζησα, perf. οδωδα (in Homer and the later writers) with a present signification.
19. οιομαι and οιμαι, *I think*, 2 pers. οιει, imperf. ῳομην and ῳμην, fut. οιησομαι, aor. ῳηθην, οιηθηναι, perf. wanting.
20. οιχομαι, *I am out* (Lat. *abii*), imperf. ῳχομην, *I came forth*, fut. οιχησομαι, *I shall go forth*, aor. wanting; perf. ῳχημαι, *I have come forth* (commonly only in combination, as παρῳχημαι).
21. οφειλω, *I am liable, I owe, I must* (Lat. *debeo*), fut. οφειλησω, aor. 1 ωφειλησα, perf. ωφειλῆκα; aor. 2 ωφελον, -ες, -ε (1 and 2 plur. not in use), with the infinitive in expressions of a wish (Lat. *utinam*).
22. πετομαι, *I fly*, fut. πτησομαι, aor. επτομην, πτεσθαι (not so often επταμην, -μι), perf. πεποτημαι.
23. χαιρω, *I rejoice*, fut. χαιρησω, aor. εχαρην (-μι), perf. κεχαρηκα.

With these verbs may be classed several liquid verbs, which, however, form the future and the aorist regularly: for example, μενω, *I remain*, perf. μεμενηκα, otherwise regular; νεμω, *I divide*, fut. νεμῶ, aor. 1 ενειμα, perf. νενεμηκα, mid. νεμομαι, fut. νεμοῦμαι, aor. ενειμαμην, perf. mid. or pass. νενεμημαι, aor. pass. ενεμηθην.

EXERCISE 129.—GREEK-ENGLISH.

1. Οἱ στρατιωται τους πολεμιους αλεξησονται. 2. Μη αχθεσθητε ὑπερ ὡν ἡμαρτανετε ελεγχομενοι. 3. Ὁ ποιμην αιγων την αγελην εν τοις ορεσι βοσκησει. 4. Οἱ στρατιωται επι τους πολεμιους στρατευεσθαι εβουληθησαν. 5. Τοις στρατιωταις εν τῃ πολεμιᾳ γῃ των επιτηδειων δεησει. 6. Πλουσιος εστιν ουχ' ὁ πολλα κεκτημενος, αλλ' ὁ μικρων δεησομενος. 7. Πολυδευκης ουδε θεος ηθελησε μονος, αλλα μαλλον ἡμιθεος συν τῳ αδελφῳ γενεσθαι. 8. Οἱ βαρβαροι ὑπο των Ἑλληνων διωχθεντες, εις τον ποταμον ειληθησαν.

EXERCISE 130.—ENGLISH-GREEK.

1. The booty was divided. 2. I will divide the booty. 3. The city will punish the enemy. 4. My son, do not be vexed when reproved for thy sins. 5. Good boys are not vexed when reproved for their sins. 6. I will make an expedition against Athens. 7. They smell of perfume. 8. The soul will fly up to heaven. 9. Good men rejoice at good. 10. Our soldiers have need of provisions (necessaries). 11. A good man will care for his children, and good children will care for their parents.

VIII. *Verbs whose Tenses are formed from different Roots, connected only in signification.*

1. αἱρεω, *I take* (*e.g.* a city), fut. αἱρησω, perf. ἡρηκα, aor. 2 εἱλον, ἑλειν (ἙΛ), aor. pass. ἡρεθην, fut. pass. αἱρεθησομαι; mid. *I choose*, fut. αἱρησομαι, aor. εἱλομην, perf. mid. or pass. ᾑρημαι; fut. 3 ᾑρησομαι.
2. ερχομαι, *I go, I come* (the other moods and the participles are borrowed from εἶμι; accordingly ερχομαι, ιω, ιθι, ιεναι, ιων); imperf. ηρχομην, commonly aor. ηειν or ηα, opt. ιοιμι; fut. εἶμι, *I shall go* (ἡξω, *I shall come*), perf. εληλυθα, aor. 2 ηλθον, subj. ελθω, opt. ελθοιμι, imper. ελθε, inf. ελθειν, part. ελθων, root ΕΛΥΘ.
3. εσθιω, *I eat*, imperf. ησθιον, fut. εδομαι, perf. εδηδοκα; (ΦΑΓ) aor. 2 εφαγον, φαγειν, perf. mid. or pass. εδηδεσμαι, aor. pass. ηδεσθην, (ΕΙΔ) aor. 2 ειδον, ιδω, ιδοιμι, ιδε, ιδειν, ιδων; perf. 2 οιδα, *I know*.
4. ὁραω, *I see, I behold*, imperf. ἑωρων, perf. ἑωρακα; (ΙΔ) aor. 2 ειδον, (ΟΠ) fut. οψομαι, 2 pers. οψει; mid. or pass. ὁραομαι, ὁρωμαι, perf. mid. or pass. ἑωρᾶμαι or ωμμαι, ωψαι, etc., inf. ωφθαι; aor. mid. ειδομην, ιδεσθαι, ιδοῦ, also ιδού, *behold, lo!* (Lat. *ecce!*), aor. pass. ωφθην, οφθῆναι, fut. οφθησομαι.
5. τρεχω, *I run*, (ΔΡΑΜ) fut. δραμοῦμαι, aor. 2 εδραμον, perf. δεδραμηκα, perf. pass. in compounds δεδραμημαι.

6. φερω, *I bear*, (ΟΙ) fut. οισω; (ΕΝΕΓΚ), aor. 2 ηνεγκον (less often ηνεγκα), -ες, -ε, opt. ενεγκαιμι, -ειε, and -οιμι, -οι, inf. ενεγκεῖν, part. ενεγκων, imper. ενεγκε, -ετω, and -ατω, etc., (ΕΝΕΚ-) perf. ενηνοχα, perf. mid. or pass. ενηνεγμαι (-γξαι, -γκται or ενηνεκται), aor. mid. ηνεγκαμην, ενεγκαι, -ασθαι, -αμενος, aor. pass. ηνεχθην, ενεχθῆναι; fut. ενεχθησομαι, less often οισθησομαι.

7. φημι, *I say*, imperf. εφην, (ΕΠ) aor. 2 ειπον (more seldom ειπα), ειπω, ειποιμι, ειπε, -ετω and -ατω, -ετον and -ατον, -ετων and -ατων, -ατε (comp. προσειπε), ειπειν, ειπων; from the epic pres. ειρω, fut. ερῶ, perf. ειρηκα, perf. mid. or pass. ειρημαι, fut. 3 ειρησομαι. From ΡΕ aor. pass. ερρηθην, ρηθῆναι, ρηθεις, fut. pass. ρηθησομαι. Middle (only in compounds), fut. απερουμαι, and aor. 1 απειπασθαι, *to doubt, to deny*, as απειπεῖν.

EXERCISE 131.—GREEK-ENGLISH.

1. Και βραδυς ευβουλος είλε ταχυν ανδρα διωκων. 2. Οἱ Αθηναιοι Θεμιστοκλεα στρατηγον είλοντο εν τῳ Περσικῳ πολεμῳ. 3. Οδυσσευς 'Αιδου μεγα δωμα ηλθεν. 4. Ἡν αν μοιραν ἑλῃς, ταυτην φερε και μη αγανακτει. 5. Μη πιστευε ταχιστα, πριν ατρεκεως περας οψει. 6. Μη τουτο βλεψῃς, ει νεωτερος λεγω, αλλ' ει φρονουντων τους λογους ανδρων ερῶ. 7. Πενθει μετριως τους αποθανοντας φιλους ου γαρ τεθνηκασιν, αλλα την αυτην ὁδον, ἡν πασιν ελθεῖν εστιν αναγκη, προεληλυθᾶσιν.

EXERCISE 132.—ENGLISH-GREEK.

1. The Athenians took many soldiers. 2. The city chose Epaminondas general. 3. Themistocles was chosen general by the Athenians. 4. Come, O friend. 5. O dear friends, come hither. 6. If thou art hungry, thou wilt eat with pleasure (ἡδεως). 7. The boy has eaten all he had.

KEY TO EXERCISES IN LESSONS IN GREEK.—XLI., XLII.

EXERCISE 122.—ENGLISH-GREEK.

1. Ἡ στρατια εξεπλευσεν. 2. Ἡ στρατια εκπλευσειται. 3. Ὁ ανεμος Βορρας εναντιος τῃ στρατιᾳ πνει. 4. Ὁ ανεμος Βορρας εναντιος τη στρατιᾳ επνευσεν. 5. Οἱ στρατιωται ηλπισαν θευσεσθαι προς τας πυλας. 6. Τους ατυχεις κλαιεις. 7. Τους ατυχεις κλαυσεις. 8. Οἱ πολεμιοι φευξουνται. 9. Παισιν ὁμιλων παιξει. 10. Αγαθοι παιζουσιν ἁμα σπουδαζοντες. 11. Οἱ πολεμιοι τας των στρατιωτων ταξεις συγχευσουσιν. 12. Ἡ πολις ὑπο των πολεμιων κατακεκαυται. 13. Οἱ στρατιωται ἡγουνται τους πολεμιους την πολιν κατακουσειν.

EXERCISE 123.—GREEK-ENGLISH.

1. Many evil things have befallen the soldiers in the expedition. 2. By associating with wise men thou thyself also shalt turn out wise. 3. Lycurgus banished costliness from Sparta. 4. Many who have drunk together once will become friends. 5. The drunkard is the slave of drink (lit., *of having drunk*). 6. I will not drink up wine. 7. May the gods punish the evil-doers. 8. The citizens outstripped the enemy in their flight to the city. 9. The hare was bitten by the dog. 10. You will not arrive at the summit without toil. 11. The women put on beautiful garments. 12. The wine was drunk up by the soldiers. 13. The friend promised to come to me.

EXERCISE 124.—ENGLISH-GREEK.

1. Ἡ γυνη ημπεσχετο καλα ἱματια. 2. Ἡ γυνη αμφεξεται καλα ἱματια. 3. Οἱ φιλοι υπεσχοντο αφιξεσθαι. 4. Ὁ στρατηγος τους πολεμιους εφθασεν εις την πολιν. 5. Οἱ θεοι τους κακουργους αποτινουσιν. 6. Πολλοι φιλοι συμπινουσιν. 7. Φιλοι συμπινοντες εχθροι γιγνονται. 8. Πολλα κακα τους εμους παιδας συνεβησεν ενθαδε ερχομενους. 9. Τον κακουργον εκεινον Απολλων αποτισαιτο.

EXERCISE 125.—GREEK-ENGLISH.

1. Let not the evil man think that he will escape notice for ever. 2. If you have done justly, you will have God as your ally. 3. It is right to learn letters, and to have a learning mind. 4. The king did not perceive the plot against himself. 5. The Persians were hateful to the Greeks. 6. Philip himself used to declare that he had increased his own realm more by the aid of gold than arms. 7. The soldiers slept a short time. 8. Directly the horses smelt the camels they fled away. 9. Do not think that you have been forgotten if you have forsworn yourself to God. 10. It is good not to err against one's friends. 11. He is happy who has gained a noble friend.

EXERCISE 126.—ENGLISH-GREEK.

1. Ὁ βασιλευς της προς ἑαυτον επιβουλης αισθανεται. 2. Τίς ουχ ἡμαρτηκεν; 3. Ουκ εστι σοφων δις εν τῳ αυτῳ ἁμαρτανειν. 4. Ὁ πονηρος τοις αγαθοις απεχθανεται. 5. Πονηρος ων ου λησεις δια τελους. 6. Οἱ αδελφοι μανθανοντες μαθοντα νουν εχουσιν. 7. Οἱ αγαθοι αγαθων τευξονται. 8. Οἱ ανδρες κατεδαρθον. 9. Βραχυν χρονον κατεδαρθον. 10. Γενναιων φιλων τετυχηκα. 11. Μανθανω ατυχιαν φερειν. 12. Κακον εργον πραττων ελαθεν. 13. Ελπιζονται λησειν πονηροι οντες.

EXERCISE 127.—GREEK-ENGLISH.

1. You will find few men who are faithful companions in trouble. 2. It is fated to all men to die. 3. We bewail the dead. 4. Men remember with pleasure ancient deeds. 5. You cannot find a man who is completely happy in every respect. 6. The noble man wishes to live honourably or die honourably. 7. If you have suffered terrible things through your wickedness, do not at all blame the gods for what thus befalls you (lit., *for your fate of these things*). 8. If any one who is old prays for life, he deserves to live on into many decades of years.

EXERCISE 128.—ENGLISH-GREEK.

1. Ουδενα ἑταιρον πιστον εν χαλεποις πραγμασιν εὑρηκα. 2. Σοι μορσιμον εστιν αποθανειν. 3. Πενθω τον εμον πατερα τον τεθνηκοτα. 4. Πενθησουσιν τον στρατηγον τον τεθνηκοτα. 5. Ἡδεως των παλαι γενναιων μεμνημαι. 6. Ουδενα παντα ολβιωτατον εὑρον. 7. Βουλομαι η καλως ζην η καλως τεθνηκεναι. 8. Πολλα πεισει δια τον σον ἑταιρον. 9. Δυνατον εστι πολλα εξευρισκειν, αλλ' ου παντα. 10. Ουδε οἱ σοφοι βιον αλυπον εξευρηκεσαν.

PNEUMATICS.—VII.

COMMON PRESSURE-GAUGE—SAFETY TUBE—ATMOSPHERIC RAILWAY—BLOWING MACHINES—VENTILATION OF MINES.

In our last lesson we fonnd that if a gas be kept under a uniform pressure, and heat applied, it will increase in bnlk $\frac{1}{480}$ of its volume at 0° for every degree the temperatnre is raised. Snppose, now, that the gas be confined so that it cannot increase in volume, we shall find that as the temperature increases the elastic force will increase too, and in the same proportion as its volume would were it free to expand. The rule may be stated thns :—

If any gas be confined so that it cannot expand, and its temperatnre be raised from 32° to 212°, the elastic force will be increased by 0·366 of its original amount.

Sometimes the steam in an engine is exposed to a high temperature after it is first evolved, and is then said to be superheated. Its tension is increased by this, and thus it can accomplish more work, and at the same time "priming," or the condensation of the steam in the cylinders, is to a great extent prevented.

After what we have now seen respecting the change produced in the volume of a gas by variations in the temperatnre or pressure, we can very easily tell the specific gravity of a gas if we know the weight of any volnme of it, and also its temperatnre and pressnre. We have merely to ascertain the volnme it wonld occupy at the standard temperature and pressure, and then compare its weight with that of the same volnme of air. In the same way we can calculate the weight of any volume of gas, or the volnme that a given weight of it would occupy.

We described in our last lesson a manometer for measuring high pressures like that produced in the boiler of an engine. This acted by the elastic force of compressed air: a spring is more commonly used, bnt it is somewhat liable to lose its elasticity, or to become injured by the moisture of the steam. These, however, only record high pressures, and not minor changes like those prodnced by alterations of temperatnre. We want, therefore, some means of measuring these, and for this purpose we employ a U-shaped tube, open at each end. The bend is filled with water if very low pressures are to be measured, and with mercury if to be used for those rather greater.

If the gas whose tension is to be ascertained is allowed to press on the liqnid in one limb, it will depress it and raise that in the other, and the difference in level between the two will indicate the pressure. A sliding scale is usually attached to show this difference. In this way we shall find that the pressure of the gas, as nsually snpplied to our honses, is seldom equal to two inches of water, a very small amonnt indeed when we remember that the pressure of the air will sustain a column of water over thirty feet high. It is, however, found to be quite sufficient to overcome the resistance caused by the friction of the gas against the pipes, and a greater pressure wonld only cause a greatly increased loss by leakage from the mains.

This pressure is produced by weights placed upon the gasometer, and can in this way be regnlated to a considerable extent. It is found, however, that considerable variations occnr, it being greater just before the majority of people light it in their houses, and again in large towns about eleven o'clock, when many bnrners are turned off. These variations in pressure cause a loss in illuminating power, and several regulators have

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accordingly been devised to obviate this. The principle on which they act is merely that a conical valve is moved by the pressure so as to close to a greater or less extent the pipe along which the gas passes.

There is a small but useful piece of apparatus, known as the safety-pipe (Fig. 17), which may be explained here, as it acts in a similar way to the pressure-gauge just mentioned. In many chemical experiments in the laboratory, as well as in the manufactory, a large amount of gas is evolved by the changes taking place within some closed vessel. If no escape be allowed for this, the pressure may increase to such an extent as to burst the vessel; while, on the other hand, it is desirable not to allow the gas to be lost. A safety-pipe, similar to that shown in the annexed figure, is therefore introduced. This allows a portion of the gas to escape when the pressure reaches a certain limit. It is, in fact, a safety-valve of low pressure. A glass tube has a bulb B blown near the middle, and each end is then bent back upon itself. The upper end is also shaped into a funnel, which should be rather larger than the bulb. Water or mercury, according to the pressure required, is now poured into the funnel, so as to fill the bend and part of the bulb. If the pressure inside the vessel becomes too great, the liquid will be forced into the part C of the tube, and any excess of gas will then bubble up through it, the funnel preventing the escape of the liquid. If, on the other hand, the pressure inside becomes less than that without, owing to the absorption or condensation of the gas, the pressure of the air will force the liquid into the bulb, and air will then bubble up through it. In this way the tube prevents the difference between the pressures from becoming dangerous, and at the same time, under ordinary pressure, excludes all air.

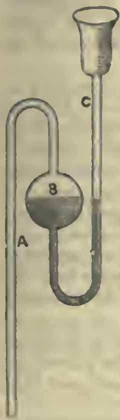

Fig. 17.

We have seen that power may be stored up in compressed air; hence it is sometimes employed to drive an engine in place of steam. Of course some power must be first employed to compress the air, and therefore in ordinary circumstances no advantage will be gained by the substitution, but in many special cases it may be and is employed. If steam has to be conveyed to any great distance, there is a considerable loss by condensation in the pipes, and in some places it is inconvenient or impracticable to have the boiler near the machine. In such cases, therefore, the steam may be employed in the compression of air, and by this the power may be transmitted to the place where it is required.

In mining operations this is especially advantageous. A narrow seam of coal, in which there is no room for an engine, has sometimes to be cut out by a machine, and even if the engine could be placed there, the steam and smoke would prevent a man being by it; such machines are therefore driven by compressed air. The same remarks apply to a narrow tunnel, as, for example, that which was driven through Mont Cenis; and here, too, compressed air was used instead of steam. There is also this further advantage attending the use of air, that the machine can be more easily moved, for a portion of the pipe may be made flexible, which cannot well be done with steam-piping.

The most important application of the pressure of air to driving machinery is seen in the atmospheric railway. At present this has not come into practical use, but it appears probable that the principle will ultimately be adopted in our underground railways, as it will effect a saving in working expenses as well as in construction, to say nothing of the much greater safety which would be ensured by its use, and the greater purity of the air in the tunnel.

The original plan proposed, and actually carried out on a short piece of line near Paris, was somewhat as follows:—A large iron tube, having all along the top an opening which was closed tightly by a flexible lid, was laid along the middle of the line. This tube was made uniform in size, and a pair of pistons, made to fit it, were fixed one to each end of a little carriage which travelled along in the tube. From the middle of this carriage rose an arm which projected through the slit, and was attached to the carriage on the line. A coulter-shaped piece of metal was placed on each side of the arm, so as to open the slit for it to pass along, and the aperture closed of itself as soon as the arm had passed. The pistons were also attached to short arms, so that the valve admitted no air in front of them. At each end of this tube was fixed a powerful double-acting air-pump, and whenever it was required to start the train, the pump at the end to which it was going was set to work. It soon produced a vacuum in the tube, and the pressure of the air behind the piston was sufficient to drive the train. There were, however, many practical difficulties in the carrying out of this plan. The valves could not be got to close well, and hence there was a considerable leakage of air which greatly diminished the power. All the strain, too, was transmitted through the arm, and thus there was danger of breakage. From these and many similar causes the design was not carried out elsewhere.

More recently, however, an altogether different plan was tried with much greater success. In this the tube was built of brickwork, and made of such a diameter as to take in it an ordinary-sized railway carriage. A trial line, of nearly a mile in length, was constructed in the grounds of the Crystal Palace at Sydenham. The line was made with steeper gradients and sharper curves than any line yet worked, so as to give the system a full trial. The tunnel was carefully constructed, so as to be of uniform size, and one end of the carriage was made nearly to fit it, an aperture of a few inches being left all round. A brush fixed round the carriage nearly filled this, and was found to exclude the air sufficiently. The ends of the tunnel were closed by air-tight doors, and in a building near one end was fixed a large fan, constructed somewhat after the plan of a centrifugal pump, and so arranged that by causing it to rotate in one direction it exhausted the tube, while on reversing it the air was condensed. The pipe leading from this entered the tunnel at a little distance from the end. The carriage being now placed just in the mouth of the tunnel at the further end, the engine was set to work, and, as soon as a slight amount of exhaustion was produced, the pressure outside forced it rapidly along. As the whole area of the carriage was exposed to the pressure, it was found that only a very small degree of rarefaction was required, a pressure of a few ounces to the inch being quite sufficient to impart to it a great velocity. As soon as the carriage had passed the portion of the tunnel where the exhaust pipe entered, it ceased to be carried forward by the pressure of the air, but it had acquired an amount of momentum sufficient to propel it with considerable violence beyond the end of the tunnel. The doors at the end were, however, closed by powerful springs. The air, therefore, enclosed between them and the carriage became more and more compressed, until the pressure was sufficient to open the doors, and allow the carriage to run slowly out. The air acted, in fact, as a buffer, and brought the carriage to rest with scarcely any shock. When the carriage was to be sent back to the other end, the engine first exhausted the tube until the carriage passed the opening, the doors were then closed, the engine reversed, and then the air behind was condensed, and drove the carriage to the other end on the same principle as a boy drives a pea through his pea-shooter by the pressure of his breath.

The experiment appeared satisfactory, through no practical use has yet been made of it. The carriage, with passengers in it, could be started from one end, driven round the curves, and up and down the steep inclines, and yet stop at the other end, nearly a mile off, in the space of about one minute. The system appears to possess many advantages. Much greater inclines can be allowed, and all danger of the carriage running off the line on sharp curves is avoided. There is also much greater safety from accidents. Collision is impossible, for two carriages can never be travelling in opposite directions at the same time, nor can one overtake the other. The boiler, too, being away from the train, cannot injure the passengers if it explodes, and the only inconvenience then would be that the passengers would have to walk along the line to the nearest station. Further, as the trains would travel very rapidly, one line would, in most cases, be sufficient, and the additional expense incurred by the careful building of the tunnel would, in many places, be compensated for by the smaller amount of land required. The tunnel, too, unlike our present ones, would be well ventilated, as the air would be entirely changed each time a train passed through. There are, of course, many practical difficulties which might occur in the actual working, but the plan seems to promise well, and to be worthy of a thorough trial.

We must now notice the construction of a few common pneumatic machines, and perhaps the most important are those used for blowing. In furnaces for reducing and melting metals it is found impossible to cause a sufficient degree of heat to be produced unless a large additional quantity of air be forced into the fire, so as to quicken combustion. In mines, too, and underground passages ventilation must be carried on by artificial means, and for these and other purposes blowing machines are employed.

The most simple of these is the common household bellows, so familiar to all. In the lower of the two boards is a circular aperture, over which a piece of board is hinged, so as to act as a common clack valve. When the boards are separated, the air opens this valve, and enters, but as they are again pressed together this valve closes, and the air is then forced to escape by the nozzle. With this kind, however, only an intermittent current can be produced, for while the boards are being separated, air is drawn in at the nozzle as well as at the valve, though in a less degree. This was often found to be a serious disadvantage, and therefore two bellows, working alternately, were used in many furnaces. Double-acting bellows are, however, used now in nearly all forges, and these produce a uniform stream. They consist of two ordinary bellows, placed one above the other. When the under board E (Fig. 18) is lowered, the valve C opens and admits the air; this is forced, by the rising of the board, through the valve B into the upper bellows. A weight A, placed on the top, drives the air with a constant pressure out of the nozzle D. The board F is fixed, and E is usually worked by a lever. Though these bellows are powerful enough for a blacksmith's forge, when the metal has only to be softened sufficiently to cause it to weld, they will not answer for a furnace for melting iron; and a fan, driven by steam, is usually employed in this case (Fig. 19). The air enters at the axle, and is thrown off by centrifugal force from the edges, and conducted along large tubes to the furnace.

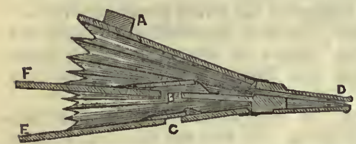

Fig. 18.

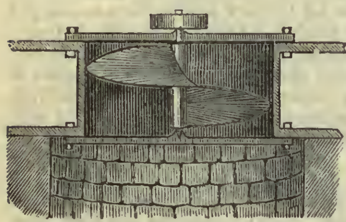
Fig. 19.

Another purpose for which these machines are employed is in the winnowing of corn. In former times, and in some places at the present day, the corn, when threshed, is thrown up in air, and the wind carries away the chaff. The plan now adopted is to allow it to fall through a narrow slit, and cause a rapid current of air, produced by rotating fans, to remove the chaff. One great advantage of this plan is that the strength of the blast may be so regulated as not only to remove the chaff, but to separate also the small and shrivelled grains.

The pneumatic screw is another simple blowing machine, used for purposes of ventilation. It acts on exactly the same principle as the Archimedian screw, an axle with a spiral flange being made to rotate in a cylinder. This is placed at one end of the tube or shaft, and produces a powerful current, the direction of which depends upon the direction in which the screw revolves.

This machine is sometimes employed for the ventilation of mines, and is fixed above one of the shafts. A second shaft allows fresh air to pass down it, and replace that removed by the fan, and thus a constant current of air is kept up through the mine. The main galleries below are so arranged, by means of boarding and doors, that the fresh air must traverse the greater part of the mine before it can find its way to the "upcast" shaft, as it is termed. As the air will always find the most direct road, great care is required in the arrangements for effecting this.

In most mines in England blowing machines are now dispensed with, and in their stead a large furnace is placed at the base of one of the shafts. This greatly rarefies the air above it, and thus renders it much lighter than that around. It ascends, therefore, and a fresh supply rushes down the second shaft to take its place, and in this way good ventilation may nearly always be obtained. The plan, too, is more simple than the use of fans, and less liable to get out of order. Sometimes the furnace is placed in a recess, part of the way up the shaft; sometimes, too, only one shaft is sunk, and divided by bratticing into three or more divisions, one for the pumps and working machinery, the other two for the "upcast" and "downcast." This plan is, however, very dangerous, and many of the fearful accidents we hear of in mines are to be attributed to its adoption.

Ventilation in our houses and public buildings is carried on in a similar way. It is much to be regretted, however, that the principles on which this should be arranged seem to be so little understood or carried into practice. If we hold a sheet of paper near a large fire, we shall soon see by the powerful draught that there is a strong current of air up the chimney, and cold air rushes in at the cracks of the doors and windows to supply its place. A good fire, therefore, adds greatly to the ventilation of a room. As, however, the heated air rises, it is an important thing to have some outlet for this, and an opening into the chimney near the top of the room will usually be effectual. In public buildings the foul air is usually carried off near the roof, and arrangements ought to be made by which fresh air can enter in a number of small streams at different places, instead of flowing in a large body through an open door, and thus creating a violent draught.

The following examples will give the student good practice in the application of the rules in Lessons V. and VI. :—

EXAMPLES.

1. If the barometer stands at 29·04, what is the pressure of the air on a surface measuring 5in. × 6¼in. ?

2. In Fig. 15, if the length of the graduated portion of the shorter limb be 10 inches, and the mercury rise in it to a height of 5½ inches, at what height does the mercury stand in the other limb, the barometer being at 29in. ?

3. A volume of gas measures 249 cubic inches when the barometer stands at 28·7. How much will it measure at the standard pressure ?

4. Some gas at a temperature of 155° measures 1 cubic foot; how much space will it occupy when cooled to 60° ?

5. 140 cubic inches of air at 60° is heated till it occupies 215 cubic inches; what temperature has it attained ?

6. When the barometer was standing at 28·78, and the thermometer at 71°, a quantity of gas was found to measure 158 cubic inches. How much would it occupy at the standard pressure and temperature ?

LESSONS IN FRENCH.—LXXX.

§ 105.—REMARKS ON THE DEMONSTRATIVE PRONOUN CE.

(1.) **Ce**, when used as a demonstrative pronoun, is construed with the verb **être**, or with a verb followed by **être**, or with a relative pronoun :—

C'est un poids bien pesant qu'un grand nom à soutenir. MONTESQUIEU.	*A great name is a very heavy weight to sustain.*
Ce qui me plaît **c'est** sa modestie. LÉVIZAC.	*That which pleases me is her modesty.*
Ce doit être lui.	*It must be he.*
Ce que vous dites est faux.	*What (that which) you say is untrue.*
Je sais **ce dont** il se plaint.	*I know that of which (of what) he complains.*

(2.) **Ce** is used for *he*, *she*, *they*, preceding any part of the verb *to be*, when that verb is followed by a noun, or an adjective used substantively and preceded by *the*, *a*, or *an*, or a possessive or demonstrative adjective, or any kind of pronoun.

(3.) *Observe* that the verb **être** following the pronoun **ce**, is put in the plural when the noun, possessive or demonstrative pronoun following that verb is plural. The pronoun **ce**, however, remains unchanged :—

C'est un trompeur.	*He is a deceitful man.*
C'est la femme que je cherche.	*She is the woman whom I seek.*
C'étaient mes amis.	*They were my friends.*
Ce seraient paroles exquises, Si **c'était** un grand qui parlât. MOLIÈRE.	*They would be exquisite words, if a great man were speaking them.*

*

N'étaient-ce pas les mêmes hommes? CHÂTEAUBRIAND.	*Were they not the same men?*
Ce sont les miens, **ce** ne **sont** pas les vôtres.	*They are mine, they are not yours.*
Ce sont celles que j'ai vues.	*They are those I have seen.*

(4.) *This is, that is, these are, those are*, may also be rendered by **c'est ici, ce sont ici**, or by **voici** and **voilà** :—

C'est ici la place.	*This is the place.*
Ce sont là mes enfants.	*Those are my children.*

Voici, voilà, are, however, to be preferred to **c'est ici**, etc. :—

Voici la place.	*This is the place.*
Voilà mes enfants.	*Those are my children.*

(5.) **Ce** answers to the English pronoun *it*, when the latter stands as the impersonal subject of the verb *to be; i.e.*, without reference to an antecedent :—

Ce n'est que par les sens que l'âme peut s'instruire. FONTANES.	*It is only through the senses that the mind can receive instruction.*
Ce fut d'une retraite de pâtres et d'aventuriers, que sortirent les conquérants de l'univers. ROLLIN.	*It was from a refuge for shepherds and adventurers, that emerged the conquerors of the world.*
C'est un défaut capital qu'il faut éviter dans quelque sujet que **ce** soit. VOLTAIRE.	*This is a fatal defect which should be avoided in whatever subject it may be.*

(6.) When the verb **être**, however, is used impersonally, and followed by an adjective [§ 85, (4)], the pronoun *it* is not rendered by **ce**, but by the pronoun used with all impersonal verbs, viz., **il** :—

Il est nécessaire d'étudier.	*It is necessary to study.*
Il est plus difficile pour les nations que pour les individus, de recouvrer l'estime de leurs voisins quand elles l'ont perdue. BOISTE.	*It is more difficult for nations than for individuals, to recover the esteem of their neighbours when they have lost it.*

§ 106.—THE RELATIVE PRONOUN.

(1.) The relative pronoun **que**, *whom, which, that*, can never be suppressed like the corresponding English pronouns :—*

Les louanges **que** nous donnons, se rapportent toujours par quelque chose à nous-mêmes. MASSILLON.	*The praises (which) we give, have always in some way a relation to ourselves.*

(2.) The pronouns **quel, que, quoi, lequel**, represent the English pronouns *which or what* used interrogatively.

1. **Quel** is used before a noun in a determinative sense :—

Quel livre lirons-nous?	*What or which book shall we read?*
Quel est donc votre mal? MOLIÈRE.	*What then is your ailment?*

2. **Que** is used before a verb :—

Que dites-vous?	*What do you say?*

3. **Quoi** is used as an exclamation, and with a preposition :—

Quoi! est-ce vous?	*What! is it you?*
De quoi parlez-vous?	*Of what are you speaking?*
Quoi de plus beau que la vertu?	*What is more beautiful than virtue?*

4. **Lequel**, used interrogatively, means *which one* :—

Voici deux plumes; **laquelle** voulez-vous?	*Here are two pens; which (which one) will you have?*

(3.) **Qui** is used without antecedent, affirmatively and interrogatively as direct and as indirect object. It then means *whom, of whom, to whom, whose*, etc. :—

Qu'elle épouse **qui** elle voudra.	*Let her marry whom she likes.*
Nous savons **de qui** elle est fille.	*We know whose daughter she is.*
Qui avez-vous vu?	*Whom have you seen?*
De **qui** tenez-vous cette nouvelle?	*From whom have you this news?*
À qui est ce livre?	*Whose book is this?*

* The conjunction *that* is often omitted in English; its equivalent, **que**, must always be expressed in French :—

Je crois qu'il est ici. — *I believe (that) he is here.*

§ 107.—THE PRONOUN EN.

(1.) We have already [§ 40, (17.), § 92, (5.), § 100, Rule (1.)] made several remarks on this pronoun.

(2.) **En**, used as an equivalent for the English *some* or *any*, expressed or understood, remains, however, an indirect object :—

Avez-vous des pommes?	*Have you apples?*
J'en ai.	*I have (I some have).*

(3.) **En** sometimes is used to avoid the repetition of the whole or part of a clause :—

L'on ne saurait voir, sans **en** être piqué, Posséder par un autre un bien qu'on a manqué. MOLIÈRE.	*We cannot, without being piqued, see another person in possession of goods which we have failed to obtain.*
N'en disputons plus; chacun a sa pensée. MOLIÈRE.	*Let us no longer argue about this, every one has his own opinion.*

§ 108.—THE PRONOUN Y.

Some remarks have already been made on this pronoun [§ 40, (18.), § 100, (2.)]. **Y** means *to it, at it, to them, at them.* It is seldom used in relation to persons, but frequently in relation to things :—

Je reçois votre lettre, ma chère enfant, et j'**y** fais réponse avec précipitation. MME. DE SÉVIGNÉ.	*I receive your letter, my dear child, and answer it (make answer thereto) in haste.*
Tirer vanité de quelque chose, c'est prouver qu'on n'**y** est pas accoutumé. BOISTE.	*To feel vanity on account of any thing, is proving that we are not accustomed to it.*
Chargez-vous de cette affaire; donnez-**y** tous vos soins. BONIFACE.	*Take this affair upon yourself; give all your care to it.*

§ 109.—THE INDEFINITE PRONOUN ON [42, (4.)].

(1.) **On**, which is very extensively used in the French language, is said only of persons. This pronoun is of the masculine gender. [*See* (2.)] **On** is used in French for *people, one, some one, we, they*, whenever these words have a general and indefinite meaning, and do not refer to any particular word :—

On pardonne aisément le mal involontaire. DE LA BOUTRAYE.	*We (people, they, etc.) easily forgive involuntary injuries.*
On cherche les rieurs, et moi je les évite. LA FONTAINE.	*People (they, we) seek laughing or merry people, and I avoid them.*

Another translation of the above sentences will show us that the pronoun **on** often enables the French to make use of the active voice, in cases in which the passive voice would be used in English.† Thus the two examples last given may be rendered as follows :—

Active voice in French.	*Passive voice in English.*
On pardonne aisément le mal involontaire.	*Involuntary injuries are easily forgiven.*
On cherche les rieurs, mais moi je les évite.	*Merry or joyful people are generally sought; for my part, I avoid them.*
Quand **on** est chrétien, de quelque sexe que **l'on** soit, il n'est pas permis d'être lâche. FÉNELON.	*A Christian, of whichever sex he may be, is not allowed to be cowardly.*
On peut être honnête homme, et faire mal des vers. MOLIÈRE.	*One may be a worthy man, and make bad verses.*
On aime peu celui qui n'ose aimer personne. DELILLE.	*We feel but little love for him who dares love nobody.*
A-t-**on** jamais pleuré d'avoir fait son devoir? CHAMFORT.	*Have we ever grieved on account of having done our duty?*
Quand **on** a même but, rarement **on** s'accorde. LEBRUN.	*Those who have the same aim, rarely agree.*
Artistes, écrivains, poètes, si vous vous copiez toujours, **on** ne vous copiera jamais. BERNARDIN DE ST. PIERRE.	*Artists, writers, poets! if you always copy each other, no one will copy you.*

† **On dit**, *it is said;* **on rapporte**, *it is related;* **on craint**, *it is feared*, etc. **Cela se fait ainsi**, literally, *that makes itself thus, that is made in this manner*, etc.

METEOROLOGY.—I.

SCOPE OF THE SCIENCE — AËRIAL PHENOMENA — WINDS — ISOBAROMETRIC LINES—STORMS—MEAN TEMPERATURE—ISOTHERMAL LINES — EFFECTS OF LOCAL CAUSES ON CLIMATE.

THE earth we inhabit is, as is well known, completely surrounded by an envelope of gaseous matter called the atmosphere, which is kept close to its surface by the action of gravitation. This aërial layer is the seat of many very important and interesting phenomena, which it is the province of the science of Meteorology to inquire into and explain. The science is, however, now usually restricted more particularly to those atmospheric phenomena which influence weather and climate.

Owing to the very many causes that are at work, there is great difficulty in tracing out all the laws by which these phenomena are governed; and though many weather prognostics have long passed into current proverbs, it is only recently that true progress has been made in the study of the science.

In early times, when the occupations of most men kept them much in the open air, and consequently exposed to all the vicissitudes of the weather, they would naturally make various observations, which would enable them to foretell to a limited extent the probable changes. These observations were handed down from generation to generation; but were far too vague and general to serve in any way as the foundation of a science.

In modern times, however, various instruments have been devised for ascertaining accurately the pressure, the temperature, the humidity, and other important matters in connection with atmospheric changes; and now, by means of the barometer, thermometer, and similar instruments, constant records are being kept, in different places, of all these changes.

In a science like Meteorology, it is only by the careful examination of long-continued records of this kind that true progress can be made. The first thing required is to observe the phenomena accurately, and we must endeavour to explain and account for them. To start hypotheses first, and then endeavour to reconcile observations with them, is a mistake.

So numerous and varied are the phenomena with which we have to deal, that it is somewhat difficult to classify them. For the sake of convenience we may divide them into *aërial*, *aqueous*, and *optical* phenomena. It must not, however, be supposed that these classes are indicative of fundamental differences.

The chief physical properties of the air have already been referred to in our lessons on Pneumatics and Chemistry, to which, accordingly, we must refer the student. In this aërial ocean we meet with regular tides, but currents produced by other causes are far more common and important.

These currents in the air are known as the winds, and they usually arise either from a change in temperature, or in the amount of watery vapour it holds in solution. The direction of the wind is always indicated by the point of the compass, *from* which it appears to come; and as the weather and climate of any place are greatly affected by the prevailing direction, considerable attention has been directed to the subject, and records are kept in many places showing the direction and intensity of the wind at stated times every day. From such registers it appears that in this country S.W. winds are the most prevalent, since they blow on the average 225 days out of every 1,000. We find, too, that westerly winds are more common than easterly, in the proportion of about 220 to 145.

The prevailing character of any wind depends chiefly upon the countries over which it passes. With us, a west wind is usually moist and mild, having swept over the Atlantic Ocean, and thus become partly charged with vapour and warmed. So, too, in the south of Europe, especially in places where the Mediterranean is narrow, a south wind is very hot and dry, from having swept over the arid deserts of Africa. In Italy this is especially noticeable, and this wind is there distinguished as the "Sirocco." A similar wind, but more injurious in its effects, is very prevalent in the desert regions of Arabia and Syria, and is known as the "Simoom." This is frequently spoken of as poisonous. It appears, however, that it is merely a very hot, dry wind, completely charged with fine dust. Everything exposed to its influence becomes rapidly dried up; the skin is parched and dry; a general languor comes over everything; and if the traveller is unable to find a place of shelter, he not unfrequently perishes.

The trades, monsoons, and other periodical winds, have already been explained in treating of Pneumatics. Near the equator, and running almost parallel to it, is a belt some 4° or 5° in breadth, known as the Region of Calms. The position of this varies with that of the sun, and the whole region is characterised by very heavy rains and frequent thunderstorms.

As the winds are mainly produced by variations in the barometric pressure, great light is often thrown on their phenomena by observing the different pressure at neighbouring places. Maps are now drawn with *isobarometric* lines marked on them; that is, lines passing through those places where the mean pressure is the same; and when these are carefully constructed, much may be learnt from them.

The climate of most places is greatly influenced by local peculiarities, as will be more fully explained, and hence these must be taken into account. In tropical regions, however, these local influences are almost overpowered by the great and regular currents which prevail, and therefore they interfere far less than they do in more temperate climes.

The investigation of the laws governing storms and their movements is one of the most important but most difficult questions in Meteorology. The great destructive power which they possess, and the extent to which they may be guarded against when expected, show the importance of this inquiry. What is most needed for this purpose is a complete set of simultaneous observations made during the prevalence of any storm; and, as observers are now stationed in different parts of Europe, these observations have frequently been obtained.

The best method of examining them is to lay down on a map isobarometric lines showing the pressure during the storm in different places, since this appears to be the most important item in the inquiry. By charts of this kind it is found that the centre of the storm is marked by a region of unusually low pressure, the barometer often standing considerably below 29 inches. The barometric lines, too, are usually circular or elliptical. Occasionally, these curves are very irregular, but this often arises from two or three storms which have parted from the original one, and sometimes re-unite with it.

As a storm dies out, the central depression becomes much less, and occupies a more limited area. The direction in which storms travel in Europe is usually from S.W. or W.S.W., and is more or less circular. The rate at which they move varies considerably, but is usually about eighteen or twenty miles an hour, though it has been known to be twice as great.

Since the west of Ireland is some 450 miles from the east coast of England, a storm appearing in the former locality may at once be announced to eastern seaports, and thus nearly twenty-four hours' notice of its approach may be gained. In order, however, to be of much service, these notices must be transmitted at frequent intervals. If only daily signals are sent, the storm may outstrip them. In calm weather, one report would, of course, suffice, but in unsettled weather they should be much more frequent.

The direction of the wind during a storm is not directly towards the point of least pressure, but usually to some point a little to the right of it, so that the wind flows in a spiral direction round the area of low pressure. The force at any place is usually proportional to the difference in the pressures at the places between which it is situated.

In tropical regions storms are much more frequent, and are there preceded by a very sudden and remarkable fall in the barometer. During a storm which raged at Guadaloupe on the 6th of September, 1865, the mercury fell 1·693 in. in one hour and ten minutes. This sudden fall relieves the ocean of a large portion of its pressure, and hence the water is often raised to a considerable height by the greater pressure all around. To this cause must be attributed those storm-waves which frequently accompany tropical hurricanes, and often cause a great loss of life and property. The rotating character of these storms is very clearly seen, and when the centre is over any place, the clouds in the zenith are frequently seen to be revolving rapidly.

In the tropics the movements of the barometer are very regular indeed, the daily variation being most distinctly observed. Any deviation from this at once indicates a disturbance of the atmosphere in the locality, and affords a sure method of foretelling a storm. An isolated observer may, in fact, easily ascertain their approach, and give warning of it.

In our latitudes the irregular variations of the barometer are so much greater than the regular ones, that this cannot be done by a single observer. By means, however, of a staff of observers scattered over Western Europe, and able to communicate by telegraph, most storms can be predicted, and notice be sent to various ports, so as to warn sailors of their approach.

A system of this kind was commenced and carried out by the late Admiral Fitzroy, and though many errors crept in at first, the majority of the warnings were correct, and the per-centage of these steadily increased.

Those places on or near the west coast were, of course, unfavourably situated for receiving the warnings, since the storms usually commenced in that quarter; and, in the case of a few storms not foretold, the reason usually was that a constant watch was not kept at Valentia, in the west of Ireland. The great difficulty in this matter is not the foretelling of the storm itself, but the ascertaining in what direction it is travelling, and thus only sending the warnings to those places where it is likely to be felt. In more recent years the study of meteorology in Great Britain, the United States, and foreign countries, has wonderfully advanced, and storm warnings are now published in all the leading newspapers.

A very important point in connection with the climate of any place is the mean temperature of the air. This is ascertained by reading the temperature indicated by a thermometer every hour, and taking the mean of the twenty-four observations thus made in the day. If we take the mean temperature at any two hours of the same name, we arrive at a result differing only by a fraction of a degree. This is most accurate if we take the mean of 9 a.m. and 9 p.m., or of 10 a.m. and 10 p.m. The two former are usually chosen as being most convenient; when practicable, four equidistant observations should be made. Several years' observations must be compared to obtain the true mean.

Another important thing to notice is the extreme temperatures registered during the day. These are very easily noted, as thermometers are now made which register the maximum and minimum temperature. The maximum thermometer usually employed is a mercurial one, with a small steel index moving in the tube above the column. As the mercury expands, it drives this before it, and leaves it at the highest point attained, the mercury not attracting the steel enough to draw it back again.

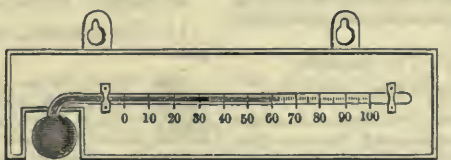

Fig. 1.

In the minimum thermometer (Fig. 1), the tube is usually filled with spirit, and a similar index is placed in it. As the spirit contracts, it drags this index with it; but when the temperature rises again, the spirit passes it, and it is thus left lying at the point indicating the lowest temperature reached. Both these thermometers are set by bringing the index to the top of the column, either by inclining the instrument, or by means of a small magnet. They are read off and set at a regular time each day, the highest and lowest temperature being entered in a book provided for the purpose. If we take the mean of these two readings, we shall find that it differs very slightly from the mean daily temperature obtained as already explained.

When daily records of temperature are kept, great care is required to ensure that the thermometers employed are correctly graduated and properly placed. Many common thermometers, when compared with a standard one, are found to be very inaccurate. The instrument employed should therefore be carefully verified; and most good instruments are now sent to a Government Observatory for that purpose before they are sold. To ensure accurate readings, the instrument should be shielded from the direct or reflected rays of the sun, but at the same time be exposed to a free current of air. The minimum thermometer should also be placed at a distance of four feet above the surface of the ground, as the readings are otherwise considerably affected by radiation from the earth. In a spirit thermometer there is frequently a tendency for some of the spirit to condense in the upper part of the tube, and thus to render all the readings too low by this amount. Many of the very low readings which are sometimes noticed by newspaper correspondents may be accounted for in this way. The thermometer should therefore be occasionally examined and compared with another to guard against errors of this kind.

The climate of any place, however, does not depend alone upon the *mean* temperature, for the *range* of temperature—that is the difference between the maximum and minimum readings—exerts a very important influence on it. Thus, for instance, Madrid, and Mentone on the Gulf of Genoa, were observed to have the same mean temperature, viz. 72·8° during September, 1865. The climates were, however, widely different, for, in the case of the former, the means of the hottest and the coldest periods of each day were 86·2°, and 59·5° respectively. Those at the latter place were 77·6° and 68·0° only. The importance of observing this point is further shown by the fact that the rate of mortality is found to vary with the range.

An insular climate usually has this range very limited in extent. The specific heat of water being very high, it varies but little in temperature through the year, and the changes that do occur in it are very gradual. The result is that in localities close to the sea, the hot winds are cooled and the cold ones warmed by passing over the water, and thus the temperature is much more uniform than in situationsfurther inland.

The following list shows the difference between the extreme temperatures recorded at a few places:—

Rome	73°	Greenwich	99°	Petersburg	117°
Copenhagen	90°	Paris	110°	Moscow	126°

In some localities the range is even greater than any of these.

By taking a long series of observations at different places, the mean temperature of each is ascertained, and lines can then be drawn on a map, passing through those places which have the same mean annual temperature. These lines are called *isothermal* lines. They were first noticed by Humboldt, and serve to show the general distribution of temperature. On the sea they are almost parallel, but on the land they are somewhat irregular, as elevation above the sea-level greatly influences the temperature.

The line showing the highest mean temperature, or, as it is usually called, the warmth equator, is almost entirely in the northern hemisphere, attaining on the eastern side of the African desert the latitude of 17° N. The mean temperature of the place is 87° or 88°. The fact of this isothermal being thus situated is owing to the great preponderance of the land in the northern hemisphere over that in the southern, the surface of the land absorbing the heat more readily than that of the sea.

Besides the general causes which account for temperature, there are local ones which exert a great influence on that of any particular place. The most important of these are the altitude above the sea-level, the direction of the prevailing winds, and the proximity of the sea.

In many places, the climate of which is remarkably salubrious, the mean temperature is often found to be scarcely at all higher than that of the surrounding district, but very often some local cause, such as a range of hills, affords a shelter from cold or injurious winds. Ventnor, in the Undercliff of the Isle of Wight, is a good illustration of this fact, and hence it is a favourite winter residence for invalids. Not only is it sheltered from the cold east winds, but its proximity to the sea raises its winter temperature several degrees.

Forests likewise exert a considerable influence on climate and mean temperature. Trees, like all other bodies, become greatly heated by the sun's rays. They do not, however, acquire their maximum temperature till a little after sunset, while the maximum temperature of the air is attained about two or three o'clock. They also change their temperature much more slowly than the air around them. Hence they make the days cooler and the nights warmer, and thus render the climate more mild, imparting to it somewhat of the insular character. They also exert a considerable influence on the evaporation from the earth, and increase the humidity of the air. In this way they serve to increase the rainfall of any district.

In some places, where a large expanse of country has been cleared of most of the forests, the difference in the rainfall has been shown by the partial drying up of rivers and lakes.

Not only is the influence of the mean temperature upon man distinctly seen and felt, but it also exerts a great influence on the distribution of plants, the limits to the cultivation of various trees and varieties of grain being almost coincident with some of the isothermal lines already referred to.

LESSONS IN ITALIAN.—XXXIV.

IRREGULAR VERBS OF THE SECOND CONJUGATION.

VERBS ENDING IN *ere* LONG (*continued*).

7. The irregular verb *parére*, to seem, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Parére, *to seem.—Pres. Gerund.* Paréndo, *seeming.—Past Part.* Párso or parúto,* *seemed.——Compound Tenses.—Past.* Éssere párso, *to have seemed.—Past Gerund.* Esséndo párso, *having seemed.*

Ind. *Pres.* Pájo,† pári, páre *or* pár; pajámo, paréte, pájono.—*Imp.* Paréva *or* paréa, parévi *or* paréi, paréva *or* paréa; parevámo, pareváte, parévano *or* paréano.—*Ind. Pret.* Párvi *or* pársi, parésti, párve *or* párse; parémmo, paréste, párvero *or* pársero.—*Fut.* Parrò, parrái, parrà; parrémo, parréte, parránno.—*Cond. Pres.* Parréi *or* parría, parrésti, parrébbe *or* parría; parrémmo, parréste, parrébbero *or* parríano.

Imp. Pári, pája; pajámo, paréte, pájano.

Sub. *Pres.* Che pája, che pája, che pája; che pajámo, che pajáte, che pájano.—*Imp.* Che paréssi, che paréssi, che parésse; che paréssimo, che paréste, che parèssero.

8. The irregular verb *persuadére*, to persuade, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Persuadére, *to persuade.—Pres. Gerund.* Persuadéndo, *persuading.—Past Part.* Persuáso, *persuaded.——Compound Tenses.—Past.* Avére persuáso, *to have persuaded.—Past Gerund.* Avéndo persuáso, *having persuaded.*

Ind. *Pres.* Persuádo, persuádi, persuáde; persuadiámo, persuadéte, persuádono.—*Imp.* Persuadéva, persuadévi, persuadéva; persuadevámo, persuadeváte, persuadévano.—*Ind. Pret.* Persuási, persuadésti, persuáse; persuadémmo, persuadéste, persuásero.—*Fut.* Persuaderò, persuaderái, persuaderà; persuaderémo, persuaderéte, persuaderánno.—*Cond. Pres.* Persuaderéi, persuaderésti, persuaderébbe; persuaderémmo, persuaderéste, persuaderébbero.

Imp. Persuádi, persuáda; persuadiámo, persuadéte, persuádano.

Sub. *Present.* Che persuáda, che persuáda, che persuáda; che persuadiámo, che persuadiáte, che persuádano.—*Imp.* Che persuadéssi, che persuadéssi, che persuadésse; che persuadéssimo, che persuadéste, che persuadéssero.

After this example, conjugate *dissuadére*, to dissuade.

9. The irregular verb *piacére*, to please, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Piacére, *to please.—Pres. Gerund.* Piacéndo, *pleasing.—Past Part.* Piaciúto, *pleased.——Compound Tenses.—Past.* Avére piaciúto, *to have pleased.—Past Gerund.* Avéndo piaciúto, *having pleased.*

Ind. *Pres.* Piáccio *or* piácio, piáci, piáce; piacciámo *or* piaciámo, piacéte, piácciono *or* piáciono.—*Imp.* Piacéva, piacévi, piacéva; piacevámo, piaceváte, piacévano.—*Ind. Pret.* Piácqui, piacésti, piácque; piacémmo, piacéste, piácquero.—*Fut.* Piacerò, piacerái, piacerà; piacerémo, piaceréte, piaceránno.—*Cond. Pres.* Piaceréi *or* piacería; piacerésti; piacerébbe *or* piacería. Piacerémmo; piaceréste; piacerébbero, piaceríano, piaceríeno.

Imp. Piáci, piáccia *or* piácia; piacciámo *or* piaciámo, piacéte *or* piacciáte, piácciano *or* piáciano.

Sub. *Pres.* Che piáccia *or* piácia; che piáccia, piácci or piáci; che piáccia *or* piácia. Che piacciámo *or* piaciámo; che piacciáte *or* piaciáte; che piácciano or piáciano.—*Imp.* Che piacéssi, che piacéssi, che piacésse; che piacéssimo, che piacéste, che piacéssero.

After this example conjugate the following irregular verbs:—

Compiacére, *to please.*	Ripiacére, *to please again.*
Dispiacére, *to displease.*	Spiacére, *to displease.*

10. The irregular verb *potére*, to be able, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Potére, *to be able.—Pres. Gerund.* Poténdo, *being able.—Past Part.* Potúto, *been able.——Compound Tenses.—Past.* Avére potúto, *to have been able.—Past Gerund.* Avéndo potúto, *having been able.*

Ind. *Pres.* Póssa; puói *or* puó'; può, puóte *or* póte. Possiámo *or* potémo; potéte; póssono, pónno *or* pon.—*Imp.* Potéva *or* potéa; potévi; potéva, potéa *or* potía. Potevámo; poteváte; potévano, potíeno *or* potéano.—*Ind. Pret.* Potéi *or* potè; potésti; potè *or* potéo. Potémmo; potéste; potérono, potéttero, potéro *or* potér.—*Fut.* Potrò, potrái, potrà; potrémo, potréte, potránno.—*Cond. Pres.* Potréi, potría *or* poría; potrésti; potrébbe, potría *or* poría. Potrémmo; potréste; potrébbero, potríano, poríano *or* potríeno.

(*No Imperative.*)

Sub. *Pres.* Che póssa, che póssa, che póssa; che possiámo, che possiáte, che póssano.—*Imp.* Che potéssi, che potéssi, che potésse; che potéssimo, che potéste, che potéssero.

* *Parúto* is not so often used, and not so good as *párso.*

† Some Italians have used *páro, pariámo*, and *párono*, instead of *pájo, pajámo*, and *pájano*. The learner must take care not to imitate them, for the former come from *paráre*, to adorn.

11. The irregular verb *rimanére*, to remain, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Rimanére, *to remain.—Pres. Gerund.* Rimanéndo, *remaining.—Past Part.* Rimáso,* *remained.——Compound Tenses.—Past.* Éssere rimáso, *to have remained.—Past Gerund.* Esséndo rimáso, *having remained.*

Ind. *Pres.* Rimángo,† rimáni, rimáne; rimaniámo, rimanéte, rimángono.—*Imp.* Rimanéva, rimanévi, rimanéva; rimanevámo, rimaneváte, rimanévano.—*Ind. Pret.* Rimási, rimanésti, rimáse; rimanémmo, rimanéste, rimásero.—*Fut.* Rimarrò, rimarrái, rimarrà; rimarrémo, rimarréte, rimarránno.—*Cond. Pres.* Rimarréi *or* rimarría, rimarrésti, rimarrébbe *or* rimarría; rimarrémmo, rimarréste, rimarrébbero.

Imp. Rimáni, rimánga; rimaniámo, rimanéte, rimángano.

Sub. *Pres.* Che rimánga *or* rimágua, che rimánga *or* rimágna, che rimánga; che rimaniámo, che rimaniáte, che rimángano.—*Imp.* Che rimanéssi, che rimanéssi, che rimanésse; che rimanéssimo, che rimanéste, che rimanéssero.

12. The irregular verb *sapére*, to know, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Sapére, *to know.—Pres. Gerund.* Sapéndo, *knowing.—Past Part.* Sapúto, *known.——Compound Tenses.—Past.* Avére sapúto, *to have known.—Past Gerund.* Avéndo sapúto, *having known.*

Ind. *Pres.* Sò, sái, sà or sápe; sappiámo, sapéte, sánno.—*Imp.* Sapéva *or* sapéa, sapévi, sapéva *or* sapéa; sapevámo, sapeváte, sapévano *or* sapeáno.—*Ind. Pret.* Séppi, sapésti, séppe; sapémmo, sapéste, séppero.—*Fut.* Saprò, saprái, saprà; saprémo, sapréte, saprànno.—*Cond. Pres.* Sapréi *or* sapría; saprésti; saprébbe *or* sapría. Saprémmo; sapréste; saprébbero, sapríano *or* saprieno.

Imp. Sáppi, sáppia; sappiámo, sappiáte, sáppiano.

Sub. *Pres.* Che sáppia, che sáppia, che sáppia; che sappiámo, che sappiáte, che sáppiano.—*Imp.* Che sapéssi, che sapéssi, che sapésse; che sapéssimo, che sapéste, che sapéssero.

After this example conjugate the following irregular verbs:—

Assapére, *to let one know.*	Risapére, *to know again.*
Antisapére, *to foresee.*	Strasapére, *to be too knowing.*

13. The irregular verb *sedére*, to sit down, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Sedére, *to sit down.—Pres. Gerund.* Sedéudo *or* seggéndo, *sitting down.—Past Part.* Sedúto, *sat down.——Compound Tenses.—Past.* Avére sedúto, *to have sat down.—Past Gerund.* Avéndo sedúto, *having sat down.*

Ind. *Pres.* Siédo *or* séggo, siédi, siéde; sediámo *or* seggiámo, sedéte, siédono *or* séggono.—*Imp.* Sedéva *or* sedéa; sedévi; sedéva *or* sedéa. Sedevámo; sedeváte; sedévano, sedíeno *or* sedéano.—*Ind. Pret.* Sedéi *or* sedétti; sedésti; sedè, sedétte *or* sedéo. Sedémmo; sedéste; sedérono, sedéttero *or* sediéro.—*Fut.* Sederò *or* sedrò, sederái, sederà; sederémo, sederéte, sederánno.—*Cond. Pres.* Sederéi, sedréi *or* sedería; sederésti; sederébbe. Sederémmo; sederéste; sederébbero.

Imp. Siédi, siéda *or* ségga; sediámo *or* seggiámo, sedéte, siédano *or* séggano.

Sub. *Pres.* Che siéda, ségga *or* séggia; che siéda, ségga, séggia *or* séggi; che siéda *or* ségga. Che sediámo *or* seggiámo; che sediáte *or* seggiáte; che siédano, séggano *or* séggiano.—*Imp.* Che sedéssi, che sedéssi, che sedésse; che sedéssimo, che sedéste, che sedéssero.

After this example conjugate the following irregular verbs:—

Possedére, *to possess.*	Risedére, *to reside.*
Presedére, *to preside.*	Soprassedére, *to supersede.*

14. The irregular verb *solére*, to be accustomed, is thus conjugated:—

Inf. *Pres.* Solére, *to be accustomed.—Pres. Gerund.* Soléndo, *being accustomed.—(No Past Participle.)*

Ind. Sóglio, suóli, suóle *or* sóle; sogliámo, soléte, sógliono.—*Imp.* Soléva *or* soléa; solévi; soléva, soléa *or* solía. Solevámo; soleváte; solévano or soléano.

Sub. *Pres.* Che sóglia, che sóglia, che sóglia; che sogliámo, che sogliáte, che sógliano.—*Imp.* Che soléssi, che soléssi, che solésse; che soléssimo, che soléste, che soléssero.

The deficiency of the tenses wanting is supplied by the verb *éssere sólito;* and the word *sólito* may, in some measure, be considered a participle.

15. The irregular verb *tacére*, to be silent, is thus conjugated:—

Inf. *Simple Tenses.—Pres.* Tacére, *to be silent.—Pres. Gerund.* Tacéndo, *being silent.—Past Part.* Taciúto, *been silent.——Compound Tenses.—Past.* Avére taciúto, *to have been silent.—Past Gerund.* Avéndo taciúto, *having been silent.*

* *Rimásto* is used in a familiar style; but as *rimáso* is more elegant, we advise the student always to prefer the latter.

† *Rimágno*, mentioned by some Italians, is not good.

IND. *Pres.* Táccio *or* tácio, táci, tace; tacciámo *or* taciámo, tacéte, tácciono *or* táciono.—*Imp.* Tacéva *or* tacéa, tacévi, tacéva *or* tacéa; tacevámo, tacevàte, tacévano.—*Ind. Pret.* Tácqui, tacésti, tácque; tacémmo, tacéste, tácquero.—*Fut.* Tacerò, tacerái, tacerà; tacerémo, taceréte, taceránno.—*Cond. Pres.* Taceréi, tacerésti, tacerébbe; tacerémmo, taceréste, tacerébbero.

IMP. Táci, táccia *or* tácia; tacciámo, tacéte, tácciano *or* táciano.

SUB. *Pres.* Che táccia *or* tácia; che táccia, tácia *or* táci; che táccia *or* tácia. Che tacciámo *or* taciámo; che taciáte; che tácciano *or* táciano.—*Imp.* Che tacéssi, che tacéssi, che tacésse; che tacéssimo, che tacéste, che tacéssero.

After this example conjugate *retacére*, to be silent again.

16. The irregular verb *tenére*, to hold, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Tenére, *to hold.—Pres. Gerund.* Tenéndo, *holding.—Past Part.* Tenúto, *held.——Compound Tenses.—Past.* Avére tenúto, *to have held.—Past Gerund.* Avéndo tenúto, *having held.*

IND. *Pres.* Téngo, tiéni, tiéne; teniámo, tenéte, téngono.—*Imp.* Tenéva *or* tenéa; tenévi; tenéva, tenéa *or* tenía. Tenevámo; teneváte; tenévano *or* tenéano.—*Ind. Pret.* Ténni, tenésti, ténne; tenémmo, tenéste, ténnero.—*Fut.*—Terrò, terrài, terrà; terrémo, terréte, terránno.—*Cond. Pres.* Terréi *or* terría, terrésti, terrébbe *or* terría; terrémmo, terréste, terrébbero *or* terríano.

IMP. Tiéni, ténga; teniámo, teniáte, téngano.

SUB. *Pres.* Che ténga, che ténga, che ténga; che teniámo, che teniáte, che téngano.—*Imp.* Che tenéssi, che tenéssi, che tenésse; che tenéssimo, che tenéste, che tenéssero.

After this example conjugate the following irregular verbs:—

Appartenére, *to belong.*	Ottenére, *to obtain.*
Astenérsi, *to abstain.*	Pertenére, *to belong.*
Attenére, *to attain.*	Rattenére, *to stop.*
Contenére, *to refrain.*	Ritenére, *to retain.*
Detenére, *to detain.*	Soprattenére, *to retain.*
Intertenére, *to detain.*	Sostenére, *to support.*
Mantenére, *to maintain.*	Trattenére, *to entertain.*

17. The irregular verb *valére*, to be worth, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Valére, *to be worth.—Pres. Gerund.* Valéndo, *being worth.—Past Part.* Valúto, *been worth.——Compound Tenses.—Past,* Avére, valúto, *to have been worth.—Past Gerund.* Avéndo valúto, *having been worth.*

IND. *Pres.* Váglio *or* válgo, váli, vále *or* val; vagliámo *or* valiámo, valéte, vágliono *or* válgono.—*Imp.* Valéva *or* valéa, valévi, valéva *or* valéa; valevámo, valeváte, valévano *or* valéano.—*Ind. Pret.* Válsi, valésti, válse; valémmo, valéste, válsero.—*Fut.*—Varrò, varrái, varrà; varrémo, varréte, varránno.—*Cond. Pres.* Varréi, varrésti, varrébbe; varrémmo, varréste, varrébbero.

IMP. Váli, váglia *or* válga; vagliámo *or* valiámo, valéte, vágliano *or* válgano.

SUB. *Pres.* Che váglia *or* válga, che váglia *or* válga, che váglia *or* válga; che vagliámo *or* valiámo, che vagliáte *or* valiáte, che vágliano *or* váliano.—*Imp.* Che valéssi, che valéssi, che valésse; che valéssimo, che valéste, che valéssero.

After this example conjugate the following irregular verbs:—

Equivalére, *to be equivalent.*	Prevalérsi, *to take advantage.*
Prevalére, *to prevail.*	Rivalérsi, *to recover.*

VOCABULARY.

Altro, -a, other.
Amíco, a friend.
Anche, also.
Anima, mind.
Astúto, -a, sharp, cunning.
Barbiére, a barber.
Bene, well.
Certo, certain, certainly.
Col tempo, in time.
Con, with.
Contáre, to count, reckon.
Corpo, body.
Crédere, to believe.
Dire, to say.
Diventáre, to become.
Domandáre, to ask, demand.
Dovére, to be obliged (with another verb); ought, must.
Dozzína, a dozen.
Effigiáre, to form, represent.
Fare, to make; *fare effigiáre*, to get or have represented.
Figúra, figure.
Gentiluómo, gentleman.
Gli, to him.
Goffo, a fool, simpleton.
Il quale, who, which.
Incirca, about.
Incontráre, to meet, catch.
Marmo, marble.
Mostráre, to show.
Mútolo, -a, dumb.
Ne, of or from it, or them.
Perchè, why, wherefore (French *pourquoi*), because.
Perfettaménte, perfectly.
Quanto, -a, how much; pl. how many.
Rassomigliánza, resemblance, likeness.
Rassomigliáre, to resemble.
Ricco, rich.
Rispondére, to answer.
Scherzáre, to joke.
Scultóre, a sculptor.
Se, if, whether.
Senza, without.
Sordo, -a, deaf.
Sposáre, to marry.
Strada, street.
Tale, such.
Tempo, time.
Vi, to you, you.
Vicíno, a neighbour.
Volére, to be willing, to wish.
Vossignoria, your lordship, sir.
Vostro, -a, your.

EXERCISE 45.

1. Fù domandáto ad uno, perchè avésse sposáto una sorda? Il quale rispóse: La sposái tale, credéndo che col tempo dovésse anche diventár mútola.

2. Un gentiluómo voléndo scherzáre con un astúto barbiére, suo vicíno, gli disse: Quanti goffi siéte nella vostra strada? Al quale il barbiére rispóse: Ne siámo incírca una dozzína senza contáre vossignoría.

3. Un ricco goffo esséndosi fatto effigiár in marmo, mostrò quella figúra ad nn amíco suo, egli domandò se lo scultóre avéva ben incontráto la rassomigliánza? A cui l' altro rispóse, Perfettaménte certo, perchè vi rassomiglia in ánima e in corpo.

LESSONS IN LOGARITHMS.—I.

DERIVATION OF NAME—USE—NATURE OF POWERS.

1. *Derivation of the Name.*—The word "logarithm" is derived from two Greek words, signifying *number* and *ratio*. The fundamental theory of the system is that a certain fixed number, called a *base*, raised to the proper power, may be made to represent any number required.

2. *Use of the Method.*—By the use of logarithms, the more tedious calculations of arithmetic are simplified, the longer processes of multiplication and division being converted into the shorter and easier processes of addition or subtraction, and a simple method provided for the otherwise difficult operations of involution or evolution.

3. *Nature of Powers.*—If unity be multiplied by any number, the product is called the first power of the number; thus—

$$6 \times 1 = 6, \text{ the first power.}$$

If the first power be mnltiplied by the number, the product is called the second power, or *square;* thus—

$$6 \times 6 = 36, \text{ the second power.}$$

This is also written 6^2, the figure written above the line being called the *index* of the power, because it *indicates* the times which the number has been repeated to form that power.

If the second power be multiplied again by the original nnmber, the product is called the third power, or *cube;* thns—

$$6 \times 6 \times 6 = 6^3 = 216;$$

and so on. Hence the following table will show the powers of the nnmber 6:—

$6 \times 1 = 6^1 = 6$, the 1st power.	$6^3 \times 6 = 6^4 = 1296$, the 4th power.
$6^1 \times 6 = 6^2 = 36$, the 2nd power.	$6^4 \times 6 = 6^5 = 7776$, the 5th power.
$6^2 \times 6 = 6^3 = 216$, the 3rd power.	$6^5 \times 6 = 6^6 = 46656$, the 6th power.

This process is called *involution*. It is obvions that it may be carried to any extent, and that by it is provided an abbreviated method of writing and dealing with large numbers. Thus, for the fifth power of 6, which is 7776, we write 6^5; and if we wish to multiply 7776 by 1296, we do so by means of 6^5 and 6^4, and obtain the result, as we shall presently prove, in the form 6^9.

4. *Nature of Roots.*—We have seen that the products obtained by multiplying a number by itself over and over again are called its powers. The number itself, in its relation to these powers, is called the *root*. Thus, while 36 is the square of 6, 6 is called the *square root* of 36. So, while 216 is the cnbe of 6, 6 is the *cube root* of 216. So, again, 1296 is the fourth power of 6, 6 is the *fourth root* of 1296; and so on to any extent. The process by which the root is obtained from any nnmber is called *evolution*. We may remark that, while involution is possible for any number, evolntion is only possible for those numbers which are themselves *exact powers* of smaller numbers.

5. We have remarked above that, in indicating the power of a number, a small figure is written above the line. Thus, 6^4 indicates that four sixes have been multiplied together to form what is called the fourth power of 6. The same method is employed to indicate evolution, bnt in this case the indices are fractions whose nnmerators are unity, and whose denominators indicate the root which has to be extracted; thus, while

$$6^4 = 1296 = \text{4th power of } 6; \quad 1296^{\frac{1}{4}} = 6 = \text{4th root of } 1296.$$

So again—

$$6^5 = 7776 = \text{5th power of } 6; \quad 7776^{\frac{1}{5}} = 6 = \text{5th root of } 7776.$$

6. We add, for the sake of illustration, a table of the powers of the number 3 :—

$3 \times 1 = 3^1 = 3$, the 1st power.	$3^6 \times 3 = 3^7 = 2187$, the 7th power.
$3 \times 3 = 3^2 = 9$, „ 2nd „	$3^7 \times 3 = 3^8 = 6561$, „ 8th „
$3^2 \times 3 = 3^3 = 27$, „ 3rd „	$3^8 \times 3 = 3^9 = 19683$, „ 9th „
$3^3 \times 3 = 3^4 = 81$, „ 4th „	$3^9 \times 3 = 3^{10} = 59049$, „ 10th „
$3^4 \times 3 = 3^5 = 243$, „ 5th „	$3^{10} \times 3 = 3^{11} = 177147$, „ 11th „
$3^5 \times 3 = 3^6 = 729$, „ 6th „	$3^{11} \times 3 = 3^{12} = 531441$, „ 12th „

7. The following is a table of the fractional indices by which the relation of the root 3 to its powers is indicated :—

$531441^{\frac{1}{12}} = 3 =$ 12th root of 531441.	$729^{\frac{1}{6}} = 3 =$ 6th root of 729.
$177147^{\frac{1}{11}} = 3 =$ 11th „ 177147.	$243^{\frac{1}{5}} = 3 =$ 5th „ 243.
$59049^{\frac{1}{10}} = 3 =$ 10th „ 59049.	$81^{\frac{1}{4}} = 3 =$ 4th „ 81.
$19683^{\frac{1}{9}} = 3 =$ 9th „ 19683.	$27^{\frac{1}{3}} = 3 =$ 3rd „ 27.
$6561^{\frac{1}{8}} = 3 =$ 8th „ 6561.	$9^{\frac{1}{2}} = 3 =$ 2nd „ 9.
$2187^{\frac{1}{7}} = 3 =$ 7th „ 2187.	

8. We have pointed out that 6^5 indicates that five sixes have been multiplied together to form the quantities which it represents; and similarly with 6^4. Hence it is obvious that to multiply 6^5 by 6^4 we should have to multiply the product of five sixes by the product of four sixes—obtaining, obviously, the product of nine sixes, or 6^9. Hence a simple rule to multiply two powers of the same number :—*Add their indices.*

9. The same rule applies for fractional indices—that is, for roots; thus—

$$729^{\frac{1}{6}} = 3; \quad 729^{\frac{1}{3}} = 9.$$

$$729^{\frac{1}{3}} \times 729^{\frac{1}{6}} = 9 \times 3; \text{ or } 729^{\frac{1}{3} + \frac{1}{6}} = 729^{\frac{1}{2}} = 27.$$

10. In a similar way, the division of quantities expressed in the form of powers of the same number is accomplished by the subtraction of the less from the greater index. Thus 6^5 indicates five sixes multiplied together; 6^4 the same for four sixes. Hence, if 6^4 be written as a denominator, it is evident that the four sixes of which it is composed will cut out four of those of which 6^5 is composed, and leave in the numerator only 1 (or $5 - 4$); thus—

$$\frac{6^5}{6^4} = \frac{6 \times 6 \times 6 \times 6 \times 6}{6 \times 6 \times 6 \times 6} = 6.$$

Hence the above rule—*To divide one power of a number by another, subtract the lesser from the greater index.*

11. The same rule holds for fractional indices—that is, for roots; thus—

$$729^{\frac{1}{3}} \div 729^{\frac{1}{6}} = 9 \div 3; \text{ or } 729^{\frac{1}{3} - \frac{1}{6}} = 729^{\frac{1}{6}} = 3.$$

12. We have seen that the multiplication or division of powers of a number is effected by the addition or subtraction of their indices. We naturally ask, what is the effect if indices be multiplied together? We shall answer this question most easily by remembering that multiplication is only an abbreviated form of addition. Thus, if we multiply 2 by 4, we do in reality only add together four twos :—

$$4 \times 2 = 2 + 2 + 2 + 2.$$

And so, if we have 6^2 and 6^4, and multiply together their indices, we have in reality done the same as if we had added the indices of 6^2, 6^2, 6^2, 6^2, or of 6^4, 6^4—that is, we have done the same as raise 6^2 to its fourth power, or 6^4 to its second power. Hence it is obvious that when the index of any power is multiplied by any quantity, that power is itself raised to the power of that quantity; thus—

$$6^{2 \times 4} = (6^2)^4 = 36^4; \text{ and } 6^{4 \times 2} = (6^4)^2 = 1296^2.$$

13. We are now in a position to determine the meanings of fractional indices whose numerators are not unity; thus—

$$6^{\frac{4}{3}} = (6^{\frac{1}{3}})^4 = (6^4)^{\frac{1}{3}};$$

that is, the fourth power of the cube root of 6, or the cube root of the fourth power of 6. As an example, take—

$$27^{\frac{2}{3}} = (27^2)^{\frac{1}{3}} = (729)^{\frac{1}{3}} = 9; \text{ or } 27^{\frac{2}{3}} = (27^{\frac{1}{3}})^2 = (3)^2 = 9$$

14. It will be observed that we have made no reference to the index 0. Remembering that any number divided by itself gives unity as a quotient, we have—

$$6^6 \div 6^6 = 6^{6-6} = 6^0 = 1.$$

Hence we arrive at the apparent paradox that any number raised to the zero power is equal to unity—an arithmetical curiosity, which the reader must be content to receive without further explanation.

LESSONS IN MORAL SCIENCE.—I.

RISE OF SCIENCE OF ETHICS—PLATO—ARISTOTLE—LEADING PRINCIPLES OF MORAL SCIENCE—MODERN WRITERS ON ETHICS.

From the very earliest times there have been recognised in every country, both by society at large and by the individual, certain rules of right and wrong. No doubt these have not been the same everywhere; the actions which in one age and in one country have been looked upon with little, if any, disfavour, have been in another age or in another country viewed in a very different light. But yet it is true that, universally, there *has* existed a standard of some sort by which actions have been judged, and that, according to their conformity or non-conformity to this, they are visited with praise or blame. Now, what is the true nature of this rule? whence are men led to seek after it and to judge actions by it? what is its origin, and within what limits is it confined? These, and questions like them, are those which the science of Ethics investigates and seeks to determine; and it is in the answers given that the different ethical systems differ from each other.

Although of ancient origin, Ethics did not engage the attention of mankind at as early a period in the history of the world as many other sciences of less real importance. The phenomena of external nature, and the sciences which aim at turning them to practical account, naturally engaged the attention of man before he commenced to turn his mind in upon itself and examine the laws by which he thinks, or in conformity to which he acts. Still, Ethical Science was cultivated very largely in ancient times. Many of the Greek philosophers not only wrote much, but thought deeply, upon the subject; and the germs of many, if not of all, the most elaborate modern systems of Ethics may be found in Plato, the earliest moral philosopher whose writings have come down to us; though he quotes many predecessors of whom nothing has survived except their names.

Aristotle, who came next, seems, indeed, to have differed with Plato more in words than in reality; and, after him, the progress of ethical philosophy was considerably advanced in the disputes between the rival schools of the Stoics and Epicureans.

The Romans borrowed their notions of moral philosophy, as they did so much else, from the Greeks; but contributed little, if anything, themselves to the most important principles of the science.

For nearly two thousand years after the close of ancient philosophy, the history of Ethics presents a blank, until the time of the schoolmen, who, directly or indirectly, first revived in modern times many of the most important questions in morals; although they hardly treated at all, or left entirely out of view, many of its most essential features. It is, however, from the writings of Hobbes, in the early part of the seventeenth century, that the commencement of modern Ethics must be dated; and from that period downwards there has been a continuous succession of ethical writers, comprising Cudworth, Malebranche, Butler, Hume, Smith, Hartley, Bentham, Mackintosh, and a multitude of others, some of whom we may subsequently have occasion to refer to more particularly.

In order to obtain a general conception of the leading principles of Ethical or Moral Science, we may consider it as involving two great questions :—Firstly, "What is virtue?" Secondly, "What is it in our minds which recommends virtue to us for our adoption?"

If we thoroughly understand the meaning of these two questions, and the different answers which have been from time to time given to them by different systems, we shall have become acquainted with the chief features of Ethical Science. Before, however, we proceed to consider these questions in detail, it is well that we should see how far the various principles of our nature can be classified.

The Epicurean theory, which was, perhaps, the oldest of all, admitted only one principle of human nature, into which every other was capable of being ultimately resolved. In the system of Epicurus our sole principles of action were the *appetites*, which had their origin in the body, and the means of gratifying which were furnished by the senses; and the sole object of man's existence was to gratify these sensual appetites. Such a theory as this is contradicted by the simple but obvious fact that men do *not* gratify such appetites only: for instance, they are often influenced by ambition and compassion. True, the Epicurean tried to account for ambition, by saying that our love for the approbation of others only exists in so far as it enables us to gratify our sensual appetites; and for compassion by saying, that it merely springs from our knowledge that, if we do not assist others, they will not assist us. But although this theory has the merit of simplicity to recommend it, it fails to account for all the appearances presented by men's actions. If we take the case of ambition, or regard for the esteem of others, many (Lucretia, for instance), in order to preserve the good opinion of their fellows, have even sacrificed their lives, by which they *knowingly* destroyed all future means of gratifying their sensual appetites. Or let us take the pleasure men feel in doing good to, or relieving the misery of, others; no doubt men may and often do act in this way from a love of fame, or a love of power; but then it is equally true that they often, perhaps oftener, do not act from such motives at all, *i.e.*, they are influenced, not by their appetites, but by what are called their *affections*. Nor can the Epicurean theory account for such phenomena as men's pursuing knowledge for its own sake without any consideration of the use it can be put to, but merely because they like to do so, because it ignores the existence of the *desires*, and recognises no pleasures except those of the body.

Hence, from observation of the differences existing amongst the various principles of our nature, we may divide them into three classes:—1, Appetites; 2, Desires; 3, Affections.

Our *Appetites* (at least such of them as are natural and not acquired) are common to us with the brutes, the chief of them being hunger and thirst, which were intended for our preservation. Besides such natural appetites, there are others which are acquired, such as that for tobacco or for opium.

The *Desires*, unlike the appetites, have not their origin in the body, and they are also more continuous in their operation. The chief of them are five:—1, The Desire of Power; 2, The Desire of Esteem; 3, The Desire of Knowledge; 4, The Desire of Superiority; and, 5, The Desire of Society.

The *Affections* include all those principles of our nature whose object is the communication of enjoyment or suffering to any of our fellow-creatures. They naturally divide themselves into the benevolent and the malevolent affections; the former including love, patriotism, friendship, benevolence, gratitude, pity, etc.; and the latter, hatred, envy, resentment, jealousy, revenge, etc.

The term *passion* is applied generally to any of these principles of our nature, when they pass beyond their proper limit.

We may now consider the two questions already stated; and, naturally, the first subject of inquiry in reference to the principles which actuate men's conduct is, what is meant by virtue and vice—wherein do they really consist? what is the particular character of the conduct, or act, or temper of mind to which we apply the terms *virtuous* or *vicious* respectively? what is it that we see in one character which excites in us approbation, esteem, and praise, and in another disapprobation, contempt, and blame?

It is possible that, at first sight, to a mind not much accustomed to reflection, it might seem that these questions did not possess much difficulty; or, at all events, that all must agree in the answers to be given. The matter, however, will not appear so simple or easy when it is remembered that the standard by which actions are to be tried has varied at different times in the history of the world; that the acts which at one time or in one country were considered even praiseworthy, have, at another time or in another country, been visited with the severest blame; and that even amongst civilised countries at the present day there is by no means complete unanimity as to the light in which various particular actions are to be esteemed. These considerations have even led some persons to imagine that there is really *no* fixed and determinate standard of moral right and wrong at all; but merely that that is virtuous or vicious which happens to be accounted so in a particular nation at a particular time. But is this really so? Is there no test except praise or blame by which it can be surely decided whether an action is virtuous or not? To these questions, amongst other things, the science of Ethics attempts to give a satisfactory reply.

Assuming, however, for the present that there is in reality a fixed criterion or standard of virtue and vice—that there is a real difference between right and wrong—let us see what are the chief accounts which have been given of the nature of virtue. Partly adopting as a basis the classification of them given by Adam Smith, it may be stated generally that the principal may be reduced to three classes, according as they resolve virtue into propriety, prudence, or disinterested benevolence, which we must consider separately, though it will not be possible to examine them accurately in detail.

By virtue, consisting in *propriety* of conduct, is meant that it consists in the suitableness of the affection from which a man acts to the object by which it is excited. This was the foundation of the Platonic, Aristotelian, and Stoical systems.

The soul, according to Plato, was composed of three faculties or parts, called the *rational*, *irascible* (including, for example, ambition, animosity, emulation, and revenge), and *concupiscent* (*i.e.*, all passions founded in the love of pleasure, and including all the bodily and sensual appetites). Justice, the greatest of all virtues, and which comprehended in it prudence, fortitude, temperance, and the rest, existed when the three parts or faculties of the soul were in a state of balance, and confined themselves each to its proper place, without either interfering with the province of the other. Hence he represented virtue as the *harmony* of the soul, or as a state of perfect health; and compared it to a well-ordered republic, in which the wise laws of the ruler were promptly and cheerfully obeyed by the ruled.

Aristotle regarded each of the virtues as a *mean* lying between two opposite vices, one of which has too much and the other too little of some particular quality—the quality being the being duly and properly affected by some particular class of objects. Thus, courage is the mean between the vices of cowardice on the one hand, and rashness on the other; the former of which consists in being too much, and the latter in being too little, affected by the objects of fear. So frugality lies in a mean between avarice, an excess, and profusion, a defect, in attending to the objects of self-interest.

Zeno, the founder of the great Stoical school, taught that virtue consisted in choosing or rejecting the different objects of choice presented to us, according as they were by nature constituted more or less the objects of choice or rejection for us. Every animal was, at its birth, entrusted to its own care by nature, and was endowed for this purpose with self-love, that it might try to preserve, not only its existence, but also all the different parts of its nature, in their most perfect state. Whatever, therefore, tended to this preservation, was pointed out by nature as an object of choice, and whatever had a contrary tendency was similarly pointed out as an object of rejection. Some, however, of the objects in each class were more the objects of choice or rejection, as the case might be, than others: for example, health was preferable to strength, strength to agility, and reputation to power; and so, also, sickness was more to be rejected than unwieldiness of body, ignominy than poverty, and poverty than the loss of power. And, accordingly, it was in choosing those objects which, out of several presented to us of which we could not obtain all, were most to be chosen; and, in like manner, rejecting those which were most to be rejected when we could not reject all, that virtue consisted.

Several modern writers on Ethics have also regarded virtue as ultimately resolvable into propriety of conduct. Clarke makes it consist in a conduct conformable to the fitness of things, and Wollaston in a conduct conformable to truth.

The earliest philosopher who made virtue to consist in *prudence* was Epicurus. According to him, bodily pleasure and pain are the *sole* ultimate objects of desire and aversion; and anything else is desired or shunned only from its tendency to procure us such pleasure or save us from such pain. "All other virtues," he said, "grow from prudence, which teaches that we cannot live pleasurably without living justly and virtuously, nor live justly and virtuously without living pleasurably." And although he regarded the pleasures and pains of the mind as infinitely greater than those of the body, yet, according to his view, the former were always ultimately resolvable into the latter; *i.e.*, the pleasures and pains of the mind were derived from the recollection and anticipation of those of the body. None of the virtues were, in this system, to be pursued upon their own account, but only because they tended to secure the greatest happiness which man can enjoy. In this respect Epicurus was wrong, though he was clearly right in his statement that a virtuous course of conduct is necessary to happiness.

Hutcheson and others (such as Cudworth and More) have made virtue to consist in *benevolence*, or love; which, as it was according to them the *sole* principle of action with the Deity, so it was the only *praiseworthy* motive to action with man. "In directing all our actions," to quote Adam Smith, "to promote the greatest possible good, in submitting all inferior affections to the desire of the general happiness of mankind, in regarding one's-self but as one of the many, whose prosperity was to be pursued no further than it was consistent with, or conducive to, that of the whole, consisted the perfection of virtue." But one circumstance alone (mentioned by Dugald Stewart) is almost decisive against this theory—it fails to account for such virtues as those of gratitude, veracity, and justice. These virtues all depend, in a greater or less degree, upon the *relations* subsisting between the agent and some one else, which could not be considered to make any difference in the action if its merit depended solely upon the amount of good or benefit to some one else intended by the person who performed it.

But omitting, for the present, any further consideration of the nature of virtue, there remains, as already stated, the question, how is it that we come to approve of virtue and disapprove of vice; in other words, the question of the theory of morals, or the existence and origin of a moral faculty which approves some actions and disapproves others.

That there *is* such a faculty in our nature, few schools of philosophers have been found to deny; and those who have done so have failed in the arguments by which they have attempted to maintain their theory. The assertion that we are not so constituted as to approve of the class of actions called virtuous, and to disapprove of the opposite class, and that habit would, after a while, induce us just as readily to praise the latter and blame the former, is repugnant to the evidence which every thinking man finds, upon reflection, in his own mind. It is quite true that a long course of vice may so harden a man as that he may find greater pleasure in a vicious than a virtuous course of conduct; but yet there is, for all that, a feeling in his mind which, however he may refuse to listen to it, condemns him for so doing. We cannot do better than quote Bishop Butler's summary upon this matter, in his "Dissertation on the Nature of Virtue." "We have," he says, "a capacity of reflecting upon actions and characters, and making them an object to our thought; and on doing this, we naturally and unavoidably approve some actions, under the peculiar view of their being virtuous and of good desert; and disapprove others, as vicious and of ill desert. That we have this moral approving and disapproving faculty is certain, from our experiencing it in ourselves, and recognising it in each other. It appears from our exercising it unavoidably in the approbation and disapprobation even of feigned characters, from the words right and wrong, odious and amiable, base and worthy, with many others of like signification in all languages applied to actions and characters; from the many written systems of morals which suppose it; . . . from our natural sense of gratitude, which implies a distinction between merely being the instrument of good, and intending it; from the like distinction every one makes between injury and mere harm, which Hobbes says is peculiar to mankind, and between injury and just punishment, a distinction plainly natural, prior to the consideration of human laws."

The *existence*, however, of such a faculty naturally leads to another question with which it sometimes is confused, that of its *origin;* and those who are quite agreed that it exists as a constituent element of our present nature, may differ widely as to how it came to be so. According to some, our perception of right and wrong is to be referred to a peculiar principle of our mind, which perceives these qualities in a manner similar to that in which our senses perceive the qualities of external things; and so they have given it the name of the "moral sense." Others hold that the distinction between right and wrong is perceived by the same intellectual faculty which discovers truth in the mathematical and kindred sciences, *i.e.*, the reason; while others, again, have attempted to resolve our moral faculty into some other more general or simpler notion of our nature, such as the "association of ideas."

Let us now suppose that we are witnesses of the doing of a good or bad action (*e.g.*, of gratitude or cruelty), and let us try to analyse the feelings to which it gives rise in our minds.

First of all, then, we are conscious that the action is right or wrong, as the case may be; *i.e.*, we feel that it conforms to or violates some rule already existing in our minds by which we are accustomed, without any effort, to judge actions, and by reference to which we pronounce them virtuous or vicious. The mode in which this rule or standard comes to be in our mind we are not at the moment conscious of; all we feel is that it is there; it requires further reflection to ascertain its origin.

This origin, according to Cudworth, is to be found in the reason; in which he was opposed to Hobbes, who, holding that all human knowledge consisted in what was perceivable by the senses, maintained that right and wrong were unreal, as they could not be so perceived. Cudworth considered that the distinction between right and wrong, so far from being a mere chimera, was perceived by the same faculty of the mind which perceived the distinction between a triangle and a square, or between truth and falsehood. Hence, to quote Adam Smith, "it became the popular doctrine, that the essence of virtue and vice did not consist in the conformity or disagreement of human actions with the law of a superior, but in their conformity or disagreement with reason, which was thus considered as the source and principle of approbation and disapprobation." And this system, which made it an absolute contradiction in terms to state that any power could change the eternal and immutable distinctions between right and wrong, was considered to have established morality upon a solid and unchangeable basis. In this Cudworth was followed by Clarke, one of whose school even went the length of asserting that "morality is the practice of reason."

Hutcheson, however, referred the distinction between right and wrong to a peculiar power of perception originally implanted in our nature, to which he gave the name of the "moral sense," which has been continued as a philosophical term ever since. Understanding by *sense* a capacity of receiving ideas, together with pleasures and pains, from a particular class of objects, he said that "all the ideas or the materials of our reasoning or judging are received by some immediate powers of perception, internal or external, which we may call senses. Reasoning or intellect seems to raise no new species of ideas, but to discover or discern the relations of those received." And moral ideas were nothing more than a distinct class of these.

Now our senses, it is admitted, do not inform us of realities in the external objects perceived through their means; but merely signify a power or capacity in the object to affect us in a certain manner, to produce a certain effect on our minds. What is really meant by the expression "The fire feels hot" is *not* that our senses inform us of heat as something really existing in the fire, *but* only that there are certain effects produced on our senses by the fire at the particular time, which we have agreed to call by the name "heat." This is the almost universally received doctrine in modern times. Once, therefore, it was laid down that right and wrong are perceived in exactly the same manner as the heat of the fire (to adopt the common but unphilosophical mode of expression), it was easy to say, that one did not signify a reality any more than the other, that each arose from an arbitrary relation between our constitution and particular objects of sense, and that right and wrong were nothing in the acts denominated virtuous or vicious, and consequently could not in any other sense be held eternal or immutable.

We cannot, therefore, adopt the exact meaning which Hutcheson has given to the phrase "moral sense," inasmuch as, whatever name be given to the faculty by which we get moral ideas and perceive the ideas of right and wrong, these ideas must be held to be *simple* ideas arising immediately in our minds upon witnessing or learning the performance of an action, and the words must be held to denote *qualities* in the acts themselves, and not merely feelings produced by them in us. If this be granted, it is of minor importance what name be given to the mental faculty which takes cognisance of them.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER III.—FIRST COMMERCIAL PERIOD—PRIMITIVE LAND TRADE (*continued*).

PHŒNICIA.

PHŒNICIA, the most famous of the commercial nations of the ancient world, took part in overland, river, and maritime trade. Its position in the Levant gave it the command of the Mediterranean. This sea was the scene of its earliest enterprises, and from the countries on its shores were obtained those commodities which it interchanged with the great commercial states of Asia. A graphic account of Phœnicia, in its prosperity, is to be found in Ezekiel xxvii. In the early Hebrew history it was included in the general designation of Canaan, and from its proximity to the Jewish nation the history of the two nations became closely connected.

Phœnicia was not, properly speaking, a kingdom, but a confederation of independent cities, of which Sidon was the head, until Tyre, the "daughter of Sidon," situated twenty miles south of that city, outgrew its parent in importance. The island of Arvad, known also as Aradus, opposite which stood Antaradus, Zarephath or Sarepta (noted for its wine and glass manufactures), Byblus, Arka, and Ptolemais, were amongst the minor civic states. Tyre, Sidon, and Aradus, in conjunction, founded Tripolis, or the triple city. Later, Berytus became an important place, and is still an Oriental emporium under the modern name of Beyrout. These cities were bound together by a community of interests and a common religion: the common worship of Melkarth, the Tyrian Hercules, called Baal in the Scriptures, strengthened still further the union of the three cities. The Phœnicians were engaged in manufactures and trade, and though they defended themselves with skill and courage when attacked, were on the whole a peaceful people. Their colonies were established, not for the sake of extended dominion, but to serve as centres of commerce.

Nebuchadnezzar besieged Sidon, and laid it in ruins, but was unable to subdue Tyre. New Tyre superseded Old Tyre in wealth and importance, but it was compelled to submit to Alexander the Great, after seven months' siege. The villages occupying the sites of the great cities of Sidon and Tyre, under the modern names of Saide and Sur or Tsur, are now petty fishing hamlets. Small villages also indicate the position of most of the other places which have been mentioned.

Phœnicia, a prey to Assyrian, Babylonian, Persian, and Macedonian conquest, still retained in its position and natural resources a vitality which made it an important Roman province, and which lasted until the time of the Crusades. Tyre was one of the last places held by the Christians against the Saracens, and dates its final and utter ruin from this epoch. The site of the ancient city is now mostly covered by the sea. Although the Phœnicians were essentially sailors, yet their inland trade was extensive and valuable. With their neighbours, the Jews, their connection during the reigns of David and Solomon was very intimate. Hiram supplied David with cedars, and sent skilful metal-workers to Jerusalem to aid in building the king's palace, and in the erection of the Temple, during the reign of Solomon.

Jewish hewers of wood joined with those of Sidon in felling the timber of Lebanon. The resources of the two states differed greatly. Phœnicia produced scarcely any grain, but fruits, timber, and metals were abundant. Palestine was in great part a fertile river-plain, producing fine wheat, barley, wine, and oil, as well as balm, honey, and gums, which the Tyrian princes were ready to receive in exchange for timber, gold, dyed cloths, metal-work, ornaments, and other commodities, the produce of their foreign traffic, or of their home industry.

The Jews carried on an extensive inland traffic, as factors or middlemen for the Phœnicians. The conquests of David extended the confines of the Hebrew kingdom to the Syrian desert, and southwards over the land of Edom to the Red Sea, on the shores of which Solomon built the ports of Elath and Ezion-geber. The latter monarch also built Tadmor in the wilderness, or the City of Palm-trees, called by the Greeks Palmyra, as a halting-place for the caravans between Syria and Mesopotamia. The name of this city shows that it owed its foundation to the existence of an oasis. Its ruins still attest its ancient grandeur.

Baalbek, or Baalath, at the foot of Anti-Libanus, was enlarged and fortified by the wise merchant-monarch. The Greeks gave it the name of Heliopolis, the City of the Sun. Its temples, now in ruins, impress travellers with wonder both on account of the massive blocks of stones of which they are built, seemingly beyond human power to move, and of the symbolical figures sculptured upon them. The care of Solomon in founding these ports and cities was not without a purpose. His subjects had as strong a predilection for inland as the Phœnicians had for maritime traffic, and each nation left to the other its special division of labour. Solomon's interest in Baalbek and Palmyra proves that the direct road between Phœnicia and Babylon was in the hands of the Jews. This was the most important caravan route in existence, and it ran entirely through the desert. The Hebrew ports on the Red Sea were open to the Phœnicians, who brought thither the products of India and Arabia, the Jews conveying them overland to Phœnicia.

The overland trade with Egypt was conducted in much the same way. The Jewish people profited as keenly by the idiosyncrasies of the Egyptians, as by those of the Phœnicians. The latter were subjected to so many restrictions in their intercourse with Egypt, that they availed themselves to a great extent of the services of the Hebrews in the conveyance of the flax, fine linen, and embroidery, for which the land of the Nile was celebrated. Solomon also traded with Egypt on his own account, for we read of his importing horses and chariots, which he sold again to the neighbouring princes. Wine and oil, with which Palestine abounded, were not produced in Egypt. The inundations of the Nile, though they deposit a soil unequalled for promoting the growth of grain and gourds, are unfavourable to both the vine and the olive. These Syrian productions were therefore the chief means of repayment at Solomon's command. To these were doubtless added the gems, spices, and balsams brought from India and Arabia, and through the ports of the Red Sea. In the direct trade of the Phœnicians with Egypt, which was confined at first to a part of the city of Thebes, but afterwards extended to a part of Memphis also, the wine of the district of Chalybonitis, around the modern city of Aleppo, was the staple of exchange, together with copper, of which the Egyptians made extensive use in their metal-work.

The great increase of Jewish wealth is narrated in Scripture history. The zenith of Jewish prosperity was reached in the reign of the merchant-king, who "made silver to be in Jerusalem as stones; and cedars made he to be as sycamore-trees, that are in the vale for abundance; and Judah and Israel were many, as the sand which is by the sea-shore for multitude, eating and drinking and making merry." That the cities of Phœnicia were no less wealthy is testified by sacred and profane historians, who refer to Tyre and Sidon as types of wealth.

From the Syrians and Cappadocians the Phœnicians obtained various products, which they bartered at a great profit for the commodities of other countries. The Chalybon wine was of such repute as to banish almost all other kinds from the tables of royalty. Its transport overland was difficult, and added to its costliness. A few jars of it could be exchanged in Egypt for as many loads of corn. From Syria was obtained the fine wool which the Phœnicians wove into choice fabrics and dyed with their famous purple. The celebrated snow-white Nicean horses, regarded in Persia as alone worthy to draw the chariot of majesty, were bred in Cappadocia. Other horses were reared, but none approached this breed in beauty. Mules also were obtained from the same parts, and Circassia and Georgia contributed slaves. Engaged in every form of commercial enterprise, this industrious people trafficked in the productions alike of maritime and of inland trade. The commodities conveyed by caravan consisted of raw materials as well as of industrial products. The cotton, linen, and woollen fabrics were so skilfully dyed that they presented the effect of shot silk. Sidon and Sarepta were noted for the manufacture of glass, which is supposed to have been first made by accident. The discovery was put to no greater use for a long time than that of making beads and trinkets, to be used as cheap objects of barter. In like manner, ornaments, chains of amber and gold, carved ivory, and other artistic work, engaged the skill of the Phœnicians, and appear to have found especial favour in the eyes of the Hebrew women. Some authors trace to this people the first use of coined money. It is probable that the arts of computation and of alphabetic writing spread from Phœnicia to Greece, and thence through the Western world. How Phœnicia learnt these arts is not clear. The fable of Cadmus satisfied ancient inquirers, but modern investigators, who have tried to penetrate further, consider the alphabet of the ancient Phœnicians and Hebrews to have been a simplified development of the hieroglyphic system of Egypt. Whether the adaptation was the work of the practical skill of the Phœnicians or of Moses is a disputed point. More certain is the fact that these characters form the foundation of all the other alphabets of the world—Sanscrit, Zend, Greek, Roman, Arabic, Ethiopian, Armenian, and Slavonian.

CHAPTER IV.—FIRST COMMERCIAL PERIOD (*continued*).

BABYLONIA.

THE alluvial plains of the Euphrates and Tigris lie eastward of Syria. These two rivers unite before they flow into the Persian Gulf, and form the modern Shat-el-Arab, anciently called the Pasitigris. Above their confluence they enclose the plain of Babylonia, of which, strictly speaking, they form the bonndaries. Higher up, the streams converge again to within a few miles of each other, at which point the Median Wall was erected, both as a fortification and defence against the approach of a hostile army and a line of demarcation between Babylonia and Mesopotamia.

Babylonia was almost a rainless region. Yet under a perfect system of irrigation it attained marvellous fertility. It was nearly destitnte of wood, and entirely so of building-stone. Babylon stood upon both banks of the Enphrates. Whole pages of ancient historians are filled with descriptions of its magnitude, and of the opulence of its inhabitants. Huge walls, pierced with a hnndred gates of brass, surrounded the city, through which the Euphrates rolled between embankments of masonry. The palace of the great king, with its terraces or gardens, was acconnted one of the world's wonders. The only towns we know of which existed on these plains besides Babylon were Forsath, now Bassora, and Borsippa, neither of much extent; indeed, the latter seems to have been rather a district of the capital than a neighbonring town.

The vast mud flat was subject to vernal floods, which by a network of canals and reservoirs were rendered serviceable to the country, that they would otherwise have devastated. Remains of these watercourses are still to be seen. Bricks burnt and unburnt, and cemented with bitumen—of which springs are still in activity on the plain—formed the building material of Babylon. Travellers are amazed at the mounds of brick which even now line the rivers for many miles, though the ruins have formed a quarry whence were taken the bricks used in the building of the large towns of Ctesiphon, Seleucia, Kufa, and Almadain. It has been computed that more bricks were used in the walls and towers of Babylon, than in the Great Wall of China, which is 1,200 miles long.

Babylon owed its prosperity principally to the fertility of its soil, which yielded abundant crops of dates and grain. The latter is said to have been mown twice, and then eaten down by cattle before it was allowed to come into ear, in order to check its tendency to run into exuberance of leaf, and even then the return was more than two hundredfold. These plains claim to be the centre from which corn spread, and where it was first used for food. The palm furnished bread, wine, vinegar, honey, sago, an esculent something like the cabbage, food for cattle, fuel, and ropes. The power and riches of Babylon were partly due to other agencies over and above its fertility.

The position of the city, as already stated, placed it in the highway of the primitive land-trade east and west, and on its waters were made the first attempts at river-traffic—attempts which opened up other lines of commerce. Food-produce in abundance, at scarcely any cost of labour, was ready for traders in exchange for Chinese silks, Indian gems and spices, Bactrian gold and gold-dust, and Western silver and wine. At home, textile manufactures of wool, linen, and cotton were carried to great perfection. *Sindones*, as some wonderfully fine and beautifully dyed cotton fabrics were called, were so costly as to be restricted to royal use. Brilliant tapestries, upon which the zoology of India was embroidered, were coveted by princes for the choicest hangings of their palaces and harems, and from these the West received its first notions of Indian natural history. Carpets and coverlets from Babylonian looms were treasures more precious than gold. Borsippa is mentioned as famous for the finest linen and cotton fabrics, but manufactures generally were carried on within the precincts of the capital. The dye-stuffs were the Tyrian purple, obtained from Phœnicia, Indian lac, the precursor of cochineal, and some other tropical products. The production of articles of luxury—minor industries compared with the preceding, but still of great value —also employed the Babylonians. Their tropical climate rendered the nse of cooling perfumed waters universal. They were expert in the art of engraving stones for seals, and they cut the gems of India for signet rings and jewellery. The curious fashion prevailed of carrying a walking-stick of fine wood, elaborately carved with a device of fruit or flowers, and serving, instead of costly jewels, to indicate the rank and means of its owner.

Both the Tigris and the Euphrates were navigated at a very early period. The first boats were rude coracles of light wood covered with skins. Such vessels are sculptured on the Assyrian monuments, and under the name of *keleks* continue to be used on both rivers for the transport of goods. The current of the Euphrates was too strong to allow such frail rafts to ascend against the stream; they were therefore used only in descending the river, and then broken up, asses being laden with the skins on the return journey. By such means the wine and oil of Armenia, and commodities gathered together within a hundred miles of the Mediterranean, reached Babylon, then the market both for the freight and the wooden framework of the vessels. At Thapsacus, a station between Babylon and Aleppo, on the upper course of the Euphrates, merchandise was again transferred to caravans. Wind power was eventually enlisted in the service of trade; the use of sails enabled the traders to enlarge and strengthen their river craft, and to make them less dependent upon the force of currents, so that they were able to navigate the rivers both up and down. Like the Egyptians, they feared the sea, and left it entirely to the daring and skill of the Phœnicians. The ports in the Persian Gulf, Gerrha, half-way up the gulf on the Arabian coast, Tylos and Arados, were all founded by Phœnician colonists. The natural resources of these cities were few. At Tylos, one of the Bahrein islands, superior cotton was cultivated, teak oak was felled, and handsome sticks, streaked and spotted like the skins of the tiger and the leopard, were cut; the pearl bank, not even yet exhansted, produced gems superior to those of Ceylon in hardness and beanty. Muscat, Djulvar, and Ormuz shared in this commerce.

The port of Gerrha opened np a caravan trade across the Arabian desert, and between all these cities and India an active maritime commerce sprang up. Through Bactria came Indian produce, amongst which were large dogs trained for hunting, cotton, silk, and wool, both raw and manufactured. Media and Hyrcania supplied timber of various kinds; Scythia, skins; Egypt, flax, cattle, horses, and mules; and the enterprising Phœnicians sent from the Jewish ports of Elath and Ezion-geber the valuable commodities procured from the shores of the Red Sea; and their own storehouses contributed the wealth of the Western world. The district around the city was called Babylonia; that extending lower down the river Tigris, as far as its mouths, bore the name of Chaldea. The Chaldeans were Aryans; the Babylonians generally, like the Jews, Semitic. The Chaldeans were the ruling caste in the state, its astrologers, seers, and soothsayers, and, for that period of history, their knowledge had an extensive range. Babylon was at first subject to the Assyrian monarchy, but afterwards became independent, conquered Nineveh, the Assyrian capital, and razed it to the ground. The Golden City, the "glory of the Chaldees' excellency," attained its greatest power during the reign of Nebuchadnezzar, who extended the Babylonian empire from the Tigris to Egypt, and from Armenia to the Arabian desert. Profuse wealth led to vicious indulgence on the part of the rulers, and invited aggression. Cyrus laid siege to Babylon, diverted the course of the Euphrates, and entered the city by the bed of the river during a nocturnal feast, B.C. 538. It became the third capital of the Persian kingdom, Susa and Ecbatana being the other two. Babylonian commerce declined under the Persians, who put an end to the maritime traffic, fearing lest an inroad upon their dominions should be the consequence of tho navigation of the Persian Gulf.

Babylon (B.C. 324) opened its gates without opposition to Alexander the Great, who endeavoured to restore its commerce, and to that end improved the navigation of the Tigris and Euphrates. His death in the following year frustrated his intention of making Babylon the capital of his empire.

We have thns briefly sketched the oldest modes of commerce practised amongst nations. We have seen how land-carriage, in its nature an expensive means of transport, became combined with river-traffic, and afterwards with a more extensive maritime commerce, a detailed account of which we shall give in another chapter. The district traversed by caravans extended from Egypt to Bokhara. Conveyance of merchandise in these parts is to this day conducted in a similar manner, though railways are perhaps destined in the end to snpersede caravans altogether.

MINERALOGY.—I.

DEFINITION OF A MINERAL—CHARACTERISTICS AND PECULIARITIES OF MINERALS — COMPARATIVE HARDNESS — SPECIFIC GRAVITY—CRYSTALLISATION.

According to Dana, a mineral is "any substance in nature not organised by vitality, which has a homogeneous structure." That is to say, a mineral is not the product of any process carried on by the agent we call life; neither is a mineral a rock, because a rock is an aggregation of particles, it may be of very different compositions, and therefore cannot be said to have a homogeneous structure. Another definition places a mineral in another light, which describes it to be "an inorganic substance formed in the earth, possessing a definite geometrical shape, and a definite chemical composition." It is evident from this definition that if the geometrical shape of the mineral and its composition be known, the mineral can be distinguished, and its name, if it has been before described, determined; so that the mineralogist must be skilled in two branches of knowledge—crystallography and chemical analysis—before he can be master of his subject. For the processes by which the chemist determines the composition of minerals, works on chemical analysis must be consulted. In this branch we only deal with the results, not with the means by which the results have been obtained. Before, however, we enter upon an outline of Crystallography, it will be but rational to aid the student to determine some of the most common and conspicuous minerals by means of those physical properties which require no other knowledge than how to observe.

Fig. 1.

The physical characteristics of minerals are—(1) of structure; (2) peculiarities depending on light, hardness, gravity, taste, and smell.

As to Structure: the way in which the particles of a mineral are placed together causes the mineral to have sundry characters. It is said to be—

1. *Brittle*, when it easily breaks, and when parts of the mineral separate into powder when an attempt is made to cut it, as many of the ores.

2. *Sectile*, when by means of a knife thin slices will separate from the mass, as *selenite*.

3. *Malleable*, when as native gold will flatten out under the hammer.

4. *Flexible*, when the mineral will bend and remain in that position, as *asbestos*, and many of the fibrous minerals.

5. *Elastic*, when the mineral returns to its original shape after having been bent, as *mica*.

Fracture depends on the state of the aggregation of the particles, and is described as—

1. *Conchoidal*, when the surface of the fracture is rendered uneven by concave depressions and convexities. This fracture is well exhibited if a lump of flint be split.

2. *Even*, when the surface is flat or nearly so.

3. *Uneven*, when it is broken.

4. *Hackly*, when the surface is very rough with sharp edges; a broken piece of zinc or of cast-iron illustrates this fracture.

Some minerals are *fibrous*, as asbestos. Some are *crystalline*, as certain marbles which possess a glistening surface like loaf sugar.

Besides these, there are other terms used to express what the words evidently indicate.

A mineral can only affect the *taste* which is soluble in the saliva.

1. *Saline* expresses the taste of common salt.

2. *Alkaline*, that of soda.

3. *Astringent*, that of alum.

There are but few which are capable of emitting any odour. *Serpentine* and some other kindred minerals give off an *argillaceous* odour when breathed upon; that is, they smell like clay; but, generally speaking, minerals are inodorous, except when so heated as to give off vapours. Under such treatment many of the *arsenic* ores produce a smell of garlic; *selenium* gives off the fumes of horseradish, and sulphur the distinctive odour of sulphurous acid gas.

Dependent upon *light* are five characters of minerals, viz., *colour*, *lustre*, *diaphaneity*, *refraction*, and *fluorescence*.

Colour is either *metallic* or *non-metallic*. Metallic lustre is that peculiar lustre which distinguishes the metals; however, it does not belong exclusively to the class; for graphite, which is carbon, and scales of iodine, both possess metallic lustre. Minerals whose colour is non-metallic may be found of every hue, from the black onyx to the colourless diamond.

Iridescence is when the rainbow hues play within the crystal; this is due to cracks which penetrate it, and the rays of light reflected from the two surfaces "interfere."

Opalescence is the pearly reflection which is seen with certain opals, and in the mineral called "cat's-eyes."

Pearly is that silky and often coloured lustre which renders of such value the nacre with which many of the mollusks line their shells. When a grain of sand or some other foreign substance finds its way within the shell, the animal, to allay the irritation, coats the intrusive grain with its beautiful polish. The reason the nacre possesses the *pearly* lustre arises from the fact that the creature deposits the substance in fine layers; the light reflected from their edges is in a condition to "interfere," as in the case of iridescence. That the play of colours is entirely due to this, may readily be proved by pressing against the mother-of-pearl a piece of white wax, and it will be found that the wax now exhibits the colours. But pearly is generally applied to minerals having the appearance of nacre without the colours; *talc* and *stilbite* are examples.

Fig. 2.

In addition to metallic and pearly lustres, there are—

Vitreous; a lump of broken glass possesses this lustre typically. Many minerals share it; as *quartz*, *calc spar*, etc.

Resinous, as the name implies, is the lustre which distinguishes the yellow resins, and is shared by *zinc-blende*, *opal*, etc.

Silky lustre is the result of a fibrous structure, and is exhibited by fibrous carbonate of lime, fibrous gypsum, and always by minerals which possess a pearly lustre when they become fibrous.

Adamantine is the lustre exhibited by the diamond, and other highly-refractive gems.

The *degrees of lustre* are five:—

1. *Splendent*, when the reflection is so good as to give the images of objects; as is the case in Elba iron ore, in some specimens of galena, and pyrites.

2. *Shining*, when there is an image, but not one well defined; as calc spar, celestine.

3. *Glistening*, when there is a general reflection from all points of the surface; talc, copper pyrites, etc., are examples.

4. *Glimmering*, when the reflection from the surface is imperfect, and only takes place from certain points, as is the case in flint and chalcedony.

5. *Dull* expresses a total absence of lustre.

The property which all bodies possess in a more or less degree, of allowing light to pass through them, is termed *diaphaneity*.

The most opaque bodies, if in sufficiently thin laminæ, will permit light to traverse them, as gold-leaf and silver-leaf.

There are five degrees of diaphaneity:—

1. *Transparent*, when objects can be distinctly seen through the mineral, as crystals of quartz, carbonate of lime, and selenite.

2. *Semi-transparent*, when the object is seen, but not clearly.

3. *Translucent*, when light passes, but not so as to define objects.

4. *Translucent on the edges*, when light passes through the edges of the mineral, while the thicker parts are opaque.

5. *Opaque*, when no light passes.

In traversing minerals, light does not always obey the ordinary laws of refraction, but in some cases the ray is divided into two. This phenomenon is termed *double refraction*, and is readily exhibited if a piece of clear calc spar be placed over a line; the line will appear double, as represented in Fig. 1. Upon turning the crystal in one position, the lines will overlap each other, and the maximum separation will be found when the crystal is turned 90° from the position in which they overlapped.

If the greatest solid angles at opposite corners of the rhomb of spar were cut off, and the new faces polished, we should find that a ray passing through the crystal in that direction was not divided. This line is called the *optic axis*, or the *axis of double refraction*.

This property belongs to all crystals having unequal axes of symmetry (this and other terms now necessarily used will be understood when the next lesson is reached), and as there is one system in which the axes are all equal, crystals of that system do not possess the property of double refraction. There are crystals, however, which have *two* optic axes, that is, which have two directions in which the ray is not divided, and these belong to the three systems which have their lateral axes unequal; so that, concisely—

1. The *Tessular* (I.) system has no double refraction.
2. The *Dimetric* (II.) and *Hexagonal* (VI.) systems have one optic axis.
3. The *Trimetric* (III.), the *Monoclinic* (IV.), and *Triclinic* (V.) have *two* optic axes.

The relative *hardness* of minerals is most useful in determining them. Kirwan was the first to arrange the table or scale of hardness now universally adopted, which is known by the name of *Moh's scale;* for that mineralogist gave the idea most publicity.

1.	= the hardness of talc.	6.	= the hardness of felspar.
2.	„ „ „ rocksalt.	7.	„ „ „ quartz.
3.	„ „ „ calc spar.	8.	„ „ „ topaz.
4.	„ „ „ fluor spar.	9.	„ „ „ sapphire.
5.	„ „ „ apatite.	10.	„ „ „ diamond.

That mineral which will scratch another is the harder of the two, so that by trying a mineral with the minerals named on the list, its relative hardness may at once be determined, and at least it may be pronounced what it is not. A good way to try the hardness of two minerals is to draw a file across them, and the way in which each is affected by the file will at once indicate their relative hardnesses.

Fluorescence is a property possessed by a few minerals of retaining the light of the sun for a short time after they have been in a dark place. Fluor spar possesses this quality.

The *specific gravity* is another means of discriminating a mineral specimen. The specific gravity is *the relative weight which a mineral bears to an equal volume of distilled water at 60° Fahr.*

It is easily obtained by attaching the mineral to one scale of a balance by a hair, and then weighing it as it is immersed in a glass of water beneath the scale. Subtract this weight from the ordinary weight of the mineral to find the weight of the water displaced, that is, of a volume of water equal to that of the mineral, and the ordinary weight of the mineral divided by this will be its specific gravity.

There is a second method, which is applicable to porous minerals and those which can only be obtained in powder.

A light glass bottle, capable of containing 1,000 grs. of water, is filled up to the mark on its neck with distilled water at 60° Fahr.; a few drops are poured out, and sufficient of the mineral is now added to make the water again reach the mark. The bottle is now weighed. The difference between this weight and 1,000 grs. divided by the weight of the water poured out, gives the required specific gravity.

Mineral tallow or *hatchetine* is the lightest of the known minerals, its specific gravity being 0·6078, whilst the *ore of iridium*, whose specific gravity is 19·5, is the heaviest.

CRYSTALLISATION.

When from any cause a mineral has been deprived of its cohesion and its particles caused to separate, if the particles are permitted to associate themselves again to form the solid, in such a way that they can follow their own inclinations, the solid will give indications of being constructed according to certain laws. That is, the force of cohesion does not act equally in every direction, but in the great majority of instances sets itself to construct regular geometrical solids, called crystals.

The student can readily assure himself of the fact, by taking any ordinary salt, common salt, or saltpetre, or alum, and adding it to boiling water until the water will dissolve no more; suspend in the water a bunch of threads, and allow the solution to stand all night; in the morning the string will be found covered with crystals. The common salt will be in cubes, the alum in four-sided pyramids placed base to base. The larger the quantity of solution and the more slowly it cools, the larger will be the crystals; muddy solutions also increase their size. The presence of a substance which does not crystallise with the salt, may modify the shape of the crystals; thus, if in the solution of common salt urea be present, the crystals will no longer be cubes, but, like those of alum, octohedra.

Many are the peculiarities of crystallisation. We might almost say that crystals in their formation exhibited signs of instinct. If a damaged crystal be suspended in a saturated solution of the salt which composes it, the salt out of the solution will begin to repair the damage, so that in a little time the general contour of the crystal will be restored. If in a solution there be small and great crystals, and the solution by an alteration of temperature be made alternately saturated and non-saturated, it will be found that the small crystals entirely become dissolved, while the large crystals grow. Crystals may also be got from a vapour condensing—sulphur, arsenic, iodine, offer examples of this—or from a liquid cooling. If, for instance, 8 or 10 lbs. of sulphur or bismuth be melted and allowed to cool, if when a crust has been formed it is removed, and the yet liquid substance be poured out, the cavity will be found lined with crystals; and often when a metal has been molten, and in its cooled state exhibits no signs of crystallisation, yet the existence of the phenomenon may be shown, if a weak solvent be applied to remove those particles which mask the formation. If a sheet of tin, while hot, be washed over with a weak solution of hydrochloric acid, the crystals which make the tin *moirée métallique*, and which previously existed, will appear. A bar of nickel, placed in dilute nitric acid, becomes covered with tetrahedra, because the acid dissolves the intervening uncrystallised metal. But, perhaps, the tendency of particles to arrange themselves in some order of polarity is most strikingly illustrated in solids which are constantly submitted to processes which move their particles. For example, the axle, or tire of the wheel of a railway carriage, by constant vibration, gives the particles of which it is composed the opportunity of taking positions according to the polarity of their kind. Of this opportunity they take advantage, and the consequence is that many axles, when broken after years of service, exhibit throughout their mass crystals of iron.

A very slight acquaintance with crystals will assure the observer that those of the same mineral have a close relationship, whenever, that is, the same forms are studied. This will be illustrated by a glance at the snow crystals represented in Fig. 2.

Although a great diversity is apparent, yet all the *angles* are equal, being those of an equilateral triangle, 60°; and it is the angles which are the constants in Mineralogy—they never vary; but the faces of the same form are always equally inclined. To measure the angles an instrument called a *goniometer* is used.

LESSONS IN SPANISH.—XV.

IRREGULAR VERBS OF THE SECOND CONJUGATION (*continued*).

19. The irregular verb *valer*, to be worth, is thus conjugated:—

INF. *Past Participle.* Valido.—*Gerund.* Valiendo.

IND. *Present.* Valgo (*no other Persons irregular*).—*First Future.* Valdré, valdrás, valdra; valdremos, valdreis, valdrán.

IMP. Valga, ——, valga; valgamos, ——, valgan.

SUB. *Present.* Valga, valgas, valga; valgamos, valgáis, valgan.—*Imperfect.* Valdría, valdrias, valdría; valdríamos, valdríais, valdrían.

20. The irregular verb *ver*, to see, is thus conjugated:—

INF. *Past Participle.* Visto.—*Gerund.* Viendo.

IND. *Present.* Veo (*no other Persons irregular*).—*Imperfect.* Veía or via, veías or vias, veía or via; veíamos or viamos, veíais or viais, veían or vian.

IMP. Vea, ——, vea; veamos, ——, vean.
SUB. *Present.* Vea, veas, vea; veamos, veáis, vean.

IRREGULAR VERBS OF THE THIRD CONJUGATION.

21. The irregular verb *adquirir*, to acquire, is thus conjugated :—
INF. *Past Participle.* Adquirido.—*Gerund.* Adquiriendo.
IND. *Present.* Adquiero, adquieres, adquiere; ——, ——, adquieren.
IMP. Adquiera, adquiere, adquiera; ——, ——, adquieran.
SUB. *Present.* Adquiera, adquieras, adquiera; ——, ——, adquieran.

22. The irregular verb *asir*, to seize, is thus conjugated :—
INF. *Past Participle.* Asido.—*Gerund.* Asiendo.
IND. *Present.* Asgo (*no other Persons irregular*).
IMP. Asga, ——, asga; asgamos, ——, asgan.
SUB. *Present.* Asga, asgas, asga; asgamos, asgáis, asgan.
The verb is but little used in those persons of tenses that are irregular.

23. The irregular verb *bendecir*, to bless, is thus conjugated :—
INF. *Past Participle.* Bendecido.—*Gerund.* Bendeciendo.
IND. *Present.* Bendigo, bendices, bendice; ——, ——, bendicen.—*Perfect Definite.* Bendije, bendijiste, bendijo; bendijimos, bendijísteis, bendijeron.
IMP. Bendiga, bendice, bendiga; bendigamos, ——, bendigan.
SUB. *Present.* Bendiga, bendigas, bendiga; bendigamos, bendigáis, bendigan.—*Imperfect.* Bendijera *or* bendijese, bendijeras *or* bendijeses, bendijera *or* bendijese; bendijéramos *or* bendijésemos, bendijérais *or* bendijéseis, bendijeran *or* bendijesen.—*First Future.* Bendijere, bendijeres, bendijero; bendijéremos, bendijérais, bendijeren.

Maldecir, to curse, is irregular in the same persons and tenses as *bendecir*.

24. The irregular verb *decir*, to say, is thus conjugated :—
INF. *Past Participle.* Dicho.—*Gerund.* Diciendo.
IND. *Present.* Digo, dices, dice; ——, ——, dicen.—*Perfect Definite.* Dijo, dijiste, dijo; dijimos, dijísteis, dijeron.—*First Future.* Diré, dirás, dirá; diremos, diréis, dirán.
IMP. Diga, di, diga; digamos, ——, digan.
SUB. *Present.* Diga, digas, diga; digamos, digáis, digan.—*Imperfect.* Dijera, diría, *or* dijese; dijeras, dirías, *or* dijeses; dijera, diría, *or* dijese. Dijéramos, diríamos, *or* dijésemos; dijérais, diríais, *or* dijéseis; dijeran, dirían, *or* dijesen.—*First Future.* Dijere, dijeres, dijere; dijéremos, dijéreis, dijeren.

Contradecir, *desdecir*, and *predecir* end their second person singular of the imperative in *ice*; as, *contradice, desdice, predice.* In other respects they are conjugated like *decir*

25. The irregular verb *dormir*, to sleep, is thus conjugated :—
INF. *Past Participle.* Dormido.—*Gerund.* Durmiendo.
IND. *Present.* Duermo, duermes, duerme; ——, ——, duermen.—*Perfect Definite.* ——, ——, durmió; ——, ——, durmiéron.
IMP. Duerma, duerme, duerma; durmamos, ——, duerman.
SUB. *Present.* Duerma, duermas, duerma; durmamos, durmáis, duerman.—*Imperfect.* Durmiera *or* durmiese, durmieras *or* durmieses, durmiera *or* durmiese; durmiéramos *or* durmiésemos, durmiérais *or* durmiéseis, durmieran *or* durmiesen.—*First Future.* Durmiere, durmieres, durmiere; durmiéremos, durmiéreis, durmieren.

26. The irregular verb *erguir*, to stand erect, is thus conjugated :—
INF. *Past Participle.* Erguido.—*Gerund.* Irguiendo.
IND. *Present.* Hiergo *or* yergo, hiergues, hiergue; ——, ——, hierguen.—*Perfect Definite.* ——, ——, irguió; ——, ——, irguieron.
IMP. Hierga *or* yerga, hiergue, hierga; irgamos, ——, hiergan.
SUB. *Present.* Hierga *or* yerga, hiergas, hierga; irgamos, irgais, hiergan.—*Imperfect.* Irguiera *or* irguiese, irguieras *or* irguieses, irguiera *or* irguiese; irguiéramos *or* irguiésemos, irguiérais *or* irguiéseis, irguieran *or* irguiesen.—*First Future.* Irguiere, irguieres, irguiere; irguiéremos, irguiéreis, irguieren.

27. The irregular verb *incluir*, to include, is thus conjugated :—
INF. *Past Participle.* Incluido.—*Gerund.* Incluyendo.
IND. *Present.* Incluyo, incluyes, incluye; ——, ——, incluyen.
IMP. Incluya, incluye, incluya; incluyamos, ——, incluyan.
SUB. *Present.* Incluya, incluyas, incluya; incluyamos, incluyáis, incluyan.—*Imperfect.* Incluyera *or* incluyese, incluyeras *or* incluyeses, incluyera *or* incluyese; incluyéramos *or* incluyésemos, incluyérais *or* incluyéseis, incluyeran *or* incluyesen.—*First Future.* Incluyere, incluyeres, incluyere; incluyéremos, incluyéreis, incluyeren.

28. The irregular verb *ir*, to go, is thus conjugated :—
INF. *Past Participle.* Ido.—*Gerund.* Yendo.
IND. *Present.* Voy, vas, va; vamos, váis, van.—*Imperfect.* Iba, ibas, iba; íbamos, íbais, iban.—*Perfect Definite.* Fuí, fuiste, fué; fuimos, fuísteis, fueron.
IMP. Vaya, ve, vaya; vamos*, id, vayan.
SUB. *Present.* Vaya, vayas, vaya; váyamos, vayáis, vayan.—*Imperfect.*—Fuera *or* fuese, fueras *or* fueses, fuera *or* fuese; fuéramos *or* fuésemos, fuérais *or* fuéseis, fueran *or* fuesen.—*First Future.* Fuere, fueres, fuere; fuéremos, fuéreis, fueren.

29. The irregular verb *lucir*, to shine, is thus conjugated :—
INF. *Past Participle.* Lucido.—*Gerund.* Luciendo.
IND. *Present.* Luzco (*no other Persons irregular*).
IMP. Luzca, ——, luzca; luzcamos, ——, luzcan.
SUB. *Present.* Luzca, luzcas, luzca; luzcamos, luzcáis, luzcan.

30. The irregular verb *oir*, to hear, is thus conjugated :—
INF. *Past Participle.* Oido.—*Gerund.* Oyendo.
IND. *Present.* Oigo, oyes, oye; ——, ——, oyen.
IMP. Oiga, oye, oiga; oigamos, ——, oigan.
SUB. *Present.* Oiga, oigas, oiga; oigamos, oigais, oigan.—*Imperfect.* Oyera *or* oyese, oyeras *or* oyeses, oyera *or* oyese; oyéramos *or* oyésemos, oyérais *or* oyéseis, oyeran *or* oyesen.—*First Future.* Oyere, oyeres, oyere; oyéremos, oyéreis, oyeren.

31. The irregular verb *prodúcir*, to produce, is thus conjugated :—
INF. *Past Participle.* Producido.—*Gerund.* Produciendo.
IND. *Present.* Produzco (*no other Persons irregular*).—*Perfect Definite.* Produje, produjiste, produjo; produjimos, produjísteis, produjeron.
IMP. Produzca, ——, produzca; produzcamos, ——, produzcan.
SUB. *Present.* Produzca, produzcas, produzca; produzcamos, produzcáis, produzcan.—*Imperfect.* Produjera *or* produjese, produjeras *or* produjeses, produjera *or* produjese; produjéramos *or* produjésemos, produjérais *or* produjéseis, produjeran *or* produjesen.—*First Future.* Produjere, produjeres, produjere; produjéremos, produjéreis, produjeren.

32. The irregular verb *salir*, to go out, is thus conjugated :—
INF. *Past Participle.* Salido.—*Gerund.* Saliendo.
IND. *Present.* Salgo (*no other Persons irregular*).—*First Future.* Saldré, saldrás, saldrá; saldremos, saldréis, saldrán.
IMP. Salga, sal, salga; salgamos, ——, salgan.
SUB. *Present.* Salga, salgas, salga; salgamos, salgais, salgan.—*Imperfect.* Saldría, saldrías, saldria; saldríamos, saldríais, saldrían.

33. The irregular verb *sentir*, to feel, is thus conjugated :—
INF. *Past Participle.* Sentido.—*Gerund.* Sintiendo.
IND. *Present.* Siento, sientes, siente; ——, ——, sienten.—*Perfect Definite.* ——, ——, sintió; ——, ——, sintieron.
IMP. Sienta, siente, sienta; sintamos, ——, sientan.
SUB. *Present.* Sienta, sientas, sienta; sintamos, sintáis, sientan.—*Imperfect.* Sintiera *or* sintiese, sintieras *or* sintieses, sintiera *or* sintiese; sintéramos *or* sintiésemos, sintiérais *or* sintiéseis, sintieran *or* sintiesen.—*First Future.* Sintiere, sintieres, sintiere; sintiéremos, sintiéreis, sintieren.

34. The irregular verb *servir*, to serve, is thus conjugated :—
INF. *Past Participle.* Servido.—*Gerund.* Sirviendo.
IND. *Present.* Sirvo, sirves, sirve; ——, ——, sirven.—*Perfect Definite.* ——, ——, sirvió; ——, ——, sirvieron.
IMP. Sirva, sirve, sirva; sirvamos, ——, sirvan.
SUB. *Present.* Sirva, sirvas, sirva; sirvamos, sirváis, sirvan.—*Imperfect.* Sirviera *or* sirviese, sirvieras *or* servieses, sirviera *or* sirviese; sirviéramos *or* sirviésemos, sirviérais *or* sirviéseis, sirvieran *or* sirviesen.—*First Future.* Sirviere, sirvieres, sirviere; serviéremos, serviéreis, sirvieren.

35. The irregular verb *venir*, to come, is thus conjugated :—
INF. *Past Participle.* Venido.—*Gerund.* Viniendo.
IND. *Present.* Vengo, vienes, viene; ——, ——, vienen.—*Perfect Definite.* Vine, viniste, vino; vinimos, viuísteis, vinieron.—*First Future.* Vendré, vendrás, vendrá; vendremos, vendréis, vendrán.
IMP. Venga, ven, venga; vengamos, ——, vengan.
SUB. *Pres.* Venga, vengas, venga; vengamos, vengáis, vengan.—*Imperfect.* Viniera, vendría, *or* viniese; vinieras, vendrias, *or* vinieses; viniera, vendría, *or* viniese. Viniéramos, vendríamos, *or* viniésemos; viniérais, vendríais, *or* viniéseis; vinieran, vendrían, *or* viniesen.—*First Future.* Viniere, vinieres, viniere; viniéremos, viniéreis, vinieren.

DEFECTIVE VERBS.

Defective verbs are those which are not employed in all the tenses or persons.

1. *Soler*, to be accustomed, is irregular, and seldom used except in the following tenses :—
IND. *Present.* Suelo, sueles, suele; solemos, soleis, suelen.—*Imperfect.* Solia, solias, solia; solíamos, solíais, solían.

2. *Yacer*, to lie, is not often used in any other persons than the third persons singular and plural of the present indicative, chiefly at the beginning of epitaphs :—
IND. *Present.* ——, ——, yace; ——, ——, yacen.

* Sometimes *vayamos*, though this form is now seldom used.

3. *Podrir*, to rot, is seldom used except in the second person plural of the imperative, *podríd;* and the third person singular of the imperfect subjunctive, *podriría*.

When *podrir* is figuratively used in any other moods or tenses, it is to be conjugated irregularly in the same tenses and persons as *servir*, by changing the *o* of the verb-root into *u;* as, *pudriendo*, rotting.

IMPERSONAL VERBS.

Impersonal verbs (or unipersonal verbs) are those which are employed only in the third person singular, and having no subject, take *it* or *there* with them in English; as *llueve*, it rains; *tronará*, it will thunder; *nieve*, let it snow; *hay*, there is, or there are; *habrá*, there will be.

1. *Llover*, to rain, is thus conjugated impersonally:—

INF. *Past Participle.* Llovido.—*Gerund.* Lloviendo.

IND. *Present.* Llueve, *it rains.*—*Imperfect.* Llovía, *it was raining.*—*Perfect Definite.* Llovió, *it rained.*—*First Future.* Lloverá, *it will rain.*

2. *Llueva*, let it rain, is thus conjugated:—

SUB. *Present.* Llueva, *it may rain.*—*Imperfect.* Lloviera, *it would rain;* llovería, *it should rain;* lloviese, *it might rain.*—*First Future.* Si lloviere, *if it should rain.*

All the impersonal verbs are conjugated like some of the verbs whose conjugation has been already given; thus, *llover*, it will be seen, is irregular, and is conjugated like *mover* in the third person singular of each tense.

Haber and *hacer* are often used as impersonal verbs, and are, in such cases, to be rendered in English by the tenses of the verb *to be;* as, *hay*, there is, or there are; *hace*, it is.

3. *Haber*, to be, used impersonally, is thus conjugated:—

INF. *Past Participle.* Habido.—*Gerund.* Habiendo, *there being.*

IND. *Present.* Hay, or ha, *there is*, or *there are.*—*Imperfect.* Había, *there was*, or *there were.*—*Perfect Definite.* Hubo, *there was*, or *there were.*—*First Future.* Habrá, *there will be.*

4. *Haya*, let there be, is thus conjugated:—

SUB. *Present.* Haya, *there may be.*—*Imperfect.* Hubiera, *there would be;* habría, *there should be;* hubiese, *there might be.*—*First Future.* Si hubiere, *if there should be.*

Hay, *habia*, and *hubo* are rendered in English sometimes in the singular and sometimes in the plural, according as a singular or plural noun follows; thus, *hay una muger que tiene calentura*, there is a woman who has a fever; *hay mugeres que no la tienen*, there are women who have it not.

Hacer, when employed impersonally, is to be rendered in English by the verb *to be;* as, *hace*, it is; *hacía*, it was; *hizo*, it was; *hará*, it will be; *haga*, it may be, etc.; thus, *hace frío*, it is cold; *hace mucho aire*, there is much wind; *hace luna*, there is a moon; *hace buen tiempo*, it is good weather; *hace diez meses que ella murió*, it is ten months since she died.

5. *Placer*, to please, is used impersonally in the following tenses only:—

IND. *Present.* Place, *it pleases.*—*Imperfect.* Placia, *it was pleasing.*—*Perfect Indefinite.* Plugo, *it pleased.*

SUB. *Present.* Plegue, *it may please.*—*Imperfect.* Plugiera, *it would please;* plugiese, *it might please.*—*First Future.* Si plugiere, *if it should please.*

The persons of *placer* in the subjunctive are used only in these expressions: *plegue*, *plugiere*, or *plugiese á Díos;* may it, should it, or might it please God; *si me plugiere*, if it should please me.

There are some verbs that can be used in all the persons of the tenses, and also, at times, impersonally; as, *es muy tarde*, it is very late; *es preciso*, it is necessary; *es menester*, there is necessity; *parece*, it seems; *conviene*, it suits; *basta*, it is sufficient.

RECREATIVE SCIENCE.—XVI.

THE OPHTHALMOSCOPE, AND CERTAIN MORBID AND HEALTHY PHENOMENA OF VISION.

Mr. CARTER thus describes Laurence's Reflecting Ophthalmoscope:—"This instrument consists essentially of a piece of plate glass, interposed between the eye of the patient and the source of light. The arrangement will be readily understood by reference to Fig. 1, in which, for our present purpose, B will represent the eye to be examined, F′ the flame, and F the eye of the observer; and the eyes A, A′, and the lens C, may be left wholly out of account. The rays of light from F′ penetrate the plate glass, S, and enter the eye, B, from which they return, either divergent, convergent, or parallel, according to the state of B's refraction. Of these returning rays, the greater part again pass through S, and regain their source; but some portion will be reflected by S to F, and will then become visible to an observer. It is quite conceivable that an observer might, under these circumstances, see an erect virtual image of the depths of the eyeball, for which purpose he would require the aid of a concave lens, if the eye under examination were myopic, for some nearer point than infinite distance. As the apparatus has been hitherto arranged, however, no details of a virtual image have been rendered visible, and nothing has been seen in this way but the red reflex of the interior of the eyeball. It is probable that the loss of light by the transparency of the reflecting surface has been one cause of this imperfect success. By interposing a convex lens between the eye, B, and the plate, S, a much better result may be obtained. The first effect of such a lens is to concentrate the light it receives from the flame, and thus increase the illumination of B's retina. Its next effect is to render the returning rays convergent, and to bring them to union in or near the plane of its principal focus, where they form an inverted image of the parts of B's retina from which they proceed. Diverging from this image, the rays impinge upon the plate, S, and are reflected by it in sufficient quantity to afford to the spectator at F a very fair view of the optic nerve and vessels. These are seen partially inverted—that is to say, upside down, but not displaced laterally. It is, of course, essential that the convex lens and the plate-glass should be separated by a greater interval than the principal focal length of the former; and the more this interval is increased, the larger will be the size of the image and the fainter its illumination. The surfaces of the glass plate must be perfectly parallel and perfectly smooth, as otherwise a separate image will be reflected from each of them, and the two images will confuse one another. There will also be an image reflected backwards from the lens, and visible to a spectator looking over the shoulder of the patient. By modifying the inclination of the plate, S, the position of the point F may be varied, and the reflection may even be thrown into the other eye of the person under examination, so as to convert the apparatus into an autophthalmoscope. By such an arrangement I find it easy to see with either of my eyes the luminosity of the other, but I have not succeeded in observing details. The acuteness of the angles of incidence and reflection is a formidable difficulty in the way of self-examination by such a method. The experimental instrument employed by Mr. Laurence consists of an horizontal stem about a foot long, supported by an upright stand. Two small uprights slide in a groove on the upper surface of the stem, and carry, one a convex lens of 2 inches focal distance, the other a small square of plate glass, both so arranged as to turn upon their vertical axes. The light is furnished by an Argand burner, surrounded by an opaque chimney with a single small opening, and the place of examination is otherwise completely darkened. The patient is placed about 3 feet from the lamp, the convex lens about 2 inches from the cornea, and the glass plate about 4 inches from the lens. The eye, the lens, the plate-glass, and the flame, must all, of course, be perfectly level, and their centres must be the same straight line. I have described the apparatus at some length, because it appears likely, if it can be brought nearer to perfection, to render important aid in the instruction of students. The reflection is visible to more than one observer at once, and may, perhaps, hereafter be rendered visible to a class. At present the matter is entirely in its infancy, and nothing but the principle can be considered as established. This idea was suggested to Mr. Laurence by the celebrated 'Ghost, which is produced in a very similar manner."

It is in the diseased state of the eye that some very curious effects have been described, of which none are more remarkable than those due to "half-vision," "half-blindness," or what is technically called "hemiopsia" or "hemiopia." Many distinguished men have contributed information on this diseased condition of the eye; and it would appear from a paper read before the Royal Society by Dr. Hubert Airy, that Wollaston, Arago, Brewster, and Tyrrell describe one form of the complaint, while Herschel, Wheatstone, Professor Airy, Dr. Hubert Airy, and Dufour give the curious and minute details of another and second form of the same affection. If they were not regarded as precursory of cerebral disease, or as incipient symptoms of apoplexy, such freaks of Nature might be thought amusing; but when the eye witnesses such alarming and abnormal optical effects, it is certainly a warning that should not be disregarded.

Dr. Forbes Winslow, in his important work entitled "Obscure Diseases of the Brain and Mind," mentions, amongst the aberrations of the sense of sight, those of "*seeing objects cut in half, double vision, inversion of objects.*" Dr. Wollaston relates that it twice occurred to him not to be able to see but one side of the axis of vision. The first time the left side of each eye was affected—he saw but half of a man's face or of any object he looked at; and in attempting to read the name JOHNSON over a door, he saw only . . . . SON, the commencement of the name being entirely obliterated from his view. The complaint was of short duration. About nineteen years afterwards, the visual phenomenon recurred—this time the right side of the eye, about three degrees from the centre of the retina, was affected, and its duration was ten minutes. Two analogous cases are also mentioned by Dr. Wollaston.

Desmoulins states that M. Arago has experienced this affection of vision three times: on the first two occasions objects situated to the right of the axis of vision were invisible; the third time he saw objects on the right only of this axis.

The same author notices, also, the following remarkable case:—In consequence of a cerebral fever, the external side of the left retina of M. de M—— became insensible; with his eye he saw objects only situate to the left of the centre of vision, and as at the same time there was an outward deviation of the axis of this eye through a paralysis of the nerve of the third pair, when he employed both eyes he saw objects double; but, what was still more singular, the right eye being closed, he saw with the left eye the objects removed from twenty to twenty-five degrees to the right of their real position. It may be mentioned that Dr. Wollaston, like many other hard workers, died of gradual softening of the brain.

Dr. Hubert Airy's experience of these attacks of "half-vision" dates from 1854. He says the blindness usually comes on while the eyes are engaged in toilsome reading—some word or letter on the page near the sight-point (generally below to the left) is found to be obliterated. This germ of blindness slowly spreads, with zigzag margin, defined by alternate bright and dark lines, with gleams of colour, the margin rapidly trembling and slowly rolling at the same time. These three orders of media—(1) gradual outward growth of the whole, (2) slow rolling of parts, (3) rapid tremor of the margin—are especially characteristic of this affection.

The region of blindness takes a horseshoe shape; the upper arm points to the centre of sight, while the lower spreads downwards and outwards away from the centre. The zigzag pattern is minute near the centre, and grows larger the further it recedes. The gleams of colour most conspicuous at the margin are red and blue, yellow, green, orange, in order of frequency. As the blindness spreads outwards, clear vision returns gradually in the concavity of the horseshoe. The sight of both eyes is affected at once exactly in the same manner and in the same degree, though naturally that eye *seems* most affected which corresponds to the obliterated side of the field of view, because the nasal half of the field of view of either eye is more limited, and vision there is less distinct than on the temporal side. The climax is reached in about twenty-five minutes from the first beginning. The whole duration of the attack is just half an hour. This half-blindness is followed by oppressive headache, lasting many hours.

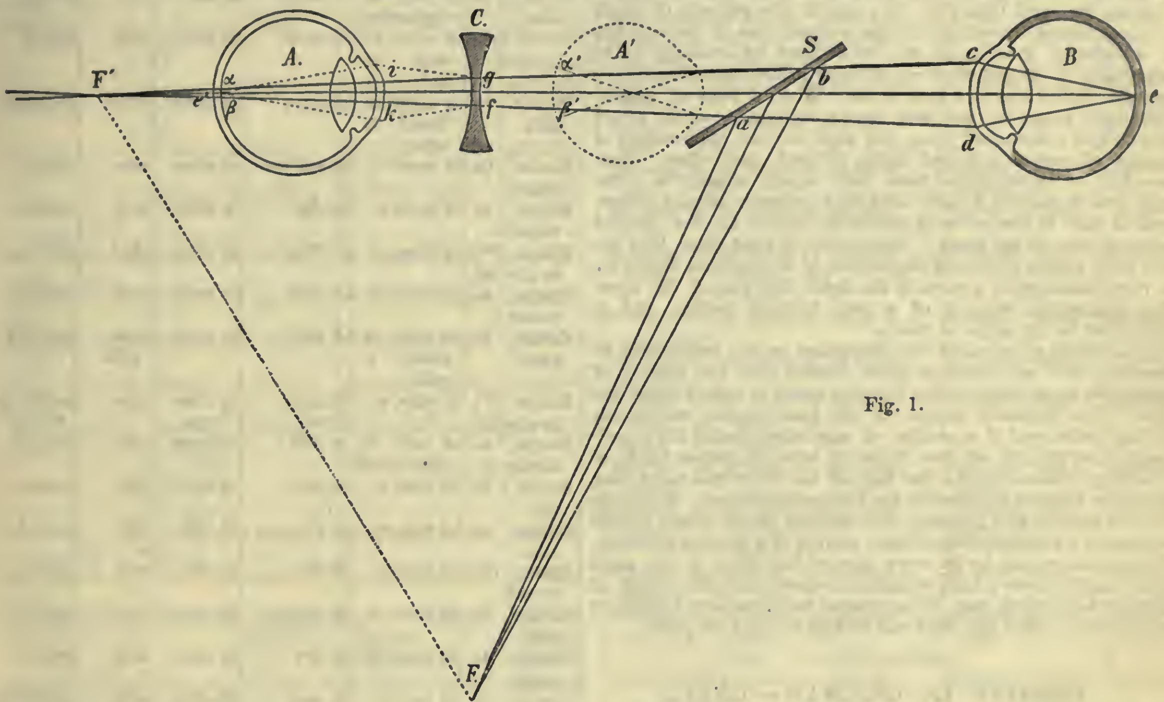

Fig. 1.

Among the circumstances that have seemed to favour an attack may be mentioned sudden change of air and living, over-exercise, and insufficient sleep.

Of this class of the affection, when a cloud creeps over a part or whole of the visual area, may be instanced that of a lady who had complained of being out of health, of slight headache, and partial deafness, and then found in the early part of the evening that her sight was disordered. In attempting to read a book, she remarked that the printed letters and sentences were running one into the other. Subsequently the page appeared as if a piece of finely-glazed paper had been placed over it, through which cloud she was just able to discern the letters. This case, like the next related by Winslow, ended fatally with an attack of apoplexy. A sportsman, out shooting, disputed with his gamekeeper as to the number of dogs they had in the field, and asked how he came to bring so many as *eight* dogs with him. The servant assured him there were but *four*, and then the gentleman became aware of his situation, mounted his horse, and rode home. He had not been long in the house when he was attacked with apoplexy, and died.

A knowledge that such spectral fantasies may disturb the vision ought to be widely spread, as it might induce those who may at any time be suffering from visual aberration to seek medical relief, instead of allowing the disagreeable phenomenon to undermine their mental strength. By the continuance of the torture arising from spectral appearances the balance is destroyed, the mind gives way, and suicide is the sad termination of that which, properly treated, might have been overcome.

Thus the admirable organ of vision, in its healthy state, ministers endless joys to the mind by enabling it to appreciate the varied beauties of nature and art; but when the exquisite mechanism is deranged, the visual power may be impaired, lost, or perverted.

In the healthy state the eye possesses an important property by which any image is retained on the retina for the eighth part of a second; if this were not the case, vision would be represented by a number of distinct and separate pictures, never blending properly one with the other, but presenting, as it were, the results of a series of optical flashes, like a number of distinct electric sparks. The French philosopher, D'Arcet, was the first who discovered that the retina had the power of retaining, for a certain definite period, the images of objects presented before it. Not only is this property of vision of the greatest importance in the ordinary use of the eye, but it contributes greatly to our amusement by enabling us to appreciate a certain class of illusions which have been very popular within the last year or so. When a piece of magnesium wire is set on fire, and then moved in a circle round the face in a darkened room, the most curious appearances of circles of various coloured lights succeed each other. They are first a bluish white, then they rapidly change to primrose yellow, then to a dark red with a primrose edge, a yellow, and at last, if the room is suddenly lighted up, the circular rings appear to be black. The circles of light show that the eye does retain a distinct impression of a luminous object for a very considerable period, if the light, like that of the burning magnesium wire, is of a very brilliant nature, and is held close to the organ of vision.

The circles of coloured light impressed on the retina may be counted, and are found to agree exactly with the number of times the hand carrying the burning metal is moved round the face. The unsteady motion of the hand causes unevenness in the circles, and if a number of spectators watch the experiment, they will all see the circles of light, or rather bands of changing colours, around the face of the experimentalist long after the burning magnesium has been extinguished. If the eye did not possess this property, the burning metal would simply appear as a brilliant spot of light, moving in a circular direction. The metal cannot be in every part of the circle at the same time, but it leaves a train of light impressed upon the retina, an illusory tail, which may, in its various modifications, furnish us with a philosophic tale that will be told in our next paper.

LESSONS IN GERMAN.—LXIV.

§ 78 (*continued*).—(1.) ALPHABETICAL LIST OF VERBS OF THE OLD FORM (*continued*).

INFINITIVE.	INDICATIVE. Present.	INDICATIVE. Imp.	SUBJUNC. Imp.	IMPERAT.	PARTICIP.
Laden, to load	ich lade, du ladest or lädst, er ladet or lädt	ich lud	ich lüde	lade	geladen
Lassen, (31) to let	ich lasse, du lässest, er läßt	ich ließ	ich ließe	lasse or laß	gelassen
Laufen, to run	ich laufe, du läufst, er läuft	ich lief	ich liefe	laufe	gelaufen
Leiden, (32) to suffer	ich leide, ꝛc.	ich litt	ich litte	leide	gelitten
Leihen, to lend	ich leihe, ꝛc.	ich lieh	ich liehe	leihe	geliehen
Lesen, to read	ich lese, du liesest, er liest	ich las	ich läse	lies	gelesen
Liegen, to lie down	ich liege, ꝛc.	ich lag	ich läge	liege	gelegen
Lügen, to lie	ich lüge, ꝛc.	ich log	ich löge	lüge	gelogen

(31) Veranlassen is regular. (32) Verleiden, to disgust, is regular.

INFINITIVE.	INDICATIVE. Present.	INDICATIVE. Imp.	SUBJUNC. Imp.	IMPERAT.	PARTICIP.
Mahlen, (33) to grind	ich mahle, ꝛc.	ich mahlte	ich mahlte	mahle	gemahlen
Meiden, to avoid	ich meide, ꝛc.	ich mied	ich miede	meide	gemieden
Melken, (34) to milk	ich melke, du melkst or milkst, er melkt or milkt	ich molk	ich mölke	melke	gemolken
Messen, to measure	ich messe, du missest, er mißt	ich maß	ich mäße	miß	gemessen
Mißlingen, to go amiss	es mißlingt	es mißlang	es mißlänge	mißlinge	mißlungen
Mögen, to be able	ich mag, du magst, er mag	ich mochte	ich möchte	möge	gemocht
Müssen, to be obliged	ich muß, du mußt, er muß	ich mußte	ich müßte	müsse	gemußt
Nehmen, to take	ich nehme, du nimmst, er nimmt	ich nahm	ich nähme	nimm	genommen
Nennen, to name	ich nenne, ꝛc.	ich nannte	ich nennte	nenne	genannt
Pfeifen, to whistle	ich pfeife, ꝛc.	ich pfiff	ich pfiffe	pfeife	gepfiffen
Pflegen, (35) to cherish	ich pflege, ꝛc	ich pflog	ich pflöge	pflege	gepflogen
Preisen, to praise	ich preise, ꝛc.	ich pries	ich priese	preise	gepriesen
Quellen, to gush	ich quelle, du quillst, er quillt	ich quoll	ich quölle	quelle, quill	gequollen
Rächen, (36) to avenge	ich räche, ꝛc.	ich rächte (roch)	ich rächte (röche)	räche	gerächt (gerochen)
Rathen, to advise	ich rathe, du räthst, er räth	ich rieth	ich riethe	rathe	gerathen
Reiben, to rub	ich reibe, ꝛc.	ich rieb	ich riebe	reibe	gerieben
Reißen, to tear	ich reiße, ꝛc.	ich riß	ich risse	reiße	gerissen
Reiten, (37) to ride	ich reite, ꝛc.	ich ritt	ich ritte	reite	geritten
Rennen, to run	ich renne, ꝛc.	ich rannte	ich rennte	renne	gerannt
Riechen, to smell	ich rieche, ꝛc.	ich roch	ich röche	rieche	gerochen
Ringen, to wrestle	ich ringe, ꝛc.	ich rang	ich ränge	ringe	gerungen
Rinnen, to run (of fluids)	ich rinne, ꝛc.	ich rann	ich ränne (rönne)	rinne	geronnen
Rufen, to call	ich rufe, ꝛc.	ich rief	ich riefe	rufe	gerufen
Salzen, to salt	ich salze, ꝛc.	ich salzte	ich salzte	salze	gesalzen
Saufen, to drink, to tipple	ich saufe, du säufst, er säuft	ich soff	ich söffe	saufe	gesoffen
Saugen, to suck	ich sauge, ꝛc.	ich sog	ich söge	sauge	gesogen
Schaffen, (38) to create	ich schaffe, ꝛc.	ich schuf	ich schüfe	schaffe	geschaffen

(33) Except the past participle gemahlen, no irregular form is in use. (34) Sometimes regular. Milkst, etc., rarely used. (35) When it signifies *to wait upon*, or *to be accustomed*, it is regular. (36) The irregular form is no longer used. Where it occurs in former writers it must not be confounded with the same forms from riechen. (37) Bereiten, to break in (horses), like all the compounds of reiten, is irregular; but bereiten, to make ready, from bereit, ready, is regular, like all derivatives. (38) In the signification of *to procure*, *to get*, it is regular, as also anschaffen, to purchase, to buy; abschaffen, to part with, to dismiss.

INFINITIVE.	INDICATIVE. Present.	INDICATIVE. Imp.	SUBJUNC. Imp.	IMPERAT.	PARTICIP.
Scheiden, to separate	ich scheide, ꝛc.	ich schied	ich schiede	scheide	geschieden
Scheinen, to appear	ich scheine, ꝛc.	ich schien	ich schiene	scheine	geschienen
Schelten, to scold	ich schelte, du schiltst, er schilt	ich schalt (scholt)	ich schälte (schölte)	schilt	gescholten
Scheeren, to shear	ich scheere, ꝛc.	ich schor	ich schöre	scheere, schier	geschoren
Schieben, to shove	ich schiebe, ꝛc.	ich schob	ich schöbe	schiebe	geschoben
Schießen, to shoot	ich schieße, ꝛc.	ich schoß	ich schösse	schieße	geschossen
Schinden, to flay	ich schinde, ꝛc.	ich schund	ich schünde	schinde	geschunden
Schlafen, to sleep	ich schlafe, du schläfst, er schläft	ich schlief	ich schliefe	schlafe	geschlafen
Schlagen,(39) to beat	ich schlage, du schlägst, er schlägt	ich schlug	ich schlüge	schlage	geschlagen
Schleichen, to sneak	ich schleiche, ꝛc.	ich schlich	ich schliche	schleiche	geschlichen
Schleifen,(40) to whet, to sharpen	ich schleife, ꝛc.	ich schliff	ich schliffe	schleife	geschliffen
Schleißen, to slit	ich schleiße, ꝛc.	ich schliß	ich schlisse	schleiße	geschlissen
Schließen, to shut	ich schließe, ꝛc.	ich schloß	ich schlösse	schließe	geschlossen
Schlingen, to sling	ich schlinge, ꝛc.	ich schlang	ich schlänge	schlinge	geschlungen
Schmeißen, to fling	ich schmeiße, ꝛc.	ich schmiß	ich schmisse	schmeiße	geschmissen
Schmelzen, to melt	ich schmelze, du schmilzest or schmelzest, er schmilzt or schmelzt	ich schmolz	ich schmölze	schmilz or schmelze	geschmolzen
Schnauben, to snort	ich schnaube	ich schnob	ich schnöbe	schnaube	geschnoben
Schneiden, to cut	ich schneide, ꝛc.	ich schnitt	ich schnitte	schneide	geschnitten
Schrauben, to screw	ich schraube, ꝛc.	ich schraubte (schrob)	ich schraubte (schröbe)	schraube	geschraubt (geschroben)
Schreiben, to write	ich schreibe, ꝛc.	ich schrieb	ich schriebe	schreibe	geschrieben
Schreien, to cry	ich schreie, ꝛc.	ich schrie	ich schriee	schreie	geschrieen
Schreiten, to stride	ich schreite, ꝛc.	ich schritt	ich schritte	schreite	geschritten
Schroten, to grind roughly	ich schrote, ꝛc.	ich schrotete	ich schrotete	schrote	geschroten, geschrotet
Schwären, to suppurate	ich schwäre, ꝛc.	ich schwor	ich schwöre	schwäre	geschworen
Schweigen, to be silent	ich schweige, ꝛc.	ich schwieg	ich schwiege	schweige	geschwiegen
Schwellen, to swell	ich schwelle, du schwillst, er schwillt	ich schwoll	ich schwölle	schwill or schwelle	geschwollen
Schwimmen, to swim	ich schwimme, ꝛc.	ich schwamm	ich schwämme, schwömme	schwimme	geschwommen
Schwinden, to vanish	ich schwinde, ꝛc.	ich schwand	ich schwände	schwinde	geschwunden
Schwingen, to swing	ich schwinge, ꝛc.	ich schwang	ich schwänge	schwinge	geschwungen
Schwören, to swear	ich schwöre, ꝛc.	ich schwor or schwur	ich schwöre or schwüre	schwöre	geschworen
Sehen, to see	ich sehe, du siehst, er sieht	ich sah	ich sähe	siehe, sieh	gesehen
Sein, to be	ich bin, ꝛc.	ich war, ꝛc.	ich wäre	sei	gewesen
Senden, to send	ich sende, ꝛc.	ich sandte and sendete	ich sendete	sende	gesandt and gesendet
Sieden, to boil	ich siede, ꝛc.	ich sott	ich sötte	siede	gesotten
Singen, to sing	ich singe, ꝛc.	ich sang	ich sänge	singe	gesungen
Sinken, to sink	ich sinke, ꝛc.	ich sank	ich sänke	sinke	gesunken
Sinnen, to think, to muse	ich sinne, ꝛc.	ich sann	ich sänne (sönne)	sinne	gesonnen
Sitzen, to sit	ich sitze, ꝛc.	ich saß	ich säße	sitze	gesessen
Sollen, to be obliged	ich soll, du sollst, er soll	ich sollte	ich sollte	solle	gesollt
Spalten, to split	ich spalte, ꝛc.	ich spaltete	ich spaltete	spalte	gespalten, gespaltet
Speien, to spit	ich speie, ꝛc.	ich spie	ich spiee	speie	gespieen
Spinnen, to spin	ich spinne, ꝛc.	ich spann	ich spänne (spönne)	spinne	gesponnen
Spleißen, to split	ich spleiße, ꝛc.	ich spliß	ich splisse	spleiße	gesplissen
Sprechen, to speak	ich spreche, du sprichst, er spricht	ich sprach	ich spräche	sprich	gesprochen
Sprießen,(41) to sprout	ich sprieße, ꝛc.	ich sproß	ich sprösse	sprieße	gesprossen
Springen, to spring	ich springe, ꝛc.	ich sprang	ich spränge	springe	gesprungen
Stechen, to sting, to prick	ich steche, du stichst, er sticht	ich stach	ich stäche	stich	gestochen
Stehen, to stand	ich stehe, ꝛc.	ich stand, stund	ich stände, stünde	stehe	gestanden
Stehlen, to steal	ich stehle, du stiehlst, er stiehlt	ich stahl	ich stähle, stöhle	stiehl	gestohlen
Steigen, to ascend	ich steige, ꝛc.	ich stieg	ich stiege	steige	gestiegen
Sterben, to die	ich sterbe, du stirbst, er stirbt	ich starb	ich stärbe, stürbe	stirb	gestorben
Stieben,(42) to fly (as dust)	ich stiebe, ꝛc.	ich stob	ich stöbe	stiebe	gestoben
Stinken, to stink	ich stinke, ꝛc.	ich stank	ich stänke	stinke	gestunken
Stoßen, to push	ich stoße, du stößest, er stößt	ich stieß	ich stieße	stoße	gestoßen
Streichen, to stroke	ich streiche, ꝛc.	ich strich	ich striche	streiche	gestrichen
Streiten, to contend	ich streite, ꝛc.	ich stritt	ich stritte	streite	gestritten

KEY TO EXERCISES IN LESSONS IN GERMAN.

EXERCISE 171 (Vol. III., page 278).

1. Sie werden mit Ihrem Bruder Schritt halten, wenn Sie fleißiger sind. 2. Geh Schritt für Schritt, und Du wirst Dein Ziel nicht verfehlen. 3. Von wem haben Sie dieses Geschenk empfangen? 4. Wovon ist es gemacht? 5. Von wem ist es gemacht? 6. Lebt meine Mutter noch? 7. Ja, sie lebt noch; aber mein Vater ist nicht mehr. 8. Wohl ihm, er ist hingegangen, wo keine Sorgen mehr sind. 9. Es weht heute ein sehr rauher Wind, und deßhalb ist es besser, zu Hause zu bleiben. 10. Ich glaube, wir werden Regen bekommen, wenn der Wind sich legt. 11. Gehen

(39) Rathschlagen and berathschlagen, to consult, are regular. (40) Regular in all other significations, as *to demolish* or *to drag*.

(41) This must not be confounded (in the imperfect) with the regular verb sprossen. (42) So Zerstieben, to be scattered as dust.

Sie ja nicht aus, denn die Luft ist sehr schneidend, und ich fürchte, daß Sie sich die Hände erfrieren werden. 12. So lange der Wind im Osten ist, wird es kalt und trocken bleiben. 13. Des langen Haders endlich müde, machte ich Frieden mit meinen Freunden.

EXERCISE 172 (Vol. III., page 326).

1. A patriot would rather die than become a traitor. 2. The first Christians preferred suffering the severest persecutions to forsaking their belief. 3. One does not suffer such a thing to be told him twice. 4. I have not seen one of my brothers for three years. 5. A friend of mine was drowned some years ago in the Danube near Vienna. 6. To travel is good, if one has money; and to live agreeable, if one has no cares. 7. It is better to live in a free country than in a despotic one. 8. It is pleasant to travel in the society of lively friends. 9. In prosperity man but too easily forgets what he is. 10. Many distinguished and noble men have been forgotten. 11. It should not satisfy a man to know what is right, but he ought also to endeavour to do right. 12. It affords me satisfaction to know that you are all still well. 13. How little is often sufficient to make a man happy! 14. He handed him the paper after he had read it himself. 15. This was sufficient to satisfy him. 16. The cook prepares the food. 17. He has produced this little confusion on purpose. 18. The cook tasted the soup before she served it up. 19. We must try if we cannot help him yet. 20. Just taste this wine (to see) if it is sweet enough. 21. He told me to remember him to you.

HEAT.—IV.

CONVERSION OF HEAT INTO FORCE—SPECIFIC HEAT—MODES OF ASCERTAINING—TRANSMISSION OF HEAT—CONDUCTION.

ILLUSTRATIONS of the conversion of heat into motive power, as described in our last lesson, are frequently met with. One of the best of these is afforded by the steam-engine. If we enter any large factory where steam-power is employed, we find different machines at work. In one place, it may be, heavy weights are being raised or moved; in another, large pieces of metal are being turned or cut into shape, or other operations being carried on with apparent ease by the aid of machinery. For all this a considerable amount of force is evidently required, and the question arises, Whence does all this force come? The machines, we know, cannot create it; it is evident, therefore, that the source of it must be sought for in the heat produced by the combustion of the fuel in the furnace.

If the supply of fuel be diminished, and consequently a smaller quantity of heat be produced, less work will be accomplished; and if we could in any way ascertain exactly the amount of heat carried away by the hot air up the chimney, and that lost by radiation and conduction, and dissipated in other ways, we should find that there was still a portion of that produced by the combustion of the fuel left unaccounted for; this balance would be exactly equivalent to the amount of work that had been performed. Allowance must, of course, be made in this calculation for the force required to impart motion to the machinery itself.

A portion of the force thus produced is often re-converted into heat. If we stand by a drilling-machine, or lathe, in which a piece of iron is being shaped, we shall find that the turnings or borings are frequently too hot to be touched with any degree of comfort, although the mass of metal and the tool were both quite cold. The motion of the machinery is here converted into one of the particles of the iron, which manifests itself in the form of heat. In this way we learn that heat, like matter, cannot be destroyed, but only converted into other modes of motion.

In our first lesson we selected as our thermal unit the quantity of heat requisite to raise a pound of water 1° in the Centigrade scale. Now we should at first suppose that the same amount of heat would raise the temperature of a pound of any other substance to the same extent. Experiment, however, the philosopher's grand resort, soon shows us that this is not the case.

Let us provide three sources of heat of equal intensity—or, better still, an oil or water bath, capable of holding three large beaker glasses. Equal weights of water, oil of turpentine, and sulphuric acid should now be put in these, and a thermometer should likewise be placed in each beaker. Now apply a powerful source of heat, such as a Bunsen's gas-burner, and watch the thermometers. The heat applied to each vessel is, of course, the same, but the thermometer in the sulphuric acid will soon be seen to be rising more rapidly than the others, that in the turpentine comes next, while that in the water is lowest of all. If we now further observe the time taken by each to attain any given temperature, as, for instance, 200°, we shall learn that the water takes nearly three times as long as the acid, and more than twice as long as the turpentine.

Now in each minute each must receive the same quantity of heat; it is clear, then, that different amounts of heat are required to raise the same weights of different substances to the same temperature. This fact, which is a very important one, is usually accounted for by saying that different bodies have different *capacities* for heat, or, as it is more commonly expressed, different *specific heats.*

Another experiment, which the student may easily repeat, will render this much more clear. Take a number of balls composed of various substances, such as lead, copper, iron, tin, bismuth, and glass (Fig. 18). Immerse them all for a short time in hot oil of a known temperature, or in some other way bring them all to one temperature, and then place them a little distance apart on a sheet of wax about half an inch thick. The balls will melt the wax at very different rates. If their temperature was high at first, the glass will soon melt through the wax, and fall; the iron and copper likewise sink rapidly, and in a short time they too will pass through it, the iron being a little in advance of the copper. The tin ball comes next, and may just be able to be seen underneath, while the lead and bismuth sink but a little way, and there remain: though they had the same temperature as the rest, the *amount* of heat they possessed was only sufficient to melt a very small portion of the wax.

This experiment suggests to us a mode of ascertaining the specific heat of different bodies, which is frequently adopted. It consists in ascertaining the amount of ice which a given weight of the substance is able to melt after being raised to a high temperature. We know that when water becomes melted, 142° of heat become latent. The thermal unit is, however, always reckoned in the Centigrade scale, instead of in Fahrenheit's, and 142° Fahr. (of heat) is about equal to 79° Cent. We may say, then, that 79 thermal units are required to melt a pound of ice. The substance to be tested is therefore carefully weighed, and raised to a high temperature, which is ascertained and noted. It is then placed in a dry cavity in a lump of ice, covered over by a slab of the same material, and left until it is reduced to the freezing point. The moisture is then carefully absorbed from it and from the cavity by a previously weighed cloth, and thus the exact amount melted is at once shown. From this the specific heat may be calculated, and in this way a table can be drawn up, showing the specific heats of different substances.

Water is always taken as the standard, and the specific heat of other bodies compared with that of an equal weight of this substance. This is partly done as a matter of convenience; it is found, however, that the specific heat of water is greater than that of any other substance. This fact is an important one in the welfare of the globe. The sea, as is well known, always tends to preserve a uniform temperature, so that islands do not suffer from the same extremes of heat or cold as continents do. The reason is that, on account of its great specific heat, a large amount of heat is requisite to produce even a small variation in the temperature of any mass of water, and hence it is very slow in manifesting these changes. In this way the sea serves as a great equaliser of temperature, absorbing a great deal of heat when the temperature is high, and giving it out again as it falls.

As it is often difficult to procure a lump of ice large enough to use in the mode described above, the apparatus represented in Fig. 19 was devised and used by Lavoisier and Laplace in their investigations on specific heat. It consists of three concentric metal vessels fitted with covers, as may be seen more clearly by the sectional view (Fig. 20). The substance, M, to be tested is weighed, and its temperature ascertained; it is then placed in the inner vessel, the spaces between that and the next, and also between the middle and outer vessels, being filled with pounded ice. The outer layer prevents any heat from without reaching the middle vessel, and the water produced from this issues by the tap E. A separate tap, D, carries off the water melted by the heat of M; this is received in a glass, and measured, and shows the amount of heat given off by the substance in cooling. The main drawback to this apparatus arises from the fact that some of the water remains among the interstices of the ice, and therefore the amount received in the glass is somewhat less than that actually melted. If M weigh exactly a pound, and it be raised to the temperature 142° Fahr., the specific heat is at once known by learning what portion of a pound of water is melted. A quarter of a pound in the vessel would indicate a specific heat of 0·25, and so on. When the substance has a different weight, or is raised to a different temperature, allowance must be made by a sum in proportion.

There is another way in which the differences in the specific heats of various substances may be shown and ascertained; this is known as the method of mixtures. If we take a pound of water at 100°, and another pound at 150°, and mix them, the temperature of the mixture will be the mean of the two, or 125°. If, however, instead of the pound of water at 150°, we take a pound of mercury at the same temperature, the temperature of the mixture will only be about 102°, showing how much less heat was contained in the mercury than in the water. The mercury has lost 48°, while the water has only gained 2°, and yet we know that whatever amount of heat the one has lost, the other must have gained. The mode of ascertaining the specific heat of any substance in this way is comparatively simple. Suppose, for instance, we have a piece of copper weighing fifty ounces; it is brought to a temperature of 200°, and maintained at that for a short time, so that every part may be equally heated. It is then immersed in one hundred ounces of water, at a temperature of 60°, and after it has had time to share its heat with the water, which is gently stirred to aid this, the temperature of the whole is found to be $66\frac{1}{2}$. The water here has gained $100\ (66\frac{1}{2} - 60) = 650°$, while the copper has lost $50\ (200 - 66\frac{1}{2}) = 6675°$, and hence its specific heat is $\frac{650}{6675}$, or 0·096. The specific heat of liquids may also be learnt by noting the time they take to cool from a high temperature, as those which gain heat most rapidly lose it likewise most rapidly. The small specific heat of mercury, it being only about $\frac{1}{30}$th that of water, renders it specially suitable for filling thermometers, since it rapidly acquires the temperature of any liquid in which it is immersed, and does so, too, without greatly lowering its temperature. The annexed table gives the specific heats of a few of the more common substances:—

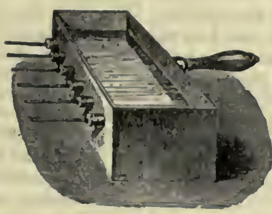

Fig. 21.

Fig. 19.

Fig. 20.

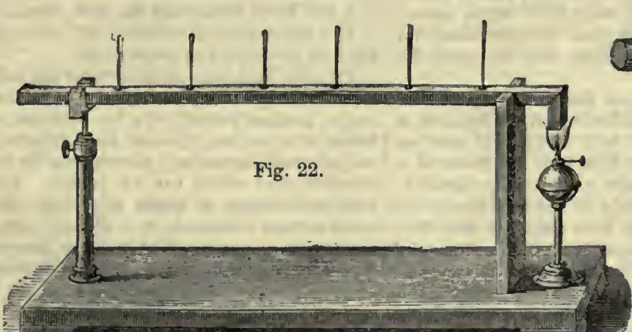

Fig. 22.

Water . . .	1·0000	Sulphur . .	0·2026	Copper . . .	0·0952
Alcohol . .	0·6603	Glass . . .	0·1977	Silver . . .	0·0570
Turpentine .	0·4259	Iron . . .	0·1138	Mercury . .	0·0333
Charcoal . .	0·2411	Zinc . . .	0·0955	Gold . . .	0·0324

Now in this table no relation whatever is visible between the different numbers, but if, instead of taking equal weights, we take the substances in the proportion of their atomic weights, we shall find a simple law. To check this, let us multiply the numbers placed above against the elementary bodies by the atomic weights of those bodies. Sulphur we multiply by 16, iron by 28, zinc by $32\frac{1}{2}$, copper by 32, and so on, and we shall then find that the products so obtained correspond in most cases very closely. As a result of a great number of experiments, it is found that the *specific heat of equivalent weights* of most simple bodies varies between 3 and 3·3. This is usually accounted for by supposing that the molecules of all the elements have the same capacity for heat. In those cases where this does not hold true, the proportion is usually a simple one, as a half, or double. Investigation further shows that in chemical compounds having similar formulæ, the specific heats of equivalent weights are likewise similar, so that evidently some hidden link of connection exists between chemical composition and specific heat.

It now remains for us to inquire into the ways in which heat may be communicated from one body to another, and these may be classed under three different heads—conduction, convection, and radiation. The former of these is most common, and must be spoken of first. If we take a rod of glass, and another of iron, and place one end of each in the flame of a spirit-lamp, these ends will soon become red-hot. After remaining so a few minutes, the iron rod will be too hot to be touched within a considerable distance of the hot end, whereas the glass rod may be handled with impunity almost up to the heated part. In the case of the iron the motion of the molecules is transferred from one to another till, in a little time, the whole rod becomes hot; the glass rod, on the other hand, prevents the passage of these vibrations, and hence is called a bad conductor.

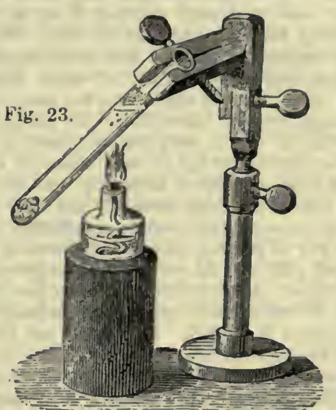

Fig. 23.

Fig. 24.

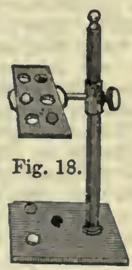

Fig. 18.

The apparatus shown in Fig. 21 illustrates the difference in the conducting powers of various bodies. A metallic trough has a number of holes made along one side. These are closed by corks, through which rods of various substances—as wood, glass, and metal—are passed. Melted wax or tallow is now smeared on the rods, and allowed to cool, and the trough is then filled with boiling water. The rate at which the heat is conducted along the different rods is at once seen by observing the distances to which the wax is melted along them.

Fig. 22 shows a more elaborate plan of ascertaining conducting power. A bar of the metal to be tested has cavities made along it at regular distances of three or four inches. Mercury is now poured into these, and a delicate thermometer put in each. Heat is then applied at one end, and the rate at which it travels along is shown by observing the readings of the different thermometers. Other experimenters have done away with the cavities, and employed a flat bar, testing the temperature at different parts by means of a thermo-electric pile. It is found in this way that the conducting power of different metals varies very greatly, that of silver, which is the greatest, being expressed by 100, while that of German silver is only 6. One important fact which strikes us here is that their conducting power for electricity seems to correspond closely with that for heat.

We shall now understand the reason why metals and other bodies feel cold to the touch. They are good conductors, and therefore carry away rapidly the heat from the part of the body with which they are in contact; bad conductors, on the other hand, only rob us of a small amount. As a general rule, all organic substances, and those which are loose in texture, are bad conductors, hence these are selected as the materials for our clothing. A great mistake is often made in supposing that clothing actually imparts heat; the real fact is, that it merely keeps in the heat which is produced in the system. The human body is considerably above the surrounding air in temperature, being kept so by that portion of our food which is burnt in the system. This heat would be very rapidly dissipated, and imparted to the air and surrounding objects, did not our garments intervene and, by their non-conducting power, prevent its escape. A further illustration that this is really the case is seen in the fact that ice-carts are carefully covered over with blankets, certainly not with the intention of keeping the ice warm, but for the sake of keeping out the warmth of the air, which would rapidly melt it.

Air is a bad conductor; hence loose bodies, such as sawdust, shavings, or tow, which enclose a large amount of air in their interstices, are frequently employed to exclude cold. Water, likewise, is a very bad conductor. This at first seems unlikely, when we remember how quickly a quantity of water may be brought to the boiling point; but we shall soon see that this is not heated by conduction, but by convection. To prove this, we may take a large jar of water, and, having placed a delicate thermometer at the bottom, set light to a tin saucer of spirit floating on the top. A large amount of heat will thus be produced, and the saucer will soon become intensely hot; the thermometer at the bottom, however, will remain unaffected for a long time. A simpler way of proving this fact is shown in Fig. 23. A test-tube is filled with ice-cold water, some fragments of ice being kept at the bottom. A spirit-lamp may then be applied to the upper part, and the water there will boil for a long time before the ice at the bottom is melted. This would not be the case if the water could conduct the heat.

That important invention, the safety-lamp, depends for its action on the conducting power of the metals. The lamp is entirely surrounded by a shade composed of wire gauze, which virtually consists of a large number of very short tubes, placed side by side. As the flame attempts to pass through these, its heat is conducted away, and it is no longer able to ignite the explosive gases outside.

The mode in which the metal conducts the heat away will be easily seen by taking a cylinder, one end of which, A (Fig. 24), is composed of wood, while the other end is of metal. If now we wind a piece of paper round this, and hold it in the flame of a spirit-lamp, the paper over the wooden part will be charred, while that over the other end will merely be smoked, the metal underneath having conducted away the heat before it had time to scorch the paper. This also explains how a bullet may be melted in a piece of writing-paper. The paper must be wrapped smoothly round it, and the flame allowed to play only on the part in contact with the lead. The metal will, of course, burn through the paper as soon as it is melted, but up to this time the heat is all employed in melting the lead, and is thus kept away from the paper.

If we take a few flakes of solid carbonic acid, procured as described in our last lesson, and place them on the hand, they will not feel as cold as we should expect. The reason of this is that they become slowly converted into gas, which keeps them from absolute contact with the hand. If a little ether be mixed with them, and the mixture dropped on the heat, intense cold will be produced, and all the effects of a severe burn will be experienced. If a lump of frozen mercury be taken up in the finger, exactly the same result will be produced. We see, then, that an intensely cold substance *burns* as an intensely hot one does. If a quantity of mercury be frozen, with a wire in it to serve as a handle, it may be lifted like a solid mass. Now dip it into a vessel of water, and in a short time it will begin to melt, drops of it falling to the bottom of the vessel. These, as they fall, will absorb so much heat as to freeze tubes in the water, down which the mercury will run.

LESSONS IN ENGLISH.—LI.

VERBS—REVIEW—VERB-PARSING.

THE three root-forms of the English verb may pass into a great variety of forms, as appears from the following combinations of the verb *to teach*:—

1. *With the Infinitive Mood.*—I do teach, I shall teach, I will teach, I may teach, I can teach, I must teach, let me teach.

2. *With the Participle Present.*—I am teaching, I shall be teaching, I will be teaching, I may be teaching, I can be teaching, I must be teaching, let me be teaching.—I have been teaching, I shall have been teaching, I will have been teaching, I may have been teaching, I can have been teaching, I must have been teaching, let me have been teaching.

3. *With the Participle Past.*—I am taught, I shall be taught, I will be taught, I may be taught, I can be taught, I must be taught, let me be taught.—I have taught, I shall have taught, I will have taught, I may have taught, I can have taught, I must have taught, let me have taught.—I have been taught, I shall have been taught, I may have been taught, I might have been taught, I can have been taught, I must have been taught, let me have been taught.

Mark that when two or more of what are called auxiliary verbs are combined with a participle, usually the first expresses the manner and the second the time; the first only admits of variation in itself (inflection), as, *I might have loved, thou mightst have loved.*

The forms just given have to be multiplied first by the persons—three singular, three plural; secondly, by the tenses—present and past; thirdly, by *if* and other conjunctions giving rise to the dependent and the elliptical constructions. Then there are the affirmative, the negative, and the interrogative forms; as well as the interrogative-negative. Besides this there is the uncontracted and the contracted form, as well as the solemn or the scriptural form: for example:—

1. *Forms multiplied by the Persons.*—I am teaching, thou art teaching, he is teaching, we are teaching, you are teaching, they are teaching.
2. *Forms multiplied by the Tenses.*—I teach, I taught, I was teaching.
3. *Forms multiplied by* IF, *etc.*—If I teach, if I taught, if I am teaching, if I was teaching, etc.
4. *Affirmative, Negative, Interrogative, and Interrogative-negative Forms, etc.*—I teach; I do not teach; do I teach? do I not teach?
5. *Contracted and Uncontracted Forms.*—They don't teach, they do not teach; I don't teach, I do not teach.
6. *Scriptural Forms.*—He teacheth, he loveth, he instructeth, he guideth.

A few facts respecting the verb remain to be set forth.

The most general division of verbs is that which exhibits them as *personal* and *impersonal.*

Personal verbs are such as take the ordinary persons *I, thou, he,* etc. *Impersonal* verbs take only the third person of the neuter gender, namely, *it;* for example, *it rains, it snows, it hails, it thunders.* It has been proposed to call these verbs *uni*personal (having one person), on the ground that *im*personal signifies that which has no person. I do not know that the proposed change is worth adopting. Strictly speaking, it is not a person, inasmuch as a thing is not a person. It is more important to remark that in these impersonal verbs the action of the verb is represented in the most abstract form of which it is possible next to the infinitive. Thus the noun *snow* passes into an indefinite verbal shape in *to snow,* and *to snow* becomes a little less indefinite in the form of *it snows.* Impersonal verbs mostly refer to atmospheric changes, and are used less extensively in English than in most other languages.

Verbs may be divided into *primitive* and *derivative.* The *primitive* are intransitive, the *derivative* are transitive. The change is effected for the most part by operating on the vowel: for example:—

Primitive.—Rise, lie, sit, fall, drink.
Derivative.—Raise, lay, set, fell, drench.

I have already given instances of verbs derived from nouns by a change in the accent or pronunciation. Another class of verbs is formed from nouns by hardening the final consonant; as—

Nouns.	*Verbs.*	*Nouns.*	*Verbs.*	*Nouns.*	*Verbs.*
Abuse.	Abuse (abuze).	Diffuse.	Diffu'se.	Prophecy.	Pro'phesy
Advice.	Advi'se.	Excuse.	Excu'se.	Rise.	Rise (rize).
Close.	Clo'se.	Grease.	Grea'se.		
Device.	Devi'se.	House.	Hou'se.	Use.	Us'e.
		Mouse.	Mou'se.		

Some verbs are termed *defective*; they are such as want some of the parts ordinarily ascribed to verbs. *Beware* is a defective verb, being used only in the imperative or to give a caution. *Quoth* is a defective verb, and is employed in no other than the third person singular. *Begone* may be accounted another defective verb like *beware*. *Begone* is a compound, made up of *be* and *gone*, that is, *get away*; and *beware* is composed of *be* and *ware*, found in *aware* and *wary*.

THE PARTICIPLE.

Participles can scarcely be considered a separate form of speech. A participle (Latin pars, *a part*, and capio, *I take*) is so called because it partakes of the qualities of a verb and an adjective. It would be more correct to say that participles may be used as adjectives, and that sometimes, wholly losing their verbal force, they become adjectives.

We have seen that the English verb, when reduced to its simplest form, consists of three parts; as, *talk*, *talking*, *talked*. *Talking* is called a present participle; it is emphatically present. "I talk" describes a general habit rather than an act now taking place; *I am talking* is evidently a continued act, and in regard to time may be spoken of as *a continued present*.

It is the termination *ing* that makes *talking* present.

A transitive participle may be used intransitively; as—

The house is building.

The present participle has the force of the Latin gerund; for example, in this sentence:—

In building the house they used stone.

The present participle may stand as an infinitive; as—

Buying a house is better than building one; that is, *to buy* is better than to build.

The other participle—namely, that ending in *ed* (abbreviated into *d* and *t*, as build*ed*, buil*t*)—seems to have for its essence the idea of past time.

A word which denotes what is past, may easily be made to denote the past effect of an action some time present. We may see this fact illustrated in the verb *to think*. The result of thinking is thought, and so thought is at once the past tense, the past participle, and a noun: for example—

Pres.	*Past.*	*Past Part.*	*Noun.*
I think	I thought	thought	thought.

The past participle is sometimes termed "the passive participle."

Hence it appears that this participle may signify either simply a past act, or a result, and that as denoting a result, it at least approaches a passive signification. Hence the ambiguity which exists in what grammarians term "the passive voice present tense;" as—

The house is built. The boy is loved.

When we say "the boy is loved," we signify a present fact; but when we say "the house is built," we mean, that the house stands there complete.

When a process is meant, it is better to say, "The house is building;" or to employ the active form, as, "I am reading the volume." Some, however, prefer, "The house is being built." But this form has no sufficient authority. Besides, there is an evident absurdity in speaking of a thing as at the same moment past and present, namely, being built.

ADVERBS.

Adverbs qualify the action of verbs, and so stand in the relation to verbs which is borne by the adjective towards the noun. Now an action may be viewed either as to the place where it was done, the time when it was done, and the manner in which it was done; as—

The theft was adroitly committed here yesterday.

In this instance the *place* is indicated by *here*, the *time* is indicated by *yesterday*, the *manner* is indicated by *adroitly*.

But manner is a quality which admits of variation; one theft may be committed *more* or *less* adroitly than another; a theft may be committed *most* adroitly.

We thus obtain four classes of adverbs:—

1. Adverbs of place.	2. Adverbs of time.
3. Adverbs of manner.	4. Adverbs of degree.

Adverbs may be regarded also in reference to their component parts, and may so be divided into (1) *the primitive*; (2) *the derivative*; (3) *the compound*. Of primitive adverbs take as instances *when*, *then*, *here*, *there*; of derivative adverbs take as instances *justly* (from just), *yearly*, *surprisingly*. Of compound adverbs take as instances *sometimes*, *nowhere*, *to-morrow*.

The manner in which compound adverbs are formed from simpler forms is very obvious. *Sometimes* is made up of the adjective *some* and the noun *times*; *oftentimes* consists of the adverb *often* and the noun *times*.

Adverbs are ordinarily formed by the addition of the ending *ly* to a noun, an adjective, or a participle; as man, man*ly*, wise, wise*ly*, loving, loving*ly*. The termination *ly* is an adjective as well as an adverbial termination, being from the German *lich*, as in mann*lich* (Anglo-Saxon *lice*), *manly*; but in *early*, *dearly*, etc., it has an adverbial force.

When an adjective terminates in *ly*, the adverbial suffix *ly* is not added; the second *ly* being omitted for the sake of sound, since such forms as *godlily*, *heavenlily*, *friendlily* would be very unpleasant; accordingly we say, "he was received" not friendlily but *amicably*, or "in a friendly manner."

If the adjective ends in *le*, the termination is changed into *ly*; as noble, nob*ly*, for noblely; so idle, id*ly*. In *whole*, the *l* is doubled, as whole, whol*ly*.

Adjectives of more than one syllable ending in *y* change the *y* into *i* before *ly*; as easy, eas*ily*; angry, angr*ily*, hearty, heart*ily*.

Monosyllables ending in *y* either retain the *y*, or change it into *i*; as dry, dry*ly*, day, da*ily*.

If the adjective ends in a double *l*, *y* simply is added; as full, full*y*; but manful, manful*ly*; cheerful, cheerful*ly*.

The degree is marked in adverbs of degree by *more* and *most*, *less* and *least*; as wisely, *more* wisely, *most* wisely; actively, *less* actively, *least* actively.

But inflection properly so called belongs to some few adverbs; as *late*, *later*, *latest*; *near*, *nearer*, *nearest*; *often*, *oftener*, *oftenest*; *soon*, *sooner*, *soonest*. Hence we find in adverbs the forms *er* and *est* used in forming the degrees of comparison in adjectives.

There also occur adverbs which are irregularly formed; as *ill*, *worse*, *worst*; *well*, *better*, *best*; *much*, *more*, *most*; *lately*, *latterly*, *lastly*. *Worse* and *worst* are, however, from a root different to that from which *ill* comes; so is it with *well*, *better*, *best*.

Adverbs of place may be subdivided into those which answer to the question *where?* those which answer to the question *whither?* those which answer to the question *whence?* and those which denote *order*.

1. Adverbs of place (at or in), viz.: *where*, *here*, *there*, *yonder*, *above*, *below*, *about*, *around*, *somewhere*, *anywhere*, *elsewhere*, *everywhere*, *nowhere*, *wherever*, *wheresoever*, *within*, *without*, *whereabout*, *hereabout*, *thereabout*. The preference for a long-drawn sound at the end of a word has added an *s* to these three words, making them *hereabouts*, *thereabouts*, *whereabouts*; the same regard to sound has converted the preposition *toward* into *towards*. The retention of the *s* is a matter of doubtful propriety.

2. Adverbs which denote *motion to a certain place* are—*whither*, *hither*, *thither*, *up*, *down*, *back*, *forth*, *aside*, *ashore*, *abroad*, *aloft*, *home*, *homeward*, *inward*, *upward*, *downward*, *backward*, *forward*. Some of the adverbs ending in *ward* are also used as adjectives; as, a forward (froward) child, a backward scholar; when used with an adverbial force they are often found terminating in *s*, as backwards, outwards. *Up* and *down* may have the construction of prepositions; as—

Up the side of the house ran the flames.
The bucket went *down* the side of the well.

In order to know whether these and other words are adverbs or prepositions, you must study their construction. If, as here, nouns are dependent on them, they are prepositions; but if they go in immediate union with verbs, they are adverbs.

3. The third subdivision embraces adverbs *which denote motion from or to a place*; as, *thence*, *whence*, *hence*; sometimes pleonastically given, as, *from hence*, etc.; the word *pleonastically* (from the Greek) is employed to signify that more is said than is necessary to convey the sense according to the laws of grammar.

4. Besides, there are adverbs which indicate *the order of place*; as, *first*, *secondly*, *thirdly*, *fourthly*, etc.; thus *secondly* means *in the second place* in a series of heads or topics constituting a discourse, a speech, a chapter in a book.

Adverbs of time may be arranged in the following classes:—

1. *Adverbs of Time Present.*—Now, to-day, now-a-days, yet, instantly, immediately, straightway, directly, forthwith.

It is curious that *presently*, though from *present*, has ceased to refer to the present, and now refers to time shortly to come.

2. *Adverbs of Time Past.*—Already, just now, lately, recently, yesterday, formerly, anciently, once, heretofore, hitherto, since, till now, long ago.

3. *Adverbs of Time to Come.*—To-morrow, hereafter, henceforth, henceforward, by-and-by, soon, ere long, shortly.

4. *Adverbs of Time Relative.*—When, then, first, before, just now, after, while, meanwhile, seasonably, betimes, early, late, whenever, afterward.

5. *Adverbs of Time Absolute.*—Always, ever, aye, never, eternally, for ever, evermore, endlessly, everlastingly.

6. *Adverbs of Time Repeated.*—Oft, often, again, occasionally, frequently, sometimes, seldom, rarely, daily, weekly, monthly, yearly, annually, once, twice, thrice, three times.

Adverbs of *manner* may be placed in these categories; namely :—

1. *Manner from Quality.*—Well, ill, wisely, foolishly, justly, wickedly.

2. *Affirmation or Negation.*—Yea, nay, yes, no, not, nowise, nohow, verily, truly, indeed, surely, certainly, doubtless, undoubtedly, assuredly, forsooth (that is, *for truth*, equal to "indeed!"—used ironically). amen.

3. *Doubt or Uncertainty.*—Haply (by hap, that is, by chance), perhaps, possibly, perchance, peradventure, maybe.

4. *Manner generally taken.*—Thus, so, how, somehow, nohow, anyhow, however, howsoever, else, otherwise, across, together, apart, asunder, namely, particularly, necessarily, extempore (offhand, without the aid of a manuscript), headlong, lengthways.

There are many *adverbial phrases*, such as *not at all*, *in no way*, *by no means*, *in fine*, etc. These may be considered as forming adverbial compounds. Indeed, compound adverbs might be termed adverbial phrases. The following may also be conveniently ranked among adverbial phrases : *not a rush* ("I care not a rush"), *not a groat*, *post* (he travels post).

Adverbs are occasionally employed with *the force of nouns;* for example :—

"Shall I tell you why? Aye, sir, and wherefore, for they say every *why* hath a *wherefore.*"—*Shakespeare.*

Adverbs are found where adjectives would be used, if adjectives of the requisite kind existed. Thus we say "the present bishop of London," also a *former* bishop and a *future* bishop; but we have no adjective to characterise a bishop as being a bishop at a particular point of time past, and so we say "the *then* bishop;" the licence may be considerable, but it prevents an awkward circumlocution : for example :—

"The *then* bishop of London, Dr. Laud, attended on his Majesty." —*Clarendon.*

Adverbs are sometimes superseded by adjectives ; thus we say, speak *low*, look *sweet*, drink *deep*, run *quick*, rise *early*, go to bed *late*, cut *short*, look *clean*, deal *hard*, *scarce* seven. In some instances, however, the adjective retains its own power, and expresses a meaning different from that which would ensue from the corresponding adverb. Thus :—

Adjective.—She looks sweet.
Adverb.—She looks sweetly.

These two forms vary in meaning; the first signifies that she is not only sweet, but looks so; the second means that whether she is sweet or not, she throws out a sweet look.

HUMAN PHYSIOLOGY.—VII.

CIRCULATION.

HAVING in the last paper traced the products of digestion into the general circulation of the body, we have now to consider, under the present heading, the ultimate purpose those products serve in building up and renewing the various parts of that structure. To do this, we must try and understand what is meant by the term circulation ; and, on examining this function, we find that there are three parts necessary for us to consider; first, the circulating fluid (the blood); secondly, the circulatory apparatus (the heart and blood-vessels); and, lastly, the act itself. Taking them in this order, we must first examine into the nature and composition of the blood. We are told, on the highest authority, that the blood is the life, and the important duties it fulfils in the animal economy almost entitle it to that appellation, for it is the medium by which all the nutriment is supplied to the body, and from it are built up all the various and different parts of which that body is composed. From the blood is made alike the solid bone and the liquid milk, the hard, horny structure of the nail, and the soft, yielding flesh and fat; without its presence the heart would cease to beat, the eye to see, the ear to hear, or the brain to think and will. Very slight alteration in one of its many constituents is sufficient at once to disturb the balance of health, or even to destroy life itself. Whenever blood can be examined flowing in the vessels of a living animal, as in the web of a frog's foot, the tails of some fish, or the wing of a bat, which are all sufficiently transparent to allow the process to be observed, it appears to be a colourless fluid, in which are floating a quantity of two kinds of cells, or corpuscles, some of which are white, but a much larger number red. When, however, the blood is drawn from the body it presents a very different appearance; if coming from an artery, it is a thickish fluid, of a bright scarlet colour; when from a vein, the colour is purple or nearly black. As compared with water, the blood is considerably heavier, its ordinary specific gravity—water being taken as 1000—is 1055, but in disease it may rise as high as 1120, or sink as low as 1026. The ordinary temperature of the blood in health is about 100 degrees Fahrenheit, and this is pretty uniform throughout the body, though it is said that the blood in the left side of the heart is one or two degrees higher than that in the right. The influence of disease is very strongly manifested in its power to diminish or increase the normal temperature of the blood; thus in some fevers it rises to 104 or even 108, and in some exhausting diseases falls to 86, or even lower. The blood is always alkaline in its reaction, and when exposed to the air gives off a watery vapour, which is said to have an odour strongly resembling the smell of the breath or skin of the animal, so that it is possible by it to distinguish from what particular animal it is derived. The milky smell of the cow, and the strong smell of the cat, are very well defined.

As to the quantity of blood contained in the body, considerable disagreement still exists, the most generally received opinion being that it forms about one-fourteenth of the weight of the whole body.

It has been said that the blood in the living vessels appears to be a clear fluid holding in suspension a number of two kinds of cells. The liquid is known by the name of the liquor sanguinis, and the cells are called respectively the white and red corpuscles of the blood; but when blood is exposed to the action of the air, certain changes take place which constitute a rough analysis of it, and reveal the presence of another and most important constituent. About ten minutes after blood has been drawn from the body, if left at rest, it changes into a kind of semi-solid or jelly. This is due to a substance contained in the liquor sanguinis, which continues fluid so long as the blood is in contact with the living tissues, but spontaneously coagulates when removed from their influence; this substance is called fibrine, and is a modification of albumen, the chemical composition of each being almost identical; some time after this jelly or clot has been formed, if left exposed to the air and at rest, it contracts and squeezes out a clear yellowish fluid, in which it eventually floats. The fluid is the serum of the blood; the clot is formed of the two kinds of corpuscles, entangled by the coagulating fibrine. What this process of coagulation signifies has been much debated, and directly opposite opinions have been held by eminent physiologists; for whilst on the one hand it was considered to be a process of life—an upward step towards a higher organisation—on the other, it was believed to be a sign of death of the structure, the effect of its removal from the living tissues. The grounds upon which the first opinion was based were mainly that in the clot formed by the coagulating fibrine distinct traces of structure were apparent, very much resembling those seen in the process of reparation which takes place in the living body when a wounded part is healing; whilst in albumen coagulated by heat or chemical agency, no evidence of such change is ever observed. The latter opinion is the one most generally held, as it is universally found that in any case where vital energy is deficient, the blood has a greater tendency to coagulate; thus, when blood-letting was extensively used in medical practice, it was noticed that the blood last drawn coagulated in a less time than that which was obtained by the first bleeding. The red corpuscles of the human blood are by some considered to be circular flattened cells, composed of a delicate colourless membrane enclosing a coloured substance which appears to be uniform in composition, having no nucleus. Others believe them to be solid masses—"lumps of nutriment"—having no cell-wall. In size they vary from the $\frac{1}{3500}$ to $\frac{1}{4000}$ of an inch in diameter. Their presence is characteristic of the Vertebrata, as they do not occur in the blood of any animals not included in that division. Their proportion to the white seems to vary according to the degree of the organisation of the animal. Thus, in man and the higher animals, they are from 20 to 300 times as numerous; in the fish and reptile they are comparatively few in number, though even here they always exceed the white. Those of the class Mammalia differ from those of the fish and bird in having no nuclei, and also in shape, the latter being, as a rule, oval or elliptical. The mammals also differ in some degree in size from each other; and upon these differences it has occasionally been attempted to base a judgment as to the particular animal from which the blood was derived; but though by the aid of the microscope it is possible to say, with some certainty, as to whether the blood is that of a mammal, or that of a bird or fish, this appears to be the limit; the differences in the size of the corpuscles are neither sufficiently great nor constant to decide positively whether they are those of a man, a pig, or a cow.

The white corpuscle is larger than the red, being about $\frac{1}{2500}$ of an inch in diameter, and is spherical in shape; they have a tuberculated surface, and are of a greyish-pearly appearance; they are made up of a cell-wall, enclosing a white-looking substance, which has one or more nuclei. The serum of the blood, the liquid which remains after the coagulation of the fibrine, is an alkaline, slimy, viscid fluid of a yellowish or greenish colour. It consists of a large number of substances dissolved in water; its largest solid constituent is albumen, which is present to the extent of about 8 per cent. The presence of this element may be made manifest by heating the serum, when the albumen coagulates into a solid mass. The liquid which remains uncoagulated is called the serosity. When meat is cooked for eating, the serum of the blood is converted into solid albumen, and this, when cut, allows the serosity to escape in the shape of gravy.

Such, then, being the principal parts of the blood, we must now examine a little its chemical composition. For this purpose two tables are given, the first showing in slight detail the various chemical substances found in the blood, and the other the proportion of its ultimate elements.

THE ORGANS OF CIRCULATION.

TABLE I.

SHOWING THE PROPORTIONS OF THE PRINCIPAL CONSTITUENTS IN A THOUSAND PARTS OF BLOOD.

Water			784
Albumen			70
Fibrine			2·2
Red Corpuscles	Hæmato-crystalline	123·5	131
	Hæmatine	7·3	
Fatty Matter			1·3
Salts	Chloride of Sodium	3·6	6·03
	Oxide and Phosphate of Iron	·5	
	Other Salts	1·93	
Extractive Matters, Biliary Colouring Matters, Gases, etc.			5·47
			1000

TABLE II.

SHOWING THE ULTIMATE ELEMENTS OF DRIED BLOOD.

Carbon	57·9	per cent.
Hydrogen	7·1	"
Nitrogen	17·4	"
Oxygen	19·2	"
Ashes	4·4	"

In the serum is contained a great part of the salts, the albumen, and the water of the blood. The proportion of the latter element varies, and is influenced by many causes. Thus all active exercises which produce perspiration diminish the quantity of the water in the blood; but as they, at the same time, create thirst, a larger quantity of liquid is taken, and so the balance is restored. Water is truly one of the most important elements, because upon its presence in proper proportions depends the maintenance of the due viscidity of the blood, and the power to absorb the nutritive elements from the digested food. The fibrine is a very important substance, and in health is present to the amount of 2 to 3 parts in 1,000; but in all diseases of a low type it is diminished, and in some of the opposite character it is increased. The red corpuscles consist, as is indicated in Table I., of two distinct constituents: the one called crystalline or globuline, which forms the bulk of the whole, is one of the albuminous group of substances; the other, called hæmatine, is distinguished from all other animal substances by its peculiar red colour, and the large proportion of iron which it contains. The fatty matters vary much in quantity, being increased soon after a meal is taken if it contains fatty, starchy, or saccharine substances.

As has been already stated, the sources from which the blood is renewed are the chyle and lymph, which are poured into the circulation by the thoracic duct. The lymph and chyle corpuscles are probably identical with the white corpuscles of the blood, and the red is believed to be formed from the white—the cell-wall becoming gradually smooth and the nuclei vanishing, whilst the whole cell assumes the red colour of the completed corpuscle. The fibrine makes its appearance in the chyle almost coincidently with the corpuscles, but does not appear to have its full power of coagulating till it reaches the completed blood.

We pass on now to consider the second division of this function of circulation, the organs by which it is carried out; these are the heart and the blood-vessels, consisting of arteries, capillaries, and veins.

The heart is a hollow muscular organ of a conical form, placed between the two lungs, and enclosed in the pericardium; its position in the chest is oblique; its broad end or base, which is placed highest in the chest, is directed upwards and backwards to the right, the point or apex is directed forwards and to the left side; the heart is placed between the lower two-thirds of the sternum, and projects more to the left than it does to the right, extending about three inches from the median line in the former direction, and only an inch and a half in the latter. Anteriorly, it is rounded and convex, whilst its posterior surface is flattened and rests on the diaphragm. Its ordinary size in the adult is about five inches in length, three inches and a half in breadth at its broadest part, and two inches and a half in thickness; its weight is from ten to twelve ounces in men, and from eight to ten in women; it continues to increase in size up to an advanced period in life. The pericardium in which the heart is enclosed is one of the serous membranes, and is consequently a closed sac consisting of two layers, between which is a small quantity of fluid, to enable the surfaces to glide easily over each other; the pericardium at its lower surface is firmly attached to the diaphragm, and serves to support the heart in its place, and facilitates its various movements. When the heart is laid open, it is seen that it is composed of four chambers, divided into a right and left set by a longitudinal muscular septum which runs the whole length of the organ, so that the right set is completely cut off from those of the opposite side. The upper pair of these cavities are called the auricles; the lower pair the ventricles. The auricles, which are much smaller than the ventricles, are the chambers which receive the blood; into the right ones open the large veins which bring the used blood back to the heart from all parts of the body; into the left, the pulmonary veins, which convey the blood after it has passed through the lungs. The ventricles are the chambers which by their contraction drive the blood out, the right sending the blood which it receives from the right auricle into the pulmonary artery, to be by it conveyed to the lungs, and there exposed to the action of the air; the left pumping the aërated blood sent into it by its auricle into the great blood-vessel, the aorta, to be distributed to all parts of the body. The inside of the heart is, like the outside, covered by a serous membrane—in this instance called the endocardium, which, by its thin smooth transparency, gives to the inside of the heart its glistening appearance; this membrane, at the various apertures in the different cavities of the heart, is arranged in folds, which, with the addition of some muscular fibres and fibrous tissue, compose the valves which protect these openings. From the inner surface of the walls of the heart jut out irregular masses of muscular fibre, many of which stand out like columns or pillars, and are thence called "columnæ carneæ" (fleshy columns). From the free extremities of some of these, cords run to the under-surface of the valves, and act as check-strings, preventing them being forced too far backwards by the pressure of the blood. Into the right auricle, as has been said, the used blood is emptied by two large veins named respectively the superior and inferior cava; it is rather larger than the left auricle, and is situated at the base of the right ventricle, forming a part of the anterior surface of the heart; it communicates with its ventricle by a large oval aperture, which is protected on the ventricular side by one of the valves before-mentioned, called, on account of its being composed of three segments or cusps, the tricuspid valve. The spot where the inferior cava enters is also protected by a valve. The right ventricle is triangular in form, and forms the greater part of the anterior surface of the heart; it has opening into it the pulmonary artery, which is guarded by a set of valves, called from their shape the semi-lunar. The left auricle is thicker but rather smaller than the right; it receives the pulmonary veins, which are four in number, and communicates, by an opening similar to the one on the right side, with the left ventricle. The left ventricle is conical in shape, is longer, and its walls are much thicker than those of the right; it forms the posterior surface, and in consequence of its greater length the apex of the heart: the opening into it from the auricle is guarded by the mitral valve, which consists of two segments, but is larger, thicker, and stronger than the one on the opposite side; from the upper and back part of it springs the great main trunk, the aorta, the large vessel which conveys the blood for the use of the whole body. The heart, in common with all other organs that have important duties to fulfil, has special vessels to supply it with nutritive blood; these are called the coronary arteries, and are nearly the first branches given off from the aorta. It also is abundantly supplied with nerves, which it derives mainly, though not entirely, from the sympathetic system.

Such, then, being the engine by which the blood is put in motion, we must now consider the channels through which it travels. The blood-vessels are divided into three sets: the arteries, which are the vessels carrying the blood from the heart; the veins, which return the blood to the heart; and an intermediate set, the capillaries, which form the connection between the arteries and the veins. The arteries are cylindrical tubular vessels, owing their name to an ancient opinion, which was based on the fact that they are found empty after death, and were consequently supposed to contain air (*aer*, air; *terein*, to contain). They have three coats; the external, called also the elastic, is a membrane of great strength and elasticity; the middle or muscular coat is thick, composed of several layers of muscular and elastic tissue, which form a firm, solid, but rather brittle membrane; the internal, or serous, is a thin, nearly transparent membrane, moistened, as its name implies, by a serous fluid. The effect of these differences in the constitution of the coats of arteries is manifested when an artery is cut off by a ligature as in surgical operations, or torn through as in an injury. In either case the external coat shows the purpose for which it is made of so great strength and elasticity. In the case of the ligature, the internal and middle coats are at once cut through, but the external coat bears the pressure, and thus enables a permanent healing of the wound and closure of the vessels to take place before it separates. Also, when a limb is torn off, the artery, in common with the other structures, is forcibly lacerated, the inner and middle coats give way at once and retract, the external coat is pulled out to a fine point before it divides, and thus shuts off the channel of the vessel, and prevents that profuse bleeding which without this provision would otherwise take place.

PNEUMATICS.—VIII.

VENTILATION—WIND—ITS PRESSURE AND EFFECTS—TRADE WINDS—MONSOONS—LAND AND SEA BREEZES—SIMOOMS, ETC.

A SIMPLE experiment, which may be easily tried, affords a good illustration of the principles on which ventilation is arranged in mines or buildings. Procure a straight glass chimney (Fig. 20), such as is used with a moderator lamp, and place it over a short piece of lighted candle; in a few minutes the flame will flicker and then be extinguished. The oxygen of the air contained in the chimney has been consumed, and its place occupied by the poisonous carbonic acid gas thereby produced; and as there is no way of allowing the foul air to escape and fresh to enter, the candle goes out. Now cut a piece of cardboard of the shape represented at A, such that it will pass down the chimney nearly to the flame, but will be prevented by the enlarged top from falling lower, and, having relit the candle, place the chimney over it as before, but with the card in it. The candle will now continue to burn, and we shall find that the flame is drawn a little to one side. The partition has divided the chimney into two compartments, up one of which the smoke and carbonic acid pass, while fresh air comes down the other and maintains a constant supply. The heat of the flame rarefies the air over it, and thus creates an upward current in the one compartment, just as the furnace does at the bottom of a mine shaft.

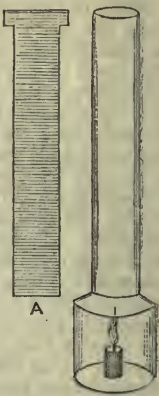

Fig. 20.

If, instead of inserting the piece of card, we raise the chimney a little from the table by a few small pieces of wood, the candle will continue to burn; an inlet is now provided for the fresh air, and the whole of the chimney is occupied by the up-current. The essential points are to provide an exit for the foul air and an entry for fresh air.

In a building the air, heated by the lights and by being breathed, ascends. This will usually suffice to ventilate the place if a proper way of escape be made for the foul air, and the importance of doing this cannot well be overrated. Care, however, is required in regulating the entry of fresh air so as to avoid draughts.

Frequently, however, the gas is not lighted, and the heat of the breath is insufficient to ventilate the building in this way, and then other means must be adopted. One of the simplest and best of these is to carry a metal shaft from the top of the room or building, and in the upper part of this to place a number of gas-burners. These, when lighted, create a powerful current of air up the shaft, and thus the foul air is removed from the place.

Gas-burners have also been invented of such a construction as to remove the impure air by means of a pipe opening over them, and, at the same time, by the draught thus created to remove the foul air from the upper part of the room.

The usual defect in ventilation is that this foul air is allowed to accumulate near the ceiling. If we stand on steps so as to have our head near the top of a room with several people and lighted gas burners in it, we shall be fully convinced of this fact.

As a knowledge of the fact that heated air always ascends is of great importance to us in understanding the theory of the wind, we will mention another simple illustration of it. Take a circular piece of card, about six or eight inches in diameter, and, beginning at the exterior, cut it spirally inwards so as to form a strip about ¾ of an inch wide. Stick a pin through the centre, and by this suspend it over a lighted gas-burner. The upward current of heated air will cause it to turn rapidly round, and it will somewhat resemble a serpent. The old smoke-jack used to act in a similar way.

If we open the door of a warm room a very little way, and hold a candle in the opening so as to observe the direction of the current by that of the flame, we shall see the mode in which the air is changed. When the candle is held close to the floor, a strong inward current of air will be perceived. Being cold, it sinks to the floor and there enters. As we raise the candle the current becomes weaker, till, about half-way up, it is quite imperceptible. Higher still the current is reversed, and we shall find the flame driven outwards, showing that the heated air is escaping near the upper part of the room.

This experiment is a very instructive one, as it explains to us the principle on which rooms must be warmed, and generally the way in which gases become heated. If we place one end of a bar of iron in the fire, the heat will gradually pass along it until the other end becomes warm. The particles do not change their position with regard to one another, but the heat passes from each to that next to it, and thus is conducted along the bar.

Liquids and gases, however, become heated in a totally different way. Instead of the heat being conveyed from one particle to another by contact, currents are set up in them by which all the particles successively become exposed to the source of heat. These currents may easily be seen by dropping some fragments of litmus into a globe of water, and heating it by means of a spirit-lamp placed nnder the centre. The litmus will colour the water, and thus it will be seen that there is an ascending column of liquid in the centre of the globe. When this reaches the surface it spreads out in all directions, and descends against the sides, to be raised to a higher temperature and again ascend. We may easily see how bad a conductor of heat a liquid is. If we place a lump of ice at the bottom of a test-tube nearly filled with water, and apply the flame of a spirit-lamp to the npper portion, we shall find that the ice will remain unmelted long after the water at the top has commenced to boil. If, however, we apply the flame to the bottom of the tube, the ice will very quickly melt. In a similar way it might be shown that air is a bad conductor, and can therefore only be warmed by convection.

Another important fact in connection with the temperature of the air is that it is not warmed by the passage of the sun's rays through it. If it were, the npper part of the atmosphere would in the daytime be warmer than the lower portion, for it is nearer the sun; we find, however, that as we ascend the temperature becomes less and less. An interesting illustration of this is seen on the higher tropical monntains. If we go to some of the lofty Andes near the equator, we shall find at their base tropical forests almost too dense for the light of the sun to penetrate; on ascending higher we meet with vegetation less rank, and pass through regions resembling those of the temperate zone. Higher still we come across a stunted polar vegetation, and reach the limit of perpetual frost, or the "snow-line." We have, in fact, in a small space a representation of all the climates we meet in travelling from the equator to the poles. The reason of this is that the rays of the snn pass through the air withont warming it, bnt when they reach the ground they are absorbed and raise its temperature. This increase is shared by the air resting on it, and thns the lower strata become warmed. As we recede from the equator, the snow-line, which there attains an elevation of 17,000 or 18,000 feet, descends lower and lower, till in the frigid zone it comes to the level of the sea, and we find continual frost and winter.


Fig. 21.

It remains for ns now to see how the principles we have examined explain the complicated phenomena of the winds.

Wind is merely air in motion; but this motion varies from time to time very greatly, both in direction and in intensity. There are various modes of measuring the speed of the wind. A rongh idea of it may sometimes be formed by noticing the shadows of clouds passing along the gronnd; bnt this is vague and nncertain. Various machines, known as anemometers, have therefore been contrived for this purpose, and are in use in most observatories. As the pressure produced on any surface varies as the sqnare of the velocity, some of the simplest anemometers merely show the pressure, and from this the velocity must be calculated by tables drawn up for the purpose. Fig. 21 represents one of the most common forms of this instrnment, which is known as Lind's anemometer: It consists of a glass tube bent into the shape of the letter U, bnt drawn out at the bend so as to diminish the bore. The object of this is to moderate the fluctuations which are cansed by the gusts of wind. One end is also turned at right angles, and the whole is suspended on a pivot, so that this open end is always presented to the wind. A small shield, placed over the end of the other limb, shelters it a little from the wind, and it is fonnd that as soon as the instrnment is exposed to the wind, its pressure acts on the liquid and depresses it in the limb exposed to its force. The difference in the level of the water in the two limbs indicates the pressure. If this difference be one inch, the pressure is abont 15 lbs. per sqnare foot.

A metal disc, supported by a spiral spring, is likewise used at times to measure the pressure. Fans arranged like the sails of a mill, and giving motion to a registering apparatus, have also been tried; but these forms have, for the most part, given way to that known as Robinson's anemometer.

He fonnd that the vertical vanes moved much more slowly than the wind, and therefore snbstituted for them metal cups or hemispheres. Four of these, with their open sides turned the same way, are accordingly mounted at the extremities of two arms crossing at right angles, and the axle to which these are fixed is connected with a train of wheels so as to register the revolutions.

When this instrument is placed in an exposed place, the wind acts on the concave sides presented to it, and thus sets the whole in rotation, the speed of the cups being nearly eqnal to that of the wind, and always bearing the same proportion to it.

This instrument is often fitted up by the side of a vane, and both are made self-registering. The construction of the apparatns for this is very ingenions, bnt its description would be too long for insertion here.

The following table gives an idea of the effects produced by different velocities of the wind:—

Miles per hour.	Pressure per square foot in pounds.	Characteristics.
1	0·005	Hardly perceptible.
2	0·020	Just perceptible.
5	0·123	Gentle breeze.
10	0·492	Brisk wind.
20	1·968	Very brisk wind.
25	3·075	Very brisk wind.
35	6·027	High wind.
45	9·963	Very high wind.
50	12·300	Storm.
60	17·715	Great storm.
80	31·490	Hurricane.
100	49·200	Great hurricane, carrying trees, etc., before it.

Winds vary in direction as mnch as in velocity. In temperate climates they are often proverbially nncertain, bnt in the tropics they are very mnch more regnlar; and we will now notice a few of them, which are distinguished by special names on account of their importance.

The most important are the *trade-winds*. These are permanent, and extend a few degrees north and sonth of the tropics, the actual limits varying with the season. Their direction in the northern hemisphere is from the north-east, and in the sonthern from the south-east. Hence they are called the north-east and sonth-east trades. Between them there exists a narrow region of calms sometimes called the Doldrums. This band is a little north of the eqnator, and nearly corresponds with the line of greatest heat on the earth.

Columbus was the first who noticed these winds; and when the sailors found that a constant wind kept on day after day, taking them further from their home, they almost mntinied. So regular are these winds that a ship will often sail from the neighbonrhood of the Canaries right across to the north coast of South America withont altering her sails. A little consideration will render the origin of these winds perfectly clear. In tropical regions the surface of the earth, being exposed to the almost vertical rays of the sun, becomes intensely heated, and communicates this high temperature to the air aronnd. This accordingly expands and rises, its place being supplied by colder air, which rushes from temperate and polar regions. Now we shonld at first expect that this would canse the wind to blow from both poles towards the equator—that is, a north wind in the northern hemisphere and a sonth wind in the sonthern (for a wind is named after the point *from* which it blows); and if the earth were at rest, this would be the case. It is not at rest, however, bnt rotating rapidly from west to east; and it is clear that since the diameter of the earth is greatest at the eqnator, and diminishes as we recede from it, the velocity too mnst be greatest there.

We find that any place at the eqnator has a velocity of nearly 1,000 miles per honr, while at 45°, north or south latitnde, it is only 660. The air, therefore, as it flows towards the eqnator, has at every point a less velocity than that of the portion of the earth's surface it is moving over, and hence it is left behind, and appears to be moving in a contrary direction to the earth. Now the motion of the earth is from west to east; the wind, therefore, appears to travel from east to west, and this, com-

*

bined with its motion towards the equator, produces the north-east and south-east trade-winds. These and other regular winds are best observed in the ocean far away from land, as that always interferes, more or less, by creating fresh currents. It is said that a difference is caused in the wind by the proximity even of a coral reef or small island.

Now it is manifest that there mnst be some return cnrrent for the air, as otherwise it could not continue to flow constantly in the same direction, and it is found that this retnrn current is above the ordinary one, and is in the contrary direction. It is difficnlt to afford full proof of this, bnt several facts show that such is the case. Rather more than fifty years ago an eruption took place of the volcano in St. Vincent, and a large qnantity of ashes and scoriæ was thrown out to a considerable elevation. A portion of this fell and covered the island of Barbadoes. Now the trade-wind blows directly away from Barbadoes; and it seems certain, therefore, that the ashes were thrown up high enough to reach the npper or return current, and were carried along with that.

Humboldt states, likewise, that when he ascended the Peak of Teneriffe he found a very strong west wind, while the ordinary north-east trade-wind was blowing on the earth below at the same time. We see, then, that there is a system of convection being carried on in the air on a gigantic scale, the air, heated by the tropical snn, ascending and making room for colder air from temperate regions. As the fact of the sun being vertical over parts of the torrid zone is thus the canse of these winds, we should expect to find that when the snn is north of the eqnator they extend fnrther north than when the snn is in the southern hemisphere, and such is really the case. The variations in their limits thns caused are usnally laid down on maps which show the prevailing winds.

After the current of heated air that ascends from the equator has travelled some distance, it becomes cooled down by radiation into space, so that its temperature falls below that of the under-current. They therefore change places, and the return current from the eqnator blows on the surface of the earth, prodncing south-west winds in the northern hemisphere, and north-west in the southern. The west direction of these arises from the fact that they come from a portion of the earth where the motion is more rapid, and they therefore travel faster than the part they blow over.

The latitude at which this cnrrent descends is about 30°. It varies, however, considerably in different parts owing to local causes, and therefore the winds in the temperate zone have not the same degree of regularity as they have nearer the equator. We find, however, by records kept at varions places, that if we measure the dnration and intensity of the wind in places in the north temperate zone, the prevailing direction is south-west or sonth-south-west. Still further north, this current, which has become heated by contact with the earth, again ascends and becomes the upper current.

In the Indian Ocean the effect of the trade-winds is but little felt, bnt they are replaced by the monsoons. These are periodical winds, and extend from a few degrees south of the equator to the northern shores of the Indian Ocean. Their direction from April to October is sonth-west, and from October to April north-east. At the periods of change violent storms are experienced, by which great damage is frequently done to shipping and property. This period usnally lasts nearly a month.

The explanation of these phenomena is fonnd in the fact that when the sun comes north of the eqnator, the plains of India and the surrounding countries become intensely heated by the almost vertical rays of the sun. The air over them, therefore, becomes rarefied and ascends, creating a strong current towards those parts from the southward, for the sea does not become so heated by the sun's rays as the land does, bnt preserves an almost uniform temperature. When the sun crosses the eqnator southward, the plains of Anstralia and the islands near it become similarly heated, and thus a reverse current is produced. These winds are, however, somewhat modified by the nature of the conntry and other causes, which are not yet fully nnderstood. For pnrposes of commerce they are found almost more useful than the trade-winds, as a vessel can proceed to a port dnring one monsoon, wait there to discharge her cargo, and re-load in the interval of the change, and return with the contrary wind.

The land and sea breezes are the next winds which we mnst notice. These are more felt in lower latitudes than in onrs; but most visitors to the seaside in our own conntry have doubtless noticed them. A short time after sunset a gentle breeze sets off the coast towards the sea, and continues to blow during the evening and night. After the sun has risen again, this wind ceases, and a contrary one sets in from the sea, mitigating the intense heat which would otherwise be felt. This breeze continues during the day. These phenomena are said to be well seen in the neighbourhood of Vesuvius, where during the day the column of smoke blows inland, but at evening it veers round till it points exactly in the contrary direction.

These winds are easily accounted for. The sea, as we have already remarked, preserves a nearly nniform temperature, being little affected by the heat of the snn. The land, on the contrary, becomes rapidly heated by day, and at night parts with its heat as rapidly by radiation. The conseqnence is that, as soon as the sun has been shining a little time, the land attains a higher temperatnre than the sea; the air over it therefore rises, and colder air flows in from the sea to fill its place. In the evening this extra heat soon passes off, and the land becomes colder than the sea. The contrary effect then ensnes: the air rises over the sea, and a breeze springs up from the land. A simple experiment will serve well to illnstrate these phenomena. Fill a tub or other large vessel with cold water, and float on it a saucer filled with warm water. This will represent the island when heated dnring the day. If we now hold a smoking taper or piece of paper near it, we shall see that a cnrrent of air is setting in towards the sancer. Now reverse the experiment, and fill the large vessel with warm water and the small with cold, and we shall find that the cnrrent of air flows over the edge of the sancer and drives the smoke away, just as at evening the wind sets off the land.

There are many other periodical winds, bnt as for the most part they are confined to small areas and only known by local names, we need not further allude to them, except to say that nearly all may be accounted for on the same principles as those we have been considering.

The winds frequently met with on the borders of desert regions, and known in Arabia as the Simoom, in the neighbourhood of the Mediterranean as the Sirocco, and by other names in other places, owe most of their dangerons character to their dryness, and to the amount of fine dust they carry with them. Sweeping over large tracts of arid sand, they become intensely hot and dry, and often canse the death of those who are unable to obtain shelter from their influence.

If we thus trace the qnarter from which any wind blows, we shall usually be able to understand the reason of its special character. Thus, in England, rain usnally comes with a south-west wind, the reason being that this wind, coming from lower latitudes, is warm, and therefore absorbs much water as it passes over the sea. When it reaches our shores it becomes cooled, and a portion of its vapour is at once condensed and falls in the form of rain.

In mountainous districts a current of air freqnently impinges against the cold tops of a mountain, and becoming in this way suddenly cooled, rushes violently down the side, often giving rise to violent and destructive hnrricanes. The *Pamperos*, or winds which rush from the Andes with great violence across the plains of Sonth America, owe their origin to this cause; and in our own lake districts in Cumberland a somewhat similar effect, thongh on a much smaller scale, may at times be noticed.

The whole snbject of the varying phenomena of the atmosphere is one of great importance and interest; but we cannot fnrther enlarge upon it here.

ANSWERS TO EXAMPLES IN LESSON VII. (Page 38.)

1. The pressure is $5 \times 6{\cdot}25 \times 29{\cdot}04 \times 0{\cdot}491$ pounds, which is equal to 415·5825 pounds.
2. Since the volume occupied by the air is only $\frac{4\frac{1}{2}}{10}$, *i.e.*, $\frac{9}{20}$, of its original volume, the pressure is increased $\frac{20}{9}$. The mercury therefore stands $\frac{20}{9} \times 29$ inches, or $64\frac{4}{9}$ above the level in the other limb, or $69\frac{17}{18}$ above 0.
3. 238·21 cubic inches.
4. Just over 1461 cubic inches.
5. The temperature to which it is raised is 338°.
6. 128·09 cubic inches.

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VOLTAIC ELECTRICITY.—XI.

ELECTRO-MAGNETS: MODE OF MAKING, AND PROPERTIES—HORSE-SHOE MAGNETS.

We have already seen the effects produced by an electric current on a magnetised needle placed near to it, and have now to notice the way in which the current is able to produce a magnet.

The properties of an ordinary magnet are familiar to most, and will be fully explained when treating of Magnetism. We shall find, however, that any piece of iron may be at once converted into a temporary magnet by causing a current to pass round it. The simplest way of showing this effect is to dip a thin wire, along which a stream of electricity is passing, into a heap of iron filings, when it will be observed that many of them are attracted and cling to the wire as long as the fluid passes, but fall the moment that contact is broken in any part of the circuit.

The action of the current is, however, seen much more clearly by taking a piece of glass tubing, about three-quarters of an inch in diameter, and twisting a piece of copper wire spirally along it, as seen in Fig. 68. Now place a small steel bar or piece of steel wire inside the tube, and allow a current to pass round the spiral. The steel will at once be converted into a magnet, the power of which will vary according to the strength of the current and the number of coils of wire. If the charge of a Leyden jar be in a similar way passed round the copper wire, the steel will in like manner be magnetised to a slight extent—thus again showing the close alliance between the two kinds of electricity.

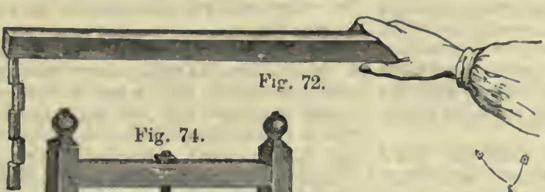
Fig. 72.

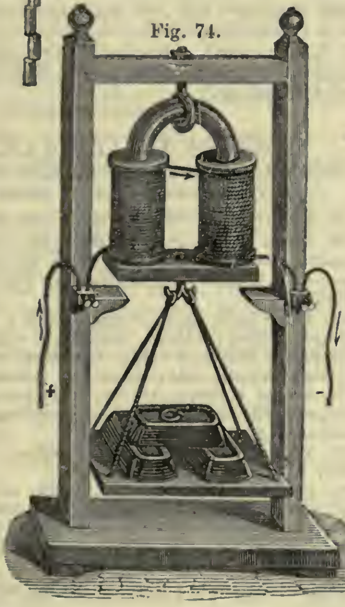
Fig. 74.


Fig. 73.


Fig. 71.

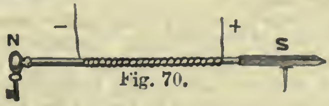

Fig. 70.

Fig. 69.

Fig. 68.


Fig. 75.

Every magnet has two poles, called respectively the north and the south, and we shall see that it depends on the direction in which the wire is coiled which end of the bar becomes the north pole. If the wire is made to coil from left to right, so that the current passes round the tube in the same direction as the hands of a watch travel, it is said to be a right-handed spiral, the coils of the wire corresponding in position with the threads of an ordinary screw. In this case the end *b*, at which the current enters, will become a *south* pole. If, however, the wire be twisted in the opposite direction, as shown in Fig. 69, it is called a left-handed spiral. In this case the end *a*, at which the current enters, will be the *north*, and *b* will be the *south* pole.

This may be easily remembered by means of Ampere's rule, already given to serve as an aid in remembering in which direction a magnetic needle becomes deflected by the passage of a current near to it. Let the observer imagine himself, or the figure of a man, placed along any portion of the wire, with his face turned towards the centre of the helix, so that the current may enter by his feet and leave by his head; the north pole will then always be at his left hand.

That a magnet may be made in this way is very easily seen by taking a rod of iron—the poker, for instance—and twisting a piece of wire round it several times, as shown in Fig. 70. The wire should be covered with cotton or some insulating material, as otherwise a portion of the electricity will pass directly along the iron rod, that being the shorter route. When the current is made to pass along the wire, the poker will be found to have become a magnet, and pieces of iron, such as keys or nails, held near either end will be attracted and remain suspended. As soon as the circuit is interrupted, and the current ceases to flow, the bar, if made of soft iron, will lose all its magnetism, and the pieces of metal will fall from its ends. If, however, the bar be composed of steel, or even of hard iron, it will be converted into a permanent magnet, but may be demagnetised by causing the current to pass round it in the reverse direction.

The electro-magnet derives much of its value from the ease with which the poles may be reversed, or its magnetism altogether laid aside. The iron bar, technically called the *core*, should, however, be made of the purest and softest iron—that which is known as scrap-iron will be found to answer well. Even with this a small amount of polarity is found to remain when the keeper is allowed to come into absolute contact with the poles. This is sometimes a disadvantage, and to guard against it thin discs of paper may be attached to the poles.

A bundle of thin iron wires, fastened together, is sometimes used for the core instead of a solid rod, as it becomes more powerfully magnetised.

Either bar magnets or horse-shoe magnets may be made by the electric current, the former being most useful when it is desirable to have the poles some little distance apart, while the horse-shoe form is most convenient for showing the lifting power of the magnet, as both poles are then brought to act on the same keeper.

To make a bar electro-magnet, a piece of iron rod about three-quarters of an inch in diameter and twelve or eighteen inches long should be taken, and copper wire covered with cotton be wound evenly round it, an inch or two of the rod being left uncovered at each end. Much care should be taken in winding the wire to guard against the coils overlapping one another, as much of the power would thus be lost. When one layer of wire has been wound on, a second may be laid outside it, winding back again to the end first commenced at, and in this way four or five layers of wire may be used. It will be found advantageous to give a coating of scaling-wax varnish between each layer of wire, as the insulation is thus much improved.

The power of such a magnet will vary in direct proportion to the strength of the current and the number of coils of wire. If, however, the wire employed be very thin, the additional quantity will cause so much additional resistance, that a limit to the increase of strength will soon be reached. As a general rule, when the magnet is wanted to attract the keeper from any distance, the wire used in winding should be somewhat thin; but when it is required to sustain heavy weights, it may be rather thicker. It must not be too stout, however, as it is found that the greatest power is obtained when a certain amount of resistance is offered to the passage of the current, so that it becomes to a certain extent delayed.

Fig. 71 represents the general construction of a bar magnet. The ends of the wire are in this twisted together, and binding-screws attached to them to join the battery wires to.

Sometimes, instead of the wire being wound directly on the core, a large reel is procured, the tube of which is made of paste-board or thin wood, and the wire is coiled on this. The core may then be inserted in the reel, and changed at pleasure; the distance to which it projects may also be altered if desired. Bars of other metals may likewise be inserted in the reel, so as to observe the effect, if any, produced on them by the passage of the current. By the employment of a series of such reels, wound with different lengths and sizes of wire, the various effects thus produced may be investigated.

Not only does a magnet attract pieces of iron held near its poles, but it converts them into magnets, so that they in turn will attract others, and thus a chain of pieces of iron may be suspended, as shown in Fig. 72. In the figure, however, a permanent, and not an electro magnet is represented, but the same result is obtained whichever is employed.

A beautiful illustration of this is seen by throwing a number of nails on to the ends of the electro-magnet, and then scattering iron filings over them. Many of the nails will stand on end like branches of trees, while the filings cluster round them so as to resemble foliage. As soon as the contact with the battery ceases, all at once drop, but spring up again on renewing it.

The magnetic power will penetrate many substances. Let a plate, for instance, be placed over the magnet, and iron filings sifted on it; they will at once collect opposite to the poles of the magnet, and shift their places as the plate is moved about. The filings, too, will arrange themselves in curves, indicating the lines of magnetic force.

Advantage is sometimes taken of the attractive power of the magnet to separate iron and brass filings. The poles are dipped into the mixture, and the magnet is gently tapped, so as to remove all particles of brass accidentally entangled with the iron. It is then moved over a tray to receive the filings, and contact with the battery broken, when they at once fall.

The horse-shoe form is employed more frequently than the straight bar. Fig. 73 shows the mode of making a magnet of this kind. A piece of iron rod is bent in the middle so that the sides may be parallel, and its ends are then filed true. The wire is wound along one limb nearly to the bend, and then carried across to the other. It may be wound round the curve, but it is usually found more convenient to leave that bare. The wire must, however, be wound in the same direction on each limb, as will be seen in the figure, where, after leaving the upper side of the left-hand limb, it passes to the under side of the right-hand one. Only one layer is here shown; in practice, however, several are laid one over the other, or else reels are placed on each limb.

The keeper, A (Fig. 73), is a bar of iron made to fit evenly to the poles, and a hook is usually fixed to it, that weights may be suspended from it.

To avoid the resistance caused when the current has to traverse a great length of wire, three or four separate lengths are sometimes wound on, the ends being united into bundles, and then connected with the battery. Care must be taken in this case that the current travels in the same direction round each coil, as otherwise they will to a great extent neutralise one another.

Magnets of this kind have been constructed of very great power, capable of lifting from 10 to 20 cwt. when a powerful battery is employed. For testing the weight that can thus be sustained, the magnet is usually suspended from a strong stand (Fig. 74), so arranged that the keeper may rest on two supports a little lower than the poles. A large pan or board is then suspended from the hook of the keeper, and to this weights are added till the attraction of the magnet is overcome. Sometimes a second magnet is inverted under the first, and so arranged that the same current may pass round the coils of both; the north pole of the one is then placed opposite to the south pole of the other, and in this way a great increase of power is gained.

By means of a powerful electro-magnet, it is very easy to make any number of permanent magnets. Take a bar of steel, and placing its middle point on one pole, draw it slowly off it two or three times; now repeat the same process with the other end of the bar on the other pole, taking great care always to draw it from the middle to the ends; after repeating this a few times the bar will be found to be converted into a powerful permanent magnet.

It is not even necessary for the steel to touch the magnet, as a faint polarity may be imparted to it by being held near to it. We had once an unpleasant illustration of this, when, after trying various experiments with a powerful magnet, we found that the balance-wheel of our watch had become so magnetised that it had to be replaced by a new one. Since then, whenever experimenting with magnets, watches have been carefully laid aside, and we advise the student always to do the same.

In a similar way, if a magnetic needle be held near a powerful magnet, its poles will frequently be reversed, and small steel objects lying near, or which have happened to touch the poles, will also become magnetised.

When a current is made to pass round a reel, it will be found to draw its core further into it. This property of the coil is taken advantage of in the construction of various pieces of apparatus. One example of this has already been given in the construction of the electric light apparatus, explained in Lesson VI.

Another illustration of the same effect is obtained by taking a bobbin (Fig. 75) with a large tube, and having connected it with the battery, hold a bar of iron—as, for instance, a poker—with the upper end just inside the bobbin, when, if the current is sufficiently powerful, the poker will at once be drawn up into it, and remain suspended in the middle without touching the sides, thus realising the tale of Mahomet's coffin being suspended in mid air.

LESSONS IN ITALIAN.—XXXV.

IRREGULAR VERBS OF THE SECOND CONJUGATION.

I. VERBS ENDING IN *ere* LONG (*continued*).

18. The irregular verb *vedére*, to see, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Vedére, *to see.—Pres. Gerund.* Vedéndo *or* veggéndo, *seeing.* — *Past Part.* Vedúto *or* vísto, *seen.*——*Compound Tenses.—Past.* Avére vedúto, *to have seen.—Past Gerund.* Avéndo vedúto, *having seen.*

IND. *Pres.*—Védo, véggo, *or* véggio; védi *or* ve'; véde. Vediámo *or* veggiámo; vedéte; védono, véggono, *or* véggiono.—*Imp.* Vedéva *or* vedéa, vedévi, vedéva *or* vedéa; vedevámo, vedeváte, vedévano.—*Ind. Pret.* Vídi, vedésti, víde; vedémmo, vedéste, vídero.—*Fut.* Vedrò, vedrái, vedrà; vedrémo, vedréte, vedránno.—*Cond. Pres.* Vedréi *or* vedría, vedrésti, vedrébbe *or* vedría; vedrémmo, vedréste, vedrébbero *or* vedríano.

IMP. Védi *or* ve'; véda, végga, *or* véggia. Vediámo *or* veggiámo; vedéte; védano, véggano, *or* véggiano.

SUB. *Pres.* Che véda, végga, *or* véggia; che véda, végga, véggia, *or* véggi; che véda, végga, *or* véggia. Che vediámo *or* veggiámo; che vediáte *or* veggiáte; che védano, véggano, *or* véggiano.—*Imp.* Che vedéssi, che vedéssi, che vedésse; che vedéssimo, che vedéste, che vedéssero.

After this example conjugate the following irregular verbs :—

Antivedére, *to foresee.*	Ravvedérsi, *to amend.*
Avvedérei, *to perceive.*	Rivedére, *to see again.*
Disvedére, *to neglect.*	Sopravvedére, *to observe attentively.*
Divedére, *to show.*	Sprovvedére, *to leave destitute.*
Malvedére, *to h[illegible]e.*	Stravedére, *to see much.*
Prevedére, *to foresee.*	Travedére, *to see double.*
Provvedére, *to provide.*	

19. The irregular verb *volére*, to be willing, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Volére, *to be willing.—Pres. Gerund.* Voléndo, *being willing.—Past Part.* Volúto, *been willing.*——*Compound Tenses.—Past.* Avére volúto, *to have been willing.—Past Gerund.* Avéndo volúto, *having been willing.*

IND. *Pres.* Vóglio *or* vo'; vuói, vuóli, *or* vuo'; vuóle. Vogliámo; voléte; vógliono.—*Imp.* Voléva *or* voléa; volévi *or* voléi; voléva, voléa, *or* volía. Volevámo; voleváte; volévano *or* voléano.—*Ind. Pret.* Vólli, volésti, vólle; volémmo, voléste, vóllero.—*Fut.* Vorrò, vorrái, vorrà; vorrémo, vorréte, vorránno.—*Cond. Pres.* Vorréi *or* vorría; vorrésti; vorrébbe *or* vorría. Vorrémmo; vorréste; vorrébbero, vorríano, *or* vorríeno.

(*This verb, according to good Italian grammarians, has no Imperative.*)

SUB. *Pres.* Che vóglia, che vóglia, che vóglia; che vogliámo, che vogliáte, che vógliano.—*Imp.* Che voléssi, che voléssi, che volésse; che voléssimo, che voléste, che voléssero.

After this example conjugate the following irregular verbs :—

Disvolére, *to refuse.*	Stravolére, *to wish for too much.*
Rivolére, *to wish again.*	Svolére, *to change one's mind.*

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II.—IRREGULAR VERBS ENDING IN *ere* SHORT.

1. *Verbs ending in* CERE.

(1.) The irregular verb *conóscere*, to know, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Conóscere, *to know.—Pres. Gerund.* Conoscéndo, *knowing.—Past Part.* Conosciúto, *known.——Compound Tenses. —Past.* Avére conosciúto, *to have known.—Past Gerund.* Avéndo conosciúto, *having known.*

IND. *Pres.* Conósco, conósci, conósce; conosciámo, conoscéte, conóscono.—*Imp.* Conoscéva *or* conoscéa, conoscévi, conoscéva *or* conoscéa; conoscevámo, conoscevàte, conoscévano *or* conoscéano.—*Ind. Pret.* Conóbbi, conoscésti, conóbbe; conoscémmo, conoscéste, conóbbero.—*Fut.* Conoscerò, conoscerái, conoscerà; conoscerémo, conosceréte, conosceránno.—*Cond. Pres.* Conoscerèi *or* conoscería; conoscerésti; conoscerébbe. Conoscerémmo; conosceréste; conoscerébbero, conosceríano, *or* conosceríeno.

IMP. Conósci, conósca; conosciámo, conoscéte, conóscano.

SUB. *Pres.* Che conósca, che conósca *or* conósci, che conósca; che conosciámo, che conosciáte, che conóscano.—*Imp.* Che conoscéssi, che conoscéssi, che conoscésse; che conoscéssimo, che conoscéste, che conoscéssero.

After this example conjugate the following irregular verbs :—

Preconóscere, *to foresee.*	Riconóscere, *to know again.*
Sconóscere, *to be ungrateful.*	

(2.) The irregular verb *créscere*, to grow, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Créscere, *to grow.—Pres. Gerund.* Crescéndo, *growing.—Past Part.* Cresciúto, *grown.——Compound Tenses.—Past.* Avére cresciúto, *to have grown.—Past Gerund.* Avéndo cresciúto, *having grown.*

IND. *Pres.* Crésco, crésci, crésce; cresciámo, crescéte, créscono.—*Imp.* Crescéva *or* crescéa, crescévi, crescéva *or* crescéa; crescevámo, crescevàte, crescévano *or* crescéano.—*Ind. Pret.* Crébbi; crescésti; crébbe. Crescémmo; crescéste; crébbero, crescéro, *or* crescér.—*Fut.* Crescerò, crescerái, crescerà; crescerémo, cresceréte, cresceránno.—*Cond. Pres.* Crescerèi *or* crescería, crescerésti, crescerébbe *or* crescería; crescerémmo, cresceréste, crescerébbero *or* cresceriano.

IMP. Crésci, crésca; cresciámo, crescéte, créscano.

SUB. *Pres.* Che crésca, che crésca, che crésca; che cresciámo, che cresciáte, che créscano.—*Imp.* Che crescéssi, che crescéssi, che crescésse; che crescéssimo, che crescéste, che crescéssero.

After this example conjugate the following irregular verbs :—

Accréscere, *to increase.*	Ricréscere, *to grow again.*
Decréscere, *to decrease.*	Riacréscere, *to increase.*
Discréscere, *to decrease.*	Rincréscere, *to displease.*
Incréscere, *to be tired.*	Scréscere, *to diminish.*

(3.) The irregular verb *cuócere*, to cook or bake, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Cuócere, *to cook.—Pres. Gerund.* Cocéndo *or* cuocéndo, *cooking.—Past Part.* Cótto, *cooked.——Compound Tenses.—Past.* Avére cótto, *to have cooked.—Past Gerund.* Avéndo cótto, *having cooked.*

IND. *Pres.* Cuóco, cuóci, cuóce; cociámo *or* cuociámo, cocéte *or* cuocéte, cuócono.—*Imp.* Cocéva, cocéa, *or* cuocéva; cocévi *or* cuocévi; cocéva *or* cuocéva. Cocevámo *or* cuocevámo; cocevàte *or* cuocevàte; cocévano *or* cuocévano.—*Ind. Pret.* Cóssi, cocésti *or* cuocésti, cósse; cocémmo *or* cuocémmo, cocéste *or* cuocéste, cóssero.—*Fut.* Cuocerò *or* cocerò, cuocerái *or* cocerái, cuocerà *or* cocerà; cuocerémo *or* cocerémo, cuoceréte *or* coceréte, cuoceránno *or* coceránno.—*Cond. Pres.* Cuocerèi, cocerèi, *or* cocería; cuocerésti *or* cocerésti; cuocerébbe, cocerébbe, *or* cocería. Cuocerémmo *or* cocerémmo; cuoceréste *or* coceréste; cuocerébbero, cocerébbero, *or* coceríano.

IMP. Cuóci, cuóca; cuociámo *or* cociámo, cuocéte *or* cocéte, cuócano.

SUB. *Pres.* Che cuóca *or* cuócia, che cuóca, che cuóca; che cociámo, che cociáte, che cuócano *or* cuóciano.—*Imp.* Che cocéssi *or* cuocéssi, che cocéssi *or* cuocéssi, che cocésse *or* cuocésse; che cocéssimo *or* cuocéssimo, che cocéste *or* cuocéste, che cocéssero *or* cuocéssero.

After this example conjugate the following irregular verbs :—

Concuócere, *to concoct.*	Ricuócere, *to stew again.*

(4.) The irregular verb *náscere*, to be born, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Náscere, *to be born.—Pres. Gerund.* Nascéndo, *being born.—Past Part.* Náto, *been born.——Compound Tenses.—Past.* Éssere náto, *to have been born.—Past Gerund.* Esséndo náto, *having been born.*

IND. *Pres.* Násco, násci, násce; nasciámo, nascéte, náscono.—*Imp.* Nascéva, nascévi, nascéva; nascevámo, nascevàte, nascévano.—*Ind. Pret.* Nácqui, nascésti, nácque *or* nascéo; nascémmo, nascéste, nácquero.—*Fut.* Nascerò, nascerái, nascerà; nascerémo, nasceréte, nasceránno.—*Cond. Pres.* Nascerèi; nascerésti; nascerébbe *or* nascería. Nascerémmo; nasceréste; nascerébbero, nasceríano, *or* nasceríeno.

IMP. Násci, násca; nasciámo, nascéte, náscano.

SUB. *Pres.* Che násca, che násca *or* náschi, che násca; che nasciámo, che nasciáte, che náscano.—*Imp.* Che nascéssi, che nascéssi, che nascésse; che nascéssimo, che nascéste, che nascéssero.

After this example conjugate the following :—

Soprannáscere, *to spring on or after something.*	Rináscere, *to be born again.*

(5.) The irregular verb *nuócere*, to hurt, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Nuócere, *to hurt.—Pres. Gerund.* Nocéndo *or* nuocéndo, *hurting.—Past Part.* Nociúto, *hurt.——Compound Tenses. —Past.* Avére nociúto, *to have hurt.—Past Gerund.* Avéndo nociúto, *having hurt.*

IND. *Pres.* Nuóco, nuóci, nuóce *or* nóce; nociámo *or* nuociámo, nocéte *or* nuocéte, nuócono.—*Imp.* Nocéva, nocéa, *or* nuocéva; nocévi *or* nuocévi; nocéva *or* nuocéva. Nocevámo *or* nuocevámo; nocevàte *or* nuocevàte; nocévano *or* nuocévano.—*Ind. Pret.* Nócqui, nocésti *or* nuocésti, nócque; nocémmo *or* nuocémmo, nocéste, nócquero *or* nuócquero.—*Fut.* Nuocerò *or* nocerò, nuocerái *or* nocerái, nuocerà *or* nocerà; nuocerémo *or* nocerémo, nuoceréte *or* noceréte, nuoceránno *or* noceránno.—*Cond. Pres.* Nocerèi *or* nuocerèi; nocerésti *or* nuocerésti; nocerébbe, nocería, *or* nuocerébbe. Nocerémmo *or* nuocerémmo; noceréste *or* nuoceréste; nocerébbero, nuocerébbero, noceriano, *or* noceríeno.

IMP. Nuóci, nuóca; nuociámo, nuocéte, nuócano.

SUB. *Pres.* Che nuóca, che nuóca, che nuóca; che nuociámo *or* nociámo, che nuociáte *or* nociáte, che nuócano.—*Imp.* Che nocéssi, che nocéssi, che nocésse; che nocéssimo, che nocéste, che nocéssero.

(6.) The irregular verb *rilúcere*, to shine, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Rilúcere, *to shine.—Present Gerund.* Rilucéndo, *shining.—(No Past Participle).*

IND. *Pres.* Rilúco, rilúci, rilúce; riluciámo, rilucéte, rilúcono.—*Imp.* Rilucéva *or* rilucéa, rilucévi, rilucéva; rilucevámo, rilucevàte, rilucévano *or* rilucéano.—*Ind. Pret.* Rilússi *or* rilucéi; rilucésti; rilússe, rilucè, *or* rilucéo. Rilucémmo; rilucéste; rilússero *or* rilucérono.—*Fut.* Rilucerò, rilucerái, rilucerà; rilucerémo, riluceréte, riluceránno.—*Cond. Pres.* Rilucerèi *or* rilucería; rilucerésti; rilucerébbe *or* rilucería. Rilucerémmo; riluceréste; rilucerébbero, riluceríano, *or* riluceríeno.

IMP. Rilúci, rilúca; riluciámo, rilucéte, rilúcano.

SUB. *Pres.* Che rilúca, che rilúca *or* rilúci, che rilúca; che riluciámo, che riluciáte, che rilúcano.—*Imp.* Che rilucéssi, che rilucéssi, che rilucésse; che rilucéssimo, che rilucéste, che rilucéssero.

After this example conjugate the following :—

Lúcere, *to shine.*	Prelúcere, *to precede with a light.*

(7.) The irregular verb *tórcere*, to twist, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Tórcere, *to twist.—Pres. Gerund.* Torcéndo, *twisting.—Past Part.* Tórto, *twisted.——Compound Tenses.—Past.* Avére tórto, *to have twisted.—Past Gerund.* Avéndo tórto, *having twisted.*

IND. *Pres.* Tórco, tórci, tórce; torciámo, torcéte, tórcono.—*Imp.* Torcéva *or* torcéa, torcévi, torcéva *or* torcéa; torcevámo, torcevàte, torcévano *or* torcéano.—*Ind. Pret.* Tórsi, torcésti, tórse; torcémmo, torcéste, tórsero.—*Fut.* Torcerò, torcerái, torcerà; torcerémo, torceréte, torceránno.—*Cond. Pres.* Torcerèi, torcerésti, torcerébbe; torcerémmo, torceréste, torcerébbero.

IMP. Tórci, tórca; torciámo, torcéte, tórcano.

SUB. *Pres.* Che tórca, che tórca, che tórca; che torciámo, che torciáte, che tórcano.—*Imp.* Che torcéssi, che torcéssi, che torcésse; che torcéssimo, che torcéste, che torcéssero.

After this example conjugate the following :—

Attórcere, *to twist.*	Estórcere, *to pull with violence.*

(8.) The irregular verb *víncere*, to conquer, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Víncere, *to conquer.—Pres. Gerund.* Vincéndo, *conquering.—Past Part.* Vinto, *conquered.——Compound Tenses.—Past.* Avére vinto, *to have conquered.—Past Gerund.* Avéndo vinto, *having conquered.*

IND. *Pres.* Vínco, vínci, vince; vinciámo, vincéte, víncono.—*Imp.* Vincéva, vincévi, vincéva; vincevamo, vincevàte, vincévano.—*Ind. Pret.* Vínsi, vincésti, vínse; vincémmo, vincéste, vínsero.—*Fut.* Vincerò, vincerái, vincerà; vincerémo, vinceréte, vinceránno.—*Cond. Pres.* Vincerèi, vincerésti, vincerébbe; vincerémmo, vinceréste, vincerébbero.

IMP. Vínci, vínca; vinciámo, vincéte, víncano.

SUB. *Pres.* Che vínca, che vínca *or* vínci, che vínca; che vinciámo, che vinciáte, che víncano.—*Imp.* Che vincéssi, che vincéssi, che vincésse; che vincéssimo, che vincéste, che vincéssero.

After this example conjugate the following :—

Avvíncere, *to tie up.*	Rivíncere, *to conquer again.*
Convíncere, *to convince.*	Sopravíncere, *to conquer again.*

2. *Verbs ending in* DERE.

(1.) The irregular verb *árdere*, to burn, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Árdere, *to burn.—Pres. Gerund.* Ardéndo, *burning.—Past Part.* Árso, *burnt.——Compound Tenses.—Past.* Avére árso, *to have burnt.— Past Gerund.* Avéndo árso, *having burnt.*

IND. *Pres.* Árdo, árdi, árde; ardiámo, ardéte, árdono.—*Imp.* Ardéva *or* ardéa, ardévi, ardéva *or* ardéa; ardevámo, ardeváte, ardévano *or* ardéano.—*Ind. Pret.* Ársi, ardésti, árse *or* ardéo; ardémmo, ardéste, ársero.—*Fut.* Arderò, arderái, arderà; arderémo, arderéte, arderánno.—*Cond. Pres.* Arderéi *or* ardería, arderésti, arderébbe *or* ardería; arderémmo, arderéste, arderébbero *or* arderíano.

IMP. Árdi, árda; ardiámo, ardéte, árdano.

SUB. *Pres.* Che árda, che árda *or* árdi, che árda; che ardiámo, che ardiate, che árdauo.—*Imp.* Che ardéssi, che ardéssi, che ardésse; che ardéssimo, che ardéste, che ardéssero.

After this example conjugate the following :—

Infinitive.	*Ind. Pret.*	*Past Part.*	*English.*
Acchiúdere,	acchiúsi,	acchiúso,	*to inclose.*
Chiédere,	chiési,	chiésto,	*to ask.*
Decídere,	decísi,	decíso,	*to decide.*
Elídere,	elísi,	elíso,	*to retrench.*
Illúdere,	illúsi,	illúso,	*to mock.*
Mórdere,	mórsi,	mórso,	*to bite.*
Precídere,	precísi,	precíso,	*to shorten.*
Rídere,	rísi,	ríso,	*to laugh.*
Schiúdere,	schiúsi,	schiúso,	*to open.*
Spérdere,	spérsi,	spérso,	*to dissipate.*
Succédere,	succéssi,	succésso,	*to succeed.*
Uccídere,	uccísi,	uccíso,	*to kill.*

(2.) The irregular verb *rispóndere*, to answer, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Rispóndere, *to answer.—Pres. Gerund.* Rispondéndo, *answering.—Past Part.* Rispósto, *answered.——Compound Tenses.—Past.* Avére rispósto, *to have answered.—Past Gerund.* Avéndo rispósto, *having answered.*

IND. *Pres.* Rispóndo, rispóndi, rispónde; rispondiámo, rispondéte, rispóndono.—*Imp.* Rispondéva, rispondévi, rispondéva; rispondevámo, rispondeváte, rispondévano.—*Ind. Pret.* Rispósi, rispondésti, rispóse; rispondémmo, rispondéste, rispósero.—*Fut.* Risponderò, risponderái, risponderà; risponderémo, risponderéte, risponderánno.—*Cond. Pres.* Risponderéi, risponderésti, risponderébbe; risponderémmo, risponderéste, risponderébbero.

IMP. Rispóndi, rispónda; rispondiámo, rispondéte, rispóndano.

SUB. *Pres.* Che rispónda, che rispónda, che rispónda; che rispondiámo, che rispondiáte, che rispóndano.—*Imp.* Che rispondéssi, che rispondéssi, che rispondésse; che rispondéssimo, che rispondéste, che rispondéssero.

After this example conjugate the following :—

Infinitive.	*Ind. Pret.*	*Past Part.*	*English.*
Accéndere,	accési,	accéso,	*to light.*
Confóndere,	confúsi,	confúso,	*to confound.*
Difféndere,	difési,	diféso,	*to defend.*
Fóndere,	fúsi,	fúso *or* fondúto,	*to melt.*
Impéndere,	impési,	impéso *or* impendúto,	*to hang on.*
Nascóndere,	nascósi,	nascóso *or* -sto,	*to conceal.*
Offéndere,	offési,	offéso,	*to offend.*
Préndere,	prési,	préso,	*to take.*
Réndere,	rési,	réso *or* rendúto,	*to render.*
Scéndere,	scési,	scéso,	*to come down.*
Tóndere,	tósi,	tondúto,	*to shear.*

VOCABULARY.

Ammirare, to admire.
Ammutire, to be dumb.
Apparecchiáre, to prepare.
Bastánza, sufficiency.
Bisognáre, to be necessary.
Cavaliére, a knight, gentleman.
Certo, certain, certainly.
Compire, to finish, complete.
Compliménto, a compliment.
Complíre, to compliment.
Deputáto, a deputy.
Digiúno, fasting.
Diventare, to become.
Dovére, to be obliged, owe, have to.
Entrare, to enter.
Fanciullézza, childhood.
Ingégno, genius, natural ability.
Mandare, to send.
Matúro, -a, mature.
Medésimo, itself.
Mostráre, to show.
Notáre, to observe.
Occórrere, to happen, to be necessary.
Pittóre, a painter.
Pranzo, a dinner.
Pregiársi, to boast, pique one's self.
Principíno, a young prince.
Profferire, to utter.
Prontezza, promptitude.
Pure, however.
Quadro, a picture.
Senato, the senate.
Sentire, to perceive.
Sontuóso, sumptuous.
Stare, to stand.
Stúpido, stupid.
Súbito, sudden, suddenly.
Ténero, -a, tender.
Toccare, to touch, concern.
Vivacità, vivacity.

EXERCISE 46.

Stando certi cavaliéri ammirándo la vivacità e prontézza d' ingégno di Pico di Mirándola, che pure non avéva compíto ancóra l' anno nono dell' età sua: un vecchio goffo venne à dire in presénza di questo principíno: "Quando li fanciúlli nella ténera età loro hanno tanto ingégno, divéntano poi nell' età matúra stúpidi e goffi." Allóra disse Pico, "Se ciò che dite è vero; bisógna certo ch' abbiáte avúto nella vostra fanciullézza un' eccellentíssimo* ingégno."

EXERCISE 47.

Dovendo un rè a due ore dopo mezzo dì entrár in una città, gli fúrono mandáti dal senáto certi deputáti per fargli compliménto. Colúi al quale toccáva di complíre, disse, "Alessándro Magno, il Grand' Alessándro;" e súbito s' ammutì senza potér più proferír alcúna paróla; il che avéndo notáto il rè, chi in quel giorno non avéva ancóra mangiáto, gli disse: "Sì, amíco, Alessándro Magno ha pranzáto, e ío son ancor digiúno:" e ciò detto sen'† andò verso il palázzo del senáto dove gli era stato apparecchiáto un sontuosíssimo pranzo.

EXERCISE 48.

Un pittóre mostrándo un cattívo quadro in presénza di molti pottóri di gran grido, si pregiáva d' avérlo finíto in pochíssimo tempo, il che senténdo Apélle, gli disse piacevolménte: "Non occórre che tu ci dica d' avérlo finíto in poco tempo, che 'l quadro medésimo lo dice à bastanza da per se."

KEY TO EXERCISES IN LESSONS IN ITALIAN.—XXXIV.

EXERCISE 45.

1. One was asked why he had married a deaf person. He replied: "I married such a one, believing that in time she must also become dumb."

2. A gentleman wishing to joke with his neighbour, a cunning barber, said to him, "How many simpletons are there in your street?" To which the barber answered, "We are about a dozen without reckoning your lordship."

3. A rich fool having had himself represented in marble, showed that figure to a friend of his, and asked if the sculptor had well taken the likeness. To whom the other answered, "Perfectly indeed, for it resembles you both in mind and body."

LESSONS IN LOGIC.—VI.

FALLACIES—WRITERS ON LOGIC.

THERE was a rather celebrated fallacy which seemingly proved that motion was impossible: "Whatever body moves must move either in the place where it is, or in the place where it is not; neither of these is possible; therefore, a body cannot move at all." The true solution of this sophism, as pointed out by Hobbes and Mr. Mansel, is, that the major premiss is false. It is not true that a body must move either in the place where it is or in the place where it is not; for it may, as it does, move partly in the one and partly in the other; and the fallacy thus lies, not in the form, but in the matter.

One more example of these ingenious puzzles may be given: "He who is most hungry eats most; he who eats least is most hungry; therefore he who eats least eats most." The true solution of this manifestly is that there are in the supposed syllogism more than three terms, inasmuch as what is really meant is, "He who is most hungry *will eat* most; he who *has eaten* most is most hungry; therefore, he who *has eaten* least *will eat* most."

It would not, however, be suitable to dwell longer upon such fallacies as these, which, even by their inventors, were looked on rather as amusing exercises for the ingenious than as leading to any useful or practical result.

It should always be borne in mind that the ambiguity of words is, perhaps, the most fruitful source of undetected fallacy in reasoning, whether it be solitary or in controversy with others. Words are constantly made use of in senses which, though apparently identical, are really different, and are thus made the means of arriving at conclusions wholly erroneous. A list of words of this kind, with illustrations of their employment, may be seen in the appendix to Archbishop Whately's "Treatise on Logic;" and such a list might easily be largely extended, and illustrated by numerous examples from polemical discussions. It will therefore be useful to mention a few of the instances

* The superlative of *eccelente*, formed, according to the ordinary rule, by adding *issimo* to the last consonant of the positive.

† For *se ne.*

which he gives of words whose different senses are likely to be confounded.

"Impossibility" (with its kindred words) is used with three different and distinct meanings. 1. It is employed to denote *mathematical* impossibility. Anything is so called which involves an absurdity or a contradiction, this name being given from the fact that the greater number of instances of it occur in the mathematical sciences: *e.g.*, that two straight lines should enclose a space is a mathematical impossibility. It is absurd, inconceivable, and a contradiction in terms, being at variance with the very definition of a straight line. It amounts, in fact, to this, that the same line should be straight and not straight at the same time. 2. A *physical* impossibility is something at variance with the existing laws of Nature, and which cannot take place while those laws remain as they are: *e.g.*, that a man should be able to live under water, or that a feather and a stone should fall to the ground in the same space of time. There is not here, as in a mathematical impossibility, any *inconceivability* implied. We can quite readily conceive the existing laws of nature altered so that a man should have the power of living under water, and a feather and a stone have the same weight (*i.e.*, be attracted with eqnal power towards the earth). There is no contradiction involved in imagining this to be so; and we, in fact, know that, whenever a *miracle* has been performed, snch a suspension or violation of the laws of Natnre *has been* brought about by the power of the Supreme Being. *We* cannot, however, surmount these laws, and so they impose restrictions upon us which it is a physical impossibility for us to overcome. Persons have been often led into error in reasoning throngh not keeping these two senses of the word distinct. 3. The word "impossibility" is used to denote that strong degree of certainty which leaves no room for doubt upon the mind. We may be convinced that a certain event will never occur, even thongh it does not involve either a contradiction or a violation of any of the known laws of Natnre. Snch an event is termed a *moral* impossibility. A good instance occurs in throwing dice. It is a moral impossibility that we should throw sixes a hundred times successively. We are certain, from our experience and reason, that such a contingency will not occur, althongh its occurrence is undoubtedly neither a mathematical nor a physical impossibility. So also it wonld be said to be morally impossible for all the inhabitants of England to be perfectly free from the commission of crime, although it is within the *power* of every individual inhabitant to refrain from any criminal act. We know, however, that while the world remains as it is such a state of things will never happen.

The words *may* and *must* have also two senses, which are not unfreqnently confounded with one another. They sometimes refer to *power*. Thns, when I say, "I *may* leave this room," I mean that I have tho power to do so when I please; or "a prisoner *must* remain in his cell," that the physical restraint he is under deprives him of the power of acting otherwise. But sometimes these words merely refer to possibility or *contingency*. "A particular individual *may* die to-morrow," merely implies the possibility of such an event as his death; or, "we *must* all die some day," merely expresses the *certainty* wo feel that we are all mortal.

It frequently escapes notice that the word *same* is used in two senses. Its primary sense is, of course, that which denotes absolute identity. In that sense I say (for example) that the shilling now before me is the *same* that I got from a certain person in change yesterday—the two being numerically one. I use the word, however, in a very different sense when I say that two persons are afflicted with the *same* disease, or have hair of the *same* colour. In *this* case, all that I mean is that tho two illnesses or the two kinds of hair are *similar*, that the very same description would apply to each. Archbishop Whately thinks that nothing has had such an effect in fostering Realism as the non-attention to this distinction between the primary and secondary use of "same" and kindred words. And it will not be out of place to give a brief account of what is involved in the famous controversy between the Nominalists and Realists which waged so fnriously in the Middle Ages.

The question which gave birth to so many different schools of thought might be treated in various ways. Perhaps the shortest statement that could be given of it is this—What is the object of our thonghts when we make use of general or universal terms? There is no difficulty, so long as we use a singular term, one which relates only to a single individual: *e.g.*, "Peter," "Julius Cæsar," "this tree," "this monntain." Here the object of which we are thinking, and which is present to our mind, can be nothing else than the one individual for which the name stands. When, however, we make use of the corresponding general or universal terms, "man," "conqueror," "tree," "mountain," the case is different. Here we cannot accurately specify the object of our thoughts with the same facility as before. We have no longer a term which is applicable to one object and one only; but one which is applicable to an indefinite number of objects—to as many, in fact, as the generic or universal term stands for. What, then, is the actual object of thought present to our minds when we use such a term? This was the snbject of controversy; and various were the answers given to the question.

Those called the Realists maintained that there was a really existing thing corresponding to the universal terms, "man," "conqueror," "mountain," etc., as truly as there was corresponding to the singular terms, "Peter," "Julins Cæsar," "Ætna," etc. This really existing thing was not the same as that denoted by the name (for instance) of an individual mountain, *e.g.*, Ætna, or else the term would be not universal but singular; but yet since the universal was applicable to the individual, this thing (whatever its nature) must exist *in* the individnal, althongh distinct from it.

The Nominalists held, on the other hand, that it is the mere term or *name* of which we think when we employ a general or universal term. It is the *word* "mountain" or "tree" which is present to our thonghts, and not any *thing*, whether universal or particular.

Varions intermediate views between these two extremes were advanced by different thinkers from time to time, which it is very often extremely difficult to distinguish one from another, and which it is unnecessary to enumerate here. Archbishop Whately's view, however, may be mentioned. According to him, the notion expressed by a universal term is merely an incomplete or inadequate notion of an individnal. The complex idea represented by the universal term omits every circumstance which makes the individual differ from other individuals of the same class (whether genus or species), and only embraces all those common features which are to be found in all the individuals of the class, *i.e.*, in all those to which the universal term can be applied: *e.g.*, "If I omit the mention and the consideration of every circumstance which distinguishes Ætna from any other mountain, I then form a notion (expressed by the common term 'mountain') which *inadequately* designates Ætna (*i.e.*, which does not imply any of its peculiarities, or its nnmerical singleness), and is equally applicable to any one of several other individnals."

Having now shortly gone through the different rules of Logic, and seen its practical application, amongst other things, in the detection of erroneous reasoning; and having, we hope successfully, shown that the study is neither so uninteresting or so useless as is frequently asserted, it is necessary, to make our outline complete, to give a brief sketch of the history of Logic down to the present day, that its progressive development may be the better seen.

The earliest writer upon any of the subjects embraced by Logic (which he called Dialectics) was Zeno the Eleatic; bnt his ideas upon the subject were so crude and limited, and his consideration of it so partial, that he hardly merits the name of a logician, as the term was subseqnently understood.

Socrates is stated by Aristotle to have made two important logical discoveries—induction and definition. The Socratic indnction, however, differed very much from that of Aristotle and subsequent writers, and was not, strictly speaking, a *logical* process at all; and a similar remark is true of his definition. Nor does Plato, so far as we are able to distinguish his views and discoveries from those of Socrates, appear to have contributed much additional to the science, except that we find that he analysed correctly the proposition into its two component elements—the noun and verb.

Bnt Aristotle is to be considered as the first writer who attempted to treat logical questions distinctly and npon a systematic plan, although many of the subjects which (at least as his works have come down to us) he inclnded within its limits would not be allowed a place in a logical treatise at the present day. Still most of the essential elements of pure Logic are to be found contained in his work called the "Organon."

Those who bestowed any attention upon the study in the period immediately after that of Aristotle need not be noticed. The Stoics, indeed, are said to have invented the *name* of Logic, and also the threefold division of philosophy into logic, physics, and ethics. Nor is it necessary to dwell upon the writings of Alexander of Aphrodisias and the other Greek commentators (on the works of Aristotle) who flourished from the second and third centuries of the Christian era down to the end of the sixth. One of them, Porphyry, was the author of the fivefold classification of the predicables into genus, species, difference, property, and accident, already mentioned.

Boethius, who lived in the sixth century, is the only Latin commentator upon Aristotle deserving of the name; and his works form the connecting link between the Greek writers upon Logic and the Schoolmen of later times.

The famous scholastic philosophy, including the periods of its infancy, progress, and decline, extended from the eleventh to the close of the sixteenth century. No doubt, in Logic, as in the other arts and sciences of which they pursued the study, the Schoolmen were too fond of over-subtle and refined inquiries; and upon this account they have been frequently treated with a contempt little merited by the ability or research which they devoted to almost every branch of learning with which the world was then acquainted; and with which they started subjects which the discoveries of later days have often enabled their successors successfully to investigate and follow up. Perhaps their chief service to the study of Logic was in fixing what may be called its terminology. They determined with a greater precision than had previously been exhibited the technical terms of the science, although they often carried to an extreme and wearisome degree of minuteness their distinctions between the various uses and significations of words in general. They also exhibited in many respects a truer and more exact conception of the nature and office of Logic than Aristotle had done; and it was with them that the famous controversy (already mentioned) between the Nominalists and Realists was begun and mainly carried on.

From the time of the Schoolmen down to that of Kant, many names of more or less note occur; amongst which may be mentioned Bacon, Hobbes, Gassendi, Descartes, Locke, Leibnitz, and Wolf. The famous German philosopher, Kant, has, however, done far more for the science of Logic than any other writer since the days of Aristotle. He defined it, in his celebrated work called the "Critique of the Pure Reason," as "the science of the necessary laws of thought," a conception of its field upon which we shall make one or two remarks afterwards; and by clearly pointing out what was and what was not to be regarded as coming within its province, he rendered the work of subsequent writers more definite and easy.

Logic has usually been popularly treated in the manner in which it has been by Aldrich and Archbishop Whately, as conversant with *reasoning* alone, to the exclusion of the other operations of the mind; but the more correct and scientific notion of it would make it embrace the analysis and consideration of the laws of *thought* in general, and not merely of the laws of reasoning in particular. This is the view of Sir W. Hamilton and Mr. Mansel; and it is one which of course makes no practical difference in the rules such as have been already given with reference to syllogistic reasoning, but merely exhibits, as well as these, laws which are applicable to all thought, no matter on what employed, and which no sound *thinker* is at liberty to transgress, just as no sound *reasoner* can transgress the laws stated as applicable to the syllogism.

It will, then, be well, without entering into a deep metaphysical discussion, for which there is not space, to examine what are the different processes of thought to which the science of Logic is, according to these writers, to be applied. These are laid down as three—conception, judgment, and reasoning, of which the two latter processes have been already explained, and the first corresponds to simple apprehension.

It might, no doubt, seem at first sight as if any laws with reference to our conceptions must be useless; as if our apprehension obeyed no laws. This is only partly true, even according to popular notions; but, viewing thought and its processes as they are viewed by Logic, it is quite erroneous.

In the product resulting in our mind from any act of thought, we must always distinguish between what is called the *matter* and what is called the *form*. The former is all that is given *to* the mind, from whatever source obtained, previous to the act of thought, and to enable it to perform it; while the latter is the shape given to these materials *by* the mind itself in the act of thought which it performs. Thus in conception the mind is *given* certain attributes, which it combines by the act of thought into a whole resembling and representing an object of intuition (*i.e.*, to explain it popularly, some object which we have learnt by means of sensation, perception, or imagination), to which a name is subsequently given: *e.g.*, my concept (as it is called) of "man" is made up by the act of conception of the given attributes of reason, life, etc.

By the act of judging, similarly, the concepts which are *given* are thought as being related in some manner (*e.g.*, as agreeing or disagreeing with) to an object of thought. Thus, when given the two concepts "man" and "mortal," the mind, by the act of judging, combines them into the judgment, "man is mortal."

So also in reasoning, judgments are what are given to be combined by the act of the mind and thought as necessitating another judgment following from them as their consequence. Of this, after what has been previously said in treating of the syllogism, an example is unnecessary.

We thus have, in each of the three operations of thought, to distinguish carefully between the *matter*—attributes, concepts, judgments—and the *form* conveyed in and by the act of the mind.

The *process* of thinking, too, may in each case be either formal or material. It is formal when no further materials are necessary for completing the act of thought than those originally given; it is material when the contrary is the case, and the mind is obliged to have recourse to some other source besides itself and what it can supply unaided, before it can complete the process. Suppose, for instance, that when I am given two attributes—A and B—I am able to think them as co-existing together in an object, without having first to appeal to experience to learn whether any object is actually in existence which possesses them both, I have performed an act of formal conception. But if I have to wait for the evidence of experience, my act of conception becomes material. So also it is with judging and reasoning. Whenever the judgment or conclusion can be formed by the mind with the data originally given, and without the necessity of having recourse to the aid of experience, the process is formal; if otherwise, material.

Those, then, who regard Logic as the science of the laws of formal thinking, regard its province (considering it as a pure theoretical science, and not as applicable to other sciences) in each of these cases as being concerned only with what is formal, and as giving rules by which it can be accurately determined whether any of the laws of thought (which we cannot here discuss) have been in the process transgressed or not. That which is material, whether in the process or product of thinking, is in this view entirely outside its province; and this notion of Logic seems to be coming more and more widely current every day.

We cannot better conclude these papers upon Logic than by quoting some remarks of Archbishop Thomson, in his "Laws of Thought:"—"The attempt to apply the rules of Logic will both raise and lower the opinion which obtains concerning the worth of the science. Those who condemn it altogether, as arbitrary and artificial, as a set of rules for arguing, put together in an age when truth was less the object of desire than argument, may find to their surprise that it is only a searching and systematic account of processes which they daily perform, whether in thought or in argument, in the pursuit of a science or in the transactions of the street and market. Those, on the other hand, who expect that Logic will be to them a golden key to unlock the treasure-house of the knowledge of the universe, will find that it neither gives them, nor pretends to give, any new power; that it only refines and strengthens powers they already possess; that out of a dunce it never yet made a philosopher. Whilst its rules apply to every science, and it may therefore lay some claim to its ancient title—the Art of Arts, the Instrument of Instruments—it only assists us in the study of the sciences, not stands in their stead. We must fight our own way over every inch of ground in the field; but Logic will often prevent our throwing away our blows. . . .

We only affirm that when men think, these are the rules according to which their thoughts run; that the knowledge of laws and principles, independent of ulterior profit, is always gratifying to active minds; and that, inasmuch as the clear understanding of what is right is always useful for the avoidance of what is wrong, Logic is an useful instrument in thinking. But it gives us the forms of knowledge, not the matter. It will not lay bare the hidden springs of moral action, nor explain the mystery of life, of sleep, of fancy, of memory; nor display the future destination of man and the world. Still less will it be to us instead of eyes, if, turning away from this ball of earth on which we stand, we try to look off to the Infinite, the Absolute, the Eternal, whose nature will not take the mould of our intellectual forms; who comprehends us when we vainly think that we comprehend Him."

LESSONS IN GERMAN.—LXV.

§ 78 (*continued*).—(1.) ALPHABETICAL LIST OF VERBS OF THE OLD FORM (*concluded*).

INFINITIVE.	INDICATIVE. *Present.*	INDICATIVE. *Imp.*	SUBJUNC. *Imp.*	IMPERAT.	PARTICIP.
Thun, to do	ich thue, du thust, er thut	ich that	ich thäte	thue	gethan
Tragen, to bear	ich trage, du trägst, er trägt	ich trug	ich trüge	trage	getragen
Treffen, to hit	ich treffe, du triffst, er trifft	ich traf	ich träfe	triff	getroffen
Treiben, to drive	ich treibe, ꝛc.	ich trieb	ich triebe	treibe	getrieben
Treten, to tread	ich trete, du trittst, er tritt	ich trat	ich träte	tritt	getreten
Triefen, to drop, to trickle	ich triefe, ꝛc.	ich troff	ich tröffe	triefe	getroffen
Trinken, to drink	ich trinke, ꝛc.	ich trank	ich tränke	trinke	getrunken
Verbleichen, to die, grow pale	ich verbleiche, ꝛc.	ich verblich	ich verbliche	verbleiche	verblichen
Verderben,(43) to perish	ich verderbe, du verdirbst, er verdirbt	ich verdarb	ich verdärbe, verdürbe	verdirb	verdorben
Verdrießen, to vex	es verdrießt	es verdroß	es verdrösse	verdrieße	verdrossen
Vergessen, to forget	ich vergesse, du vergissest, er vergißt	ich vergaß	ich vergäße	vergiß	vergessen
Verhehlen, to conceal	ich verhehle, ꝛc.	ich verhehlte	ich verhehlte	verhehle	verhehlt or verhohlen
Verlieren, to loose	ich verliere, ꝛc.	ich verlor	ich verlöre	verliere	verloren
Verlöschen, to extinguish	ich verlösche, du verlöschest or verlischest, er verlöscht or verlischt	ich verlosch	ich verlösche	verlösche or verlisch	verloschen
Verschallen, (44) to die away in sound	ich verschalle, ꝛc.	ich verscholl	ich verschölle	verschalle	verschollen
Verwirren, to perplex	ich verwirre, ꝛc.	ich verwirrte	ich verwirrte	verwirre	verwirrt or verworren
Wachsen, to grow	ich wachse, du wächsest, er wächst	ich wuchs	ich wüchse	wachse	gewachsen
Wägen or Wiegen,(45) to weigh	ich wäge or wiege, du wägst or wiegst, er wägt or wiegt	ich wog	ich wöge	wäge or wiege	gewogen

(43) Verderben, to destroy (active), is also used regular. (44) But little used, except in the imperfect and participle. (45) Wägen is transitive, and wiegen is intransitive. Wiegen, to rock, is regular.

INFINITIVE.	INDICATIVE. *Present.*	INDICATIVE. *Imp.*	SUBJUNC. *Imp.*	IMPERAT.	PARTICIP.
Waschen, to wash	ich wasche, du wäschst, er wäscht	ich wusch	ich wüsche	wasche	gewaschen
Weben, (46) to weave	ich webe, ꝛc.	ich wob	ich wöbe	webe	gewoben
Weichen, (47) to yield	ich weiche, ꝛc.	ich wich	ich wiche	weiche	gewichen
Weisen, to show	ich weise, ꝛc.	ich wies	ich wiese	weise	gewiesen
Wenden, to turn	ich wende, ꝛc.	ich wendete or wandte	ich wendete	wende	gewendet or gewandt
Werben, to sue for	ich werbe, du wirbst, er wirbt	ich warb	ich würbe	wirb	geworben
Werden, to become	ich werde, du wirst, er wird	ich ward or wurde, ꝛc.	ich würde	werde	geworden; (auxiliary) werden
Werfen, to throw	ich werfe, du wirfst, er wirft	ich warf	ich wärfe, würfe	wirf	geworfen
Winden, to wind	ich winde, ꝛc.	ich wand	ich wände	winde	gewunden
Wissen, to know	ich weiß, du weißt, er weiß	ich wußte	ich wüßte	wisse	gewußt
Wollen, to will	ich will, du willst, er will	ich wollte	ich wollte	wolle	gewollt
Zeihen, to accuse of	ich zeihe, ꝛc.	ich zieh	ich ziehe	zeihe	geziehen
Ziehen, (48) to draw	ich ziehe, ꝛc.	ich zog	ich zöge	ziehe	gezogen
Zwingen, to force	ich zwinge, ꝛc.	ich zwang	ich zwänge	zwinge	gezwungen

KEY TO EXERCISES IN LESSONS IN GERMAN.

EXERCISE 173 (Vol. III., page 326).

1. Ich habe eben einen Bruder von Ihnen gesehen, welcher von Indien zurückgekommen ist. 2. Ein Freund von mir verheirathete sich vorige Woche. 3. Der Lehrer hat mir die Erklärung dieses Gegenstandes aufgetragen. 4. Hat mein Vater Ihnen aufgetragen, Ihren Bruder heute Abend zu uns einzuladen? 5. Nein, mein Herr, aber er hat mich beauftragt, meinem Vater zu sagen, daß er ihn morgen früh besuchen könnte. 6. Der Schüler reichte ihm, auf das Gesuch des Lehrers, das Buch. 7. Reichthümer reichen nicht hin, einen Menschen glücklich zu machen. 8. Ein wahrer Christ erduldet lieber große Leiden, als daß er seinen Glauben verriethe. 9. Ist das Essen schon aufgetragen? 10. Nein, mein Herr, es ist noch nicht aufgetragen; es ist noch nicht angerichtet. 11. Einem klugen Manne genügt es nicht, zu wissen, was recht ist, sondern er handelt auch recht.

EXERCISE 174 (Vol. III., page 327).

1. The sick man will not eat anything, notwithstanding he has been advised by the doctor. 2. He has eaten but very little with us. 3. My brother has recovered from his illness. 4. The recovery of this sick man progresses but slowly. 5. The church service commences at half-past ten in the morning, and is generally closed at half-past eleven. 6. He made him his most intimate friend, without having proved him beforehand, or otherwise having an evidence of his fidelity and silence. 7. Do not choose every one as a confidential friend; the empty house is open—the rich one closed; . . . choose only one, and seek not another; what is known to three will soon reach everybody. 8. Is it probable that you will come to me for a short time this afternoon? 9. Are you likely to come to the concert this evening? 10. He lives as he pleases; he depends on nobody. 11. He rises when he pleases in the morning; at one time early, at another time late. 12. He speaks and acts as he pleases, without caring for the judgment of the people. 13. I accidentally found him at home. 14. I accidentally met him at the theatre. 15. It is indeed not so easy to adapt one's self patiently to all conditions of life. 16. What this woman has said is quite true. 17. What nobody ventured he has accomplished. 18. He has accomplished the thing. 19. The child fell asleep through weariness. 20. The company got very tired, and they separated early. 21. He wearied not only me, but also my friends.

(46) Regular except with the poets, or when used figuratively. (47) Weichen, to soften, mollify, is regular. (48) Zeucht, etc., antiquated, and only in poetical usage.

ETHNOLOGY.—II.

CLASSIFICATION OF THE SUBJECT.

ETHNOLOGY must always have excited a certain measure of attention. How carefully, for instance, are the features of men belonging to different nationalities discriminated on the old Egyptian monuments! It was not, however, till modern times that the subject was prosecuted in a thoroughly scientific method. One of the first to connect his name honourably with it was a Dutchman called Peter Camper, a sketch of whose life may be found in the eleventh volume of Jardine's "Naturalist's Library." He was born at Leyden in 1722, and died in 1789. He was the author of many scientific treatises and papers; but the special publication which has enrolled his name in the list of ethnological worthies was one designed to show the connection between the science of anatomy and the arts of drawing, painting, and sculpture. It was composed by him as early as 1768, and added to in 1772 and 1786, but was not given to the world till after his death, when it appeared under the editorship of his son in 1791. Camper proposed to trace an imaginary line, which he called the facial one, down the forehead to the most prominent portion of the upper jaw; this, again, was to be met by a second one, from the external opening of the ear. The two, of course, between them would form an angle, which Camper called the *facial angle*, and which is sometimes named after himself—Camper's angle. According as it varied in size in different people measured, did he find the expression of the countenance alter; while it also afforded him an index of the intellect, which was held to increase as the facial angle advanced in size. He says, "The two extremities of the facial angle are 70° or 100°, from the negro to the Grecian antique (Fig. 1). Make it under 70°, and you describe an ourang-outang or an ape; lessen it more, and you have the head of a dog; increase the minimum, and you form a fowl—a snipe, for example, the facial angle of which is nearly parallel to the horizon." There was a good deal of truth in what Camper said, though still, as we shall afterwards see, not at all so much as he thought.

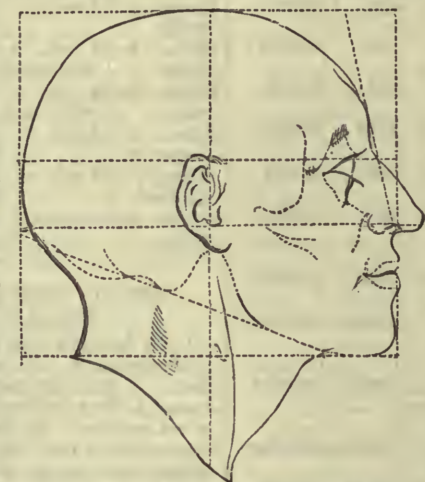


Fig. 1.—HEAD OF AN ENGLISHMAN. FACIAL ANGLE, 80°.

We come next to the great name of Blumenbach. He was born at Gotha in 1752, and died in 1840. In 1775 he published his celebrated work, "De Generis Humani Varietate Nativa," concerning the natural variety of the human race; in the third edition of which, given to the world in 1795, he subdivides mankind into five varieties, which still hold a place—though not all of them the one he assigned them—in books of ethnology. They are these: the Caucasian, the Mongolian, the Ethiopian, the American, and the Malay varieties. In the translation of his work made for the Anthropological Society by one of its vice-presidents, Mr. Thomas Bendyside, they are thus given:—

1. *The Caucasian Variety.*—"Colour white; cheeks rosy; hair brown or chestnut-coloured; head sub-globular (almost globular); face oval, straight, its parts moderately defined; forehead smooth; nose narrow, slightly hooked; mouth small; the primary teeth placed perpendicularly to each jaw; the lips (especially the lower one) moderately open; the chin full and rounded: in general, that kind of appearance which, according to our opinion of symmetry, we consider most handsome and becoming." To this first variety, Blumenbach assigns most of the inhabitants of Europe, excepting the Finns, Laplanders, etc.; also the inhabitants of western Asia as far as the river Obi, the Caspian Sea, and the Ganges. To these, finally, he adds the inhabitants of northern Africa.

2. *The Mongolian Variety.*—"Colour yellow; hair black, stiff, straight, and scanty; head almost square; face broad, at the same time flat and depressed, the parts therefore less distinct, and, as it were, running into one another; glabella (meaning the space between the eyebrows) flat and very broad; nose small, apish; cheeks usually globular, prominent outwardly; the opening of the eyelids narrow, linear; chin slightly prominent." To this variety Blumenbach assigns the Finns, Laplanders, etc., in Europe; all the Asiatics, except those already mentioned, and the Malays; and, finally, the Esquimaux in America. (Fig. 2.)

3. *The Ethiopian Variety.*—"Colour black; hair dark and curly; head narrow, compressed at the sides; forehead knotty, uneven; malar (cheek) bones protruding outwards; eyes very prominent; nose thick, mixed up, as it were, with the wide jaws; alveolar ridge (meaning the ridge in which are the sockets of the teeth) narrow, elongated (lengthened) in front, the upper primaries (among the teeth) obliquely prominent; the lips, especially the upper, very puffy; chin retreating. Many are bandy-legged." Under this variety he ranks the inhabitants of Africa, except those of its northern part.

4. *The American Variety.*—"Copper-coloured; hair black, stiff, straight, and scanty; forehead short; eyes set very deep; nose somewhat apish, but prominent; the face invariably broad, with cheeks prominent, but not flat or depressed; its parts, if seen in profile, very distinct and, as it were, deeply chiselled; the shape of the forehead and head in many artificially distorted." Under this variety Blumenbach includes all the North American Indians, with the exception of the Esquimaux.

5. *The Malay Variety.*—"Tawny-coloured; hair black, long, shining, thick, and plentiful; head moderately narrowed; forehead slightly swelling; nose full, rather wide, as it were diffuse, and thick; mouth large; upper jaw somewhat prominent, with the parts of the face, when seen in profile, sufficiently prominent and distinct from each other." To this last variety belong the inhabitants of the Malay peninsula, as also many of the islanders of the Pacific Ocean.

The great naturalist, Baron Cuvier, reduced Blumenbach's five varieties to three, believing the red men of America and the Malays of the Eastern Archipelago to have sprung originally from the Asiatic Mongolians.

It will be convenient here to depart from the strict chronological order of events, and pass at once to Dr. Prichard, a former president of the Ethnological Society of London, whose name is regarded with high consideration on the Continent as well as here. In the third edition of his "Researches into the Physical History of Mankind" (London, 1836), he thus divides the human race:—(1) Iranians, and (2) Turanians (these being the two families designated by Blumenbach Caucasians and Mongolians); (3) Native Americans, excluding the Esquimaux; (4) the Hottentots and Bushmans; (5) the Negroes; (6) the Papuas, or woolly-haired nations of Polynesia; and (7) the Alforous and Australians. By Alforous he meant the aborigines of the Malayan Archipelago. In his "Natural History of Man," of which the first edition was published in 1842, and the second in 1845, he modified this arrangement, among other changes dividing the Iranian race into two, for reasons which we shall subsequently explain at length. His successor in ethnological reputation, Dr. Latham, in his elaborate publication, "The Natural History of the Varieties of Man," given to the world in 1850, introduced new terms, and made his primary divisions Mongolidæ, Atlantidæ, and Iapetidæ. Like Cuvier, he placed the Malays and the Native Americans under the Mongolidæ. The Atlantidæ comprised the Negroes and (inaccurately, we think) the Arabs, Jews, etc., who are physically akin to Europeans, and very remote from African negroes. The Iapetidæ included Europeans and those nations of Asia to which they are most akin.

We shall now go back chronologically, and direct attention to a great discovery in quite another branch of inquiry, which affected the later classification of Prichard, and that of Latham. It commenced in the East, where Halhed, in 1776, and Sir William Jones, somewhat later in the century, were struck by the remarkable fact that Sanscrit, the language of the Brahman sacred books, and which, though nominally dead, still, in a manner, lives on in the modern forms of speech among the Hindoos, was not, as one might have conjectured, akin to Hebrew, Arabic, or other languages of western Asia, but to Greek and Latin. In 1808, a distinguished German, Frederick Schlegel, published an "Essay on the Language and Philosophy of the Hindoos." He showed that in comparing languages, while resemblances in roots were sought after, it was, above all, important to trace similarity of grammatical forms. Adopting the latter method, he completed the great discovery begun by our countrymen in the East—namely, that Sanscrit, old Persian, Greek, Latin, and German were closely allied. Other tongues have since been proved to belong to the same great assemblage, and quite a flood of light has, in consequence, been thrown both on European and Asiatic ethnology. An elaborate work by Professor Bopp, rendered accessible to English readers by Lieutenant Eastwick's translation, published in London, in two thick volumes, in 1845, and entitled, "A Comparative Grammar of the Sanscrit, Zend,* Greek, Latin, Lithuanian,† Gothic, German, and Sclavonic Languages," shows, beyond the possibility of future cavil, the close affinity of these seemingly diverse tongues. We take from Professor Bopp's work a few words and inflections fitted to make this clear to every reader :—

Eng.	*Sanscrit.*	*Zend.*	*Greek.*
I give.	dadâmi	dadhâmi	didōmi
I am.	asmi	ahmi	emmi
He is.	asti	ashti	esti

Latin.	*German.*	*Lith.*	*Old Sclav.*
do	——	dumi	damy.
sum	im	esmi	yesmy.
est	ist	esti	yesty.

Here is the present tense of the verb *to be*, as conjugated in the Sanscrit, Greek, Lithuanian, and Sclavonic :—

Singular.	SANSCRIT.	GREEK.
1st Person.	As-mi	em-mi
2nd ,,	A-si	es-si
3rd ,,	As-ti	es-ti

Singular.	LITH.	SCLAVONIC.
1st Person.	es-mi	yes-my.
2nd ,,	es-si	ye-si.
3rd ,,	es-ti	yes-ty.

	SANSCRIT.	GREEK.	LITHUANIAN.	SCLAVONIC.
		Dual.		
1st Person	S-vas	———	es-wà	yes-va.
2nd ,,	S-thas	es-ton	es-ta	yes-ta.
3rd ,,	S-tas	es-ton	*like the singular.*	yes-ta.
		Plural.		
1st Person	S-mas	es-mes	es-mo	yes-my.
2nd ,,	S-tha	es-te	es-te	yes-te.
3rd ,,	S-anti	(s)-enti	*like the singular.*	s-ûty.

The accusative of the first personal pronoun *me* is in Sanscrit *mâm* or *mâ*; in Zend, *manm* or *mâ*; in Greek, *me*; in Latin, *me*; in Gothic, *mik*; in Lithuanian, *manen*; and in old Sclavonian, *mya*. *Thee* is in Sanscrit *tvâm* or *tvâ*; in Zend, *thwanm* or *thwa*; in Greek, *te*; in Latin, *te*; in Gothic, *thuk*; in Lithuanian, *tawen*; and in old Sclavonian, *tya*. Manifestly, the races speaking these different tongues must be closely allied. But may it not be possible to take a step further? The Gothic may be called the parent of the Germanic tongues. Similarly, may there not, among the closely-allied languages whose names have been given above, be one of great antiquity, from which all the rest sprang? It was once believed that there was, and Sanscrit was assigned this honourable place; but now it is held that the parent language of all the tongues belonging to the family presently under consideration is extinct, and that Sanscrit is no more than the eldest child. Still, Sanscrit conducts us a great way towards the parent tongue. This can be shown from the remarkable fact that there are words in the European languages which now give no clue to their etymology so long as we confine ourselves to Europe, but of which it is easy to obtain the primitive meaning by turning to Sanscrit. The familiar word *daughter* is an instance in point. Its etymology in English cannot be pointed out. Let us, therefore, turn to other tongues. In old High German the word is *tohtar*; in Gothic, *dauhtar*; in Greek, *thugater*; none of which, so far as we know, give us the information we seek. It is different with the Sanscrit. In that language *daughter* is *duhitri*, which properly signifies *milk-maid*, revealing the interesting fact that in remotely ancient times, before the European and the Brahman had separated from each other, the milking of the cow was the department of household duty which daughters were expected to undertake. It is highly probable, if not even certain, that in primeval times there was a nation in Central Asia, and apparently somewhere on the great Persian table-land, from which came the ancestors of the several European races, and speaking a language from which Sanscrit, Zend, Sclavonian, Greek, Latin, German, and Celtic ultimately sprang. The nations using these diverse tongues were ranged by Blumenbach under his comprehensive division, "Caucasians;" but he associated with them others, which upon the evidence of language have since proved to be totally distinct. We refer to the Arabs, the Jews, the Syrians, the Phœnicians, and sundry allied peoples. It is necessary, therefore, to give these two great sections of the Caucasian race distinctive names. The first is sometimes called the Indo-Germanic, but now more commonly the Indo-European race, the name being designed to express the fact that nations and tribes of mankind belonging to this family are spread over all Europe and Asia as far as India. A shorter and neater term is now generally applied to them, Aryans. The word Arya occurs both in the Hindoo and in the Persian sacred books. There was an old Median tribe, called in Greek Ἄριοι, which in English would be Arians; but that word being used by theologians in quite a different sense, it is more convenient to spell the ethnological term, Aryans. The old name of Persia was Iran, which is from the same root as Arian or Aryan. Hence Prichard, as we have seen, calls the

Fig. 2.—TYPE OF MONGOLIAN VARIETY.

* The Zend language was that of the ancient Zoroastrians.

† Lithuania was the old name of a province, forming the east and north-east part of Poland. With the exception of a fragment belonging to Prussia, the whole is now under the sway of the Russian Czar.

Aryans, Iranians, an appellation which suggests that Persia was their original home. Modifications of the word Aryan have been traced in a multitude of places, and among others in the name of Ireland—*Erin*, and in the *Ire* of Ireland itself.

The second family of mankind—that which is characterised by "Caucasian" features, but which has no close affinity in language to the Aryans—are best termed the Syro-Arabians, a name which explains itself. They are also often called Semites, as if to suggest that they were all descended from Shem, and that no other races were so. But the Phœnicians, though Canaanites, sprung from Ham, spoke a "Semitic" tongue. There is some reason, moreover, for believing that the Elamites, or inhabitants of Elymais in Persia, though descended from Shem, were of the same race as the ordinary Medes and Persians, in which case they were Aryans. The term Semitic, then, is not strictly accurate.

It is almost certain that even the Asiatic part of the Mongolians belong to at least two distinct races. The Chinese language, as we shall afterwards see, is quite unique; and probably, therefore, the Chinese should be separated from the other Mongols, or, as they are now more frequently called, Turanians. Other changes will doubtless be required, as investigations go forward; meanwhile, it is satisfactory to think that at least for Europe, and a great part of Asia, the basis of a natural classification has been securely laid.

LESSONS IN FRENCH.—LXXXI.

§ 109.—The Indefinite Pronoun On [42, (4.)] (*continued*).

(2.) If the word **on** denotes definitely a female, the adjective relating to it takes the feminine termination :—

Quand **on** est **belle**, **on** ne l'ignore pas. L'Académie.	*When one (a lady) is handsome, she is not ignorant of it.*

(3.) The pronoun **on** must be repeated before every verb :—

On lève l'ancre, **on** part, **on** fuit loin de la terre, **On** découvrait déjà les bords de l'Angleterre. Voltaire.	*They raise the anchor, they depart, they flee far from the land, already they discovered the shores of England.*

(4.) Although **on** invariably governs its verb in the singular, yet the noun or adjective referring to it may be used in the plural :—

On est **amis** aujourd'hui, demain **on** est **rivaux.**	*People are friends to-day; to-morrow they will be rivals.*
On n'est pas **des esclaves.** L'Académie.	*We are not slaves.*
Ici on est **égaux** (*speaking of a cemetery*). Littré.	*Here people are equal.*

(5.) In familiar conversation, even in writing, **on** is frequently used instead of *any* of the personal pronouns :—

Il y a un siècle qu'**on** ne vous a vu.	I *have not seen you for an age.*
Soyez tranquille, **on** s'occupera de votre affaire.	*Be easy,* we *will attend to your business.*
Enfants, je vais sortir; j'espère qu'**on** sera sage.	*Children, I am going out; I hope* you *will be good.*
Vous savez bien que l'**on** vous aime. Molière.	*You know well that* she *loves you.*

§ 110.—The Verb.—Agreement of the Verb with its Subject.

(1.) The verb agrees with its subject, whether such subject precedes or follows :—

L'**homme est** né pour régner sur tous les animaux. Voltaire.	*Man is born to reign over all the animals.*
Les **hommes sont** encore enfants à soixante ans. Aubert.	*Men are still children (even) at sixty.*
Par ces portes **sortaient** les fières **legions.** Saint Victor.	*Through those gates issued the proud legions.*

(2.) When a verb has two or more subjects connected by the conjunction **et**, the verb is put in the plural, whether or not all the subjects are in the singular :—

La **colère et** la **précipitation sont** deux choses fort opposées à la prudence. Fénelon.	*Anger and precipitation are two things very much opposed to prudence.*
La **violence et** la **vertu** ne **peuvent** rien l'une sur l'autre. Pascal.	*Violence and virtue have no power over each other.*

(3.) When a verb has several subjects in the singular not connected by **et**, it is put in the singular or in the plural according to circumstances :—

1. It is put in the singular, if the subjects are in some way synonymous :—

La **douceur**, la **bonté** du grand Henri, a été célébrée de mille louanges. Pélisson.	*The mildness, the goodness of the great Henry, has been celebrated by a thousand praises.*
D'où **peut** venir cet ennui, ce dégoût? Colin d'Harleville.	*Whence can proceed that ennui, that disgust?*

2. When, in a series of subjects, the last has more force or interest attached to it, and therefore makes us, as it were, overlook the others :—

Ce sacrifice — votre intérêt, votre honneur, **Dieu** vous le **commande!**	*This sacrifice—your interest, your honour,* God *commands it!*

3. The verb is put in the plural, when the affirmation is intended to be made of all the subjects taken collectively, and not of each in particular :—

La **douceur**, les **soupirs** de cette femme infortunée ne **purent** le fléchir. Wailly.	*The sweetness, the sighs of that unfortunate woman could not move him.*
Savez vous, si demain, Sa **liberté**, ses **jours**, seront eu votre main? Racine.	*—— Do you know if to-morrow, his liberty, his life will be in your power?*

(4.) When a verb has for subjects several nouns, or nouns and pronouns of the third person, or only pronouns of that person, connected by the conjunction **ou**, the verb agrees only with the last :—

Mon frère **ou** mon oncle vous **écrira.**	*My brother or my uncle will write to you.*
Votre sœur **ou** lui l'a dit.	*Your sister or he has said it.*
Leur frère **ou** elles **y étaient.**	*Their brother or they were there.*
Le roi **ou** ses généraux **l'ont** ordonné.	*The King or his generals have ordered it.*

(5.) When a verb has for subjects one or several nouns and one or several pronouns of different persons, or only several pronouns of different persons, connected by the conjunction **ou**, the verb is put in the first person plural if there is a pronoun of that person among the subjects; and in the second person plural if there is among the subjects one of that person and none of the first :—

Toi ou lui **avez** tort.	*Thou or he are wrong.*
Mon frère, elle **ou moi** le **ferons.**	*My brother, she, or I will do it.*
Son frère, sa sœur **ou toi l'avez** dit.	*His brother, his sister, or thou have said it.*

(6.) When the several subjects of a verb are connected by the conjunction **ni**, the verb may be used in the plural according to the rules given above (5.), or in the singular; except, however, when the action can be performed only by one subject, in which case the verb must be used in the singular :—

Ni l'un **ni** l'autre ne **sont** honnêtes.	*Neither are honest.*
Ni le général **ni** l'ambassadeur ne **vint.**	*Neither the general nor the ambassador came.*
Ni le président **ni** l'avocat n'**écoutaient.**	*Neither the president nor the barrister listened.*
Ni vous **ni** moi ne le **pouvons.**	*Neither you nor I can do it.*
Ni toi **ni** lui ne le **ferez.**	*Neither thou nor he will do it.*
Ni le cardinal **ni** toi n'y **réussirez.**	*Neither the cardinal nor thou will succeed.*
Ni le prince M. **ni** le général B. ne **sera** nommé ambassadeur.	*Neither the Prince M. nor General B. will be appointed ambassador.*

*

§ 111.—Number of the Verb after a Collective Noun.

(1.) Every verb having, as its subject, a *general* collective noun [§ 3, (6.)], preceded by the definite article, such as la totalité, l'infinité, etc., takes the number of that noun :—

L'armée des infidèles **fut** entièrement détruite. L'ACADÉMIE.	*The army of the infidels was entirely destroyed.*
La multitude des bonnes choses que l'on trouve dans un ouvrage, **fait** perdre de vue la multiplicité des mauvaises. CAMINADE.	*The multitude of the good things which we find in a work, makes us lose sight of the multiplicity of the bad ones.*

(2.) When a partitive collective noun [§ 3, (6.)] occurs as the subject of a clause, the verb agrees with that noun, if it occupies the first rank in the thought of the speaker or writer.

The verb agrees, on the contrary, with the plural noun following the collective, if the latter acts only a secondary part, or if it is employed only to add an accessory idea of number :—

Agreement with the Collective.	*Agreement with the following Noun.*
Une troupe d'assassins **entra** dans la chambre de Coligny. VOLTAIRE. *A gang of assassins entered Coligny's chamber.*	Une troupe de **nymphes** couronnées de fleurs, **nageaient** autour de son char. FÉNELON. *A troupe of young nymphs, crowned with flowers, were swimming around her chariot.*
Une nuée de traits **obscurcit** l'air. *A cloud of arrows darkened the air.*	Une nuée de **barbares** *désolèrent* le pays. L'ACADÉMIE. *A cloud of barbarians desolated the country.*
Cette **espèce** de paons **paraît** avoir éprouvé les mêmes effets par la même cause. BUFFON. *That species of peacocks seems to have experienced the same effects through the same cause.*	Cette espèce de **chiens** qu'on appelle chiens de Laconie, ne **vivent** que dix ans. BOILEAU. *That species of dogs which they call Laconian dogs, live only ten years.*

§ 112.—Number of the Verb Être after the Pronoun Ce.

(1.) The verb **être** preceded or followed by **ce**, as the grammatical subject, takes the number of the noun placed after the verb (§ 105, (3.)] :—

Ce sont les mœurs qui font la bonne compagnie. LA CHAUSSÉE.	*It is morals which form good company.*
Sont-ce des religieux et des prêtres qui parlent ainsi? **sont-ce** des chrétiens? PASCAL.	*Are they monks and priests who speak so? are they Christians?*

(2.) The verb **être**, with **ce** as subject, is also put in the plural when it precedes the pronouns **eux** and **elles** :—

Ce sont eux qui viennent.	*It is they who come.*

Before **nous** and **vous** similarly placed, the verb is always in the singular: **c'est** nous; **c'est** vous.

(3.) When the verb **être** having **ce** for subject is used interrogatively and followed by a personal pronoun, it remains in the singular even before pronouns of the 3rd person plural:— **Est-ce** lui? *Is it he?* **Est-ce** eux? **Est-ce** elles? *Is it they?* **Est-ce** nous? *Is it we?* **Est-ce** vous? *Is it you?*

§ 113.—The Verb Relating to Several Subjects of Different Persons.

A verb having several subjects in different persons, is put in the plural, and assumes the termination of the first person in preference to that of the second, and that of the second in preference to that of the third. It may then be preceded by the plural pronoun of the person preferred, which sums up in one word all the other subjects and governs the verb :—

Votre père et **moi, nous avons** été longtemps ennemis l'un de l'autre. FÉNELON.	*Your father and I have long been enemies to each other.*
Allez; **vous** et vos semblables n'**êtes** point faits pour être transplantés. MONTESQUIEU.	*Go; you and such as you are not fit to be transplanted.*

PLANE TRIGONOMETRY.—II.

COMPLEMENTAL ANGLES—SUPPLEMENTAL ANGLES—TRIGONOMETRICAL CONCEPTION OF AN ANGLE—NEGATIVE ANGLES.

IV. *Complemental Angles.*—It was explained in Section II. that the *complement* of an angle (*i.e.*, of an acute angle) is the difference between it and a right angle, or, in other words, its *defect from* a right angle; and it was stated that the function of an angle is the co-function of its complement—that is,

$$\sin. A = \cos. (90° - A).$$
$$\cos. A = \sin. (90° - A)\text{; and so on.}$$

Or, in circular measure,

$$\left.\begin{aligned}\sin. A &= \cos. \left(\frac{\pi}{2} - A\right)\\ \cos. A &= \sin. \left(\frac{\pi}{2} - A\right)\end{aligned}\right\} \dots\dots\dots\dots\dots (26)$$

This is perhaps apparent enough by inspection of Fig. 2, but Fig. 3 shows it more clearly. The complement of A in that is B, and it is plain that, just as cos. A is $\frac{b}{c}$, so cos. B is $\frac{a}{c}$, since a is the adjacent side to B. But $\frac{a}{c}$ = sin. A.

$$\therefore \left.\begin{aligned}\sin. A &= \cos. B\\ \cos. A &= \sin. B\end{aligned}\right\} \dots\dots\dots\dots\dots (27)$$

And so on for other functions.

The above may, however, be thus proved geometrically :—

In Fig. 4, let CAB = A; then BAF = $\frac{\pi}{2}$ − A. Make GAF = CAB (whence CAG = BAF). Note that AB = AG = radius.

AGH and BAD are easily shown to be similar triangles, whence,

$$\left.\begin{aligned}&BD : AB :: AH : AG\\ &\quad\text{and}\\ &AD : AB :: GH : AG\end{aligned}\right\}\text{whence}\left\{\begin{aligned}\frac{BD}{r} &= \frac{AH}{r},\\ \frac{AD}{r} &= \frac{GH}{r}.\end{aligned}\right.$$

$$\therefore \left.\begin{aligned}\sin. CAB &= \cos. CAG\\ &\text{and}\\ \cos. CAB &= \sin. CAG\end{aligned}\right\}$$

But CAB = A,

and CAG = $\frac{\pi}{2}$ − A;

$$\therefore \left.\begin{aligned}\sin. A &= \cos.\left(\frac{\pi}{2} - A\right)\\ \cos. A &= \sin.\left(\frac{\pi}{2} - A\right)\end{aligned}\right\}\text{as at (26).}$$

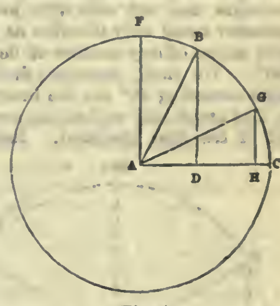


Fig. 4.

V. *Numerical Values of certain Trigonometrical Ratios.*—It was stated in the last lesson (Section II.) that the ratios of certain angles could be worked out geometrically. These angles are 45°, 60° (and therefore 30°, its complement), 18° (and therefore 72°). We select 45°, 60°, and 30° as specimens, and work to five places of decimals:—

$$\text{By (7), } \sin.^2 45° + \cos.^2 45° = 1.$$

But since complement of 45° = 45° (for 90° − 45° = 45°), sin. 45° = cos. 45°, and sin.² 45° = cos.² 45°,

$$\therefore 2 \sin.^2 45° = 1\text{, and } 2 \cos.^2 45° = 1.$$

$$\therefore \sin.^2 45° = \frac{1}{2}\text{, and } \sin. 45° = \frac{1}{\sqrt{2}} = 0{\cdot}70710.$$

$$\text{Similarly, } \cos. 45° = 0{\cdot}70710.$$

$$\text{By (11), } \tan. 45° = \frac{\sin. 45°}{\cos. 45°} = \frac{0{\cdot}70710}{0{\cdot}70710} = 1.$$

$$\text{And by (10), } \cot an. 45° = 1.$$

$$\text{By (14), } \sec. 45° = \frac{1}{\cos. 45°} = \frac{1}{0{\cdot}70710} = 1{\cdot}41421.$$

$$\text{Whence, also, } \operatorname{cosec.} 45° = 1{\cdot}41421.$$

The above results can be verified by constructing a right-angled triangle, as in Fig. 3, with angle A = angle B ($\because$ of 45° each), where side a = side b, and consequently tan. A = tan. $45° = \frac{a}{b} = 1$, and so on.

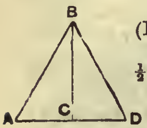


Fig. 5.

Again, draw A B D, an equilateral triangle (Fig. 5), with the perpendicular B C.

Then A = 60° and A B C = 30°. Also A C = $\frac{1}{2}$ A D = $\frac{1}{2}$ A B.

$$\text{cos. A} = \frac{\text{A C}}{\text{A B}} = \tfrac{1}{2}, \ \therefore \text{cos. } 60° = \tfrac{1}{2} = 0{\cdot}5.$$

By (16), $\text{sin. } 60° = \sqrt{1 - \text{cos.}^2\, 60°} = \sqrt{1 - \frac{1}{4}} = \sqrt{\frac{3}{4}} = \frac{\sqrt{3}}{2} = 0{\cdot}86602.$

$$\text{By (11),} \quad \text{tan. } 60° = \frac{\text{sin. } 60°}{\text{cos. } 60°} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \sqrt{3} = 1{\cdot}73205.$$

$$\text{Similarly, by (12), cot. } 60° = \frac{1}{1{\cdot}73205} = 0{\cdot}57735.$$

$$\text{By (14),} \quad \text{sec. } 60° = \frac{1}{\frac{1}{2}} = 2.$$

$$\text{By (15),} \quad \text{cosec. } 60° = \frac{1}{0{\cdot}86602} = 1{\cdot}15470.$$

As we know the ratios of 60°, we of course know the ratios of 30°, its complement.

VI. *Supplemental Angles.*—The supplement of an angle (less than two right angles) is the angle wanting to complete it to two right angles, or 180°. Thus the supplement of 30° = 180° − 30° = 150°; supplement of 175° = 180° − 175° = 5°, and so on. In sexagesimal measure, supplement of A = 180° − A. In circular measure, supplement of A = π − A.

VII. *Trigonometrical Conception of an Angle—Functions of Angles exceeding* 90°—*Use of the Signs + and* −. The trigonometrical idea of an angle being a quantity to be calculated rather than, as in Geometry, a shape to be drawn, we find ourselves quite untrammelled by compass and pencil, and may therefore deal not only with angles exceeding 180°—which a geometer could only describe as angles turned inside out—but with angles of *any* number of degrees whatever, even exceeding 360°. We shall, however, find that the functions of every angle exceeding 90° are the functions of some angle below 90°, so that practically we have no need to calculate ratios for angles out of the first quadrant. Indeed, it is obvious that Fig. 2 cannot possibly be constructed for any angle not less than a right angle.

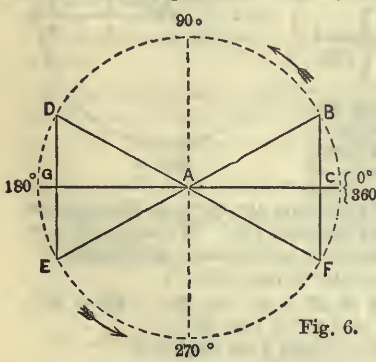


Fig. 6.

It is a conventional arrangement in this science that all positive angles (for definition of negative angles see Sect. IX.) are supposed to start from above a kind of horizontal base-line, which forms one side of the angle, the other being supposed free to revolve, in the direction of the arrows in Fig. 6, through an arc of any number of degrees, whether greater than an entire revolution or not. In Fig. 6 let A C be the "base-line" of the angle C A B (less than 90°, or "in the first quadrant"). Produce C A to G. Now let A B, the "free side," revolve to the position A D, making D A G = C A B, and A D = A B. Then C A D is more than 90° and less than 180°, or is "in the second quadrant." Now there is clearly no way of constructing, for the angle C A D, the right-angled triangle which played so important a part in Fig. 2, in determining the ratios of the angle then being examined, but by dropping the perpendicular D G on to C A produced. Sin. C A D is therefore $\frac{\text{D G}}{\text{A D}}$. But $\frac{\text{D G}}{\text{A D}}$ is also sin. D A G;

$$\therefore \text{sin. C A D} = \text{sin. D A G}.$$

But since D A G = C A B, and triangle A D G evidently = triangle A B C, $\frac{\text{D G}}{\text{A D}} = \frac{\text{B C}}{\text{A B}}$;

$\therefore$ sin. C A D (an angle in *second* quadrant) = sin. C A B (an angle in *first* quadrant).

But since C A B = D A G, C A B is the supplement of C A D; therefore, generally,

$$\left.\begin{aligned} \text{sin. } (\pi - \text{A}) &= \text{sin. A};\\ \text{or, sin. } (180° - \text{A}) &= \text{sin. A}. \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots (28)$$

From this it appears that the same ratio applies to more than one angle. A remedy for the confusion which might thus arise is found in the following arbitrary use of the signs + and −.

A perpendicular drawn *upward* from a given base is considered opposite in sign from a perpendicular drawn downward; and a line drawn to the *right* of a given point of opposite sign to a line drawn towards the *left* from the same point. Conventionally, lines measured to the right of a given point are regarded as +, therefore corresponding lines to the left are −; and lines drawn upward are +, and downward −.

By this arrangement it appears that, in Fig. 6, B C, D G, and A C are positive, while C F, G E, and A G are negative quantities. As no negative quantities enter into the ratios of any angle in the first quadrant, its functions are all + or positive.

We now return to the angle C A D, in the second quadrant, and find that its sine also (being, as already shown, $\frac{\text{D G}}{\text{A D}}$) contains no negative quantity, and is therefore positive. Formula (28) is therefore correct as regards sign as well as magnitude.

On the other hand, cos. C A D = $\frac{\text{A G}}{\text{A D}}$. A G being a negative quantity, we may write cos. C A D = $-\frac{\text{A G}}{\text{A D}}$. But $\frac{\text{A G}}{\text{A D}} = \frac{\text{A C}}{\text{A B}}$ = cos. C A B, $\therefore$ cos. C A D = − cos. C A B.

$$\left.\begin{aligned} \therefore \text{cos. } (\pi - \text{A}) &= -\text{cos. A};\\ \text{or, cos. } (180° - \text{A}) &= -\text{cos. A}; \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots (29)$$

And the cosine of an angle in second quadrant is *negative.*

Let A D now revolve to the position A E, giving us the trigonometrical angle C A E, in the third quadrant—*i.e.*, of more than 180°, and less than 270°. (This must not be mistaken for the geometrical angle lying below the lines C A, A E, but is the trigonometrical angle subtended by the arc C D E.) Making E A G = C A B, and noting that the lines A G and E G are both negative, but equal in magnitude to A C and B C respectively, it appears that

$$\text{sin. C A E} = \frac{-\text{E G}}{\text{A E}} = -\frac{\text{E G}}{\text{A E}} = -\frac{\text{B C}}{\text{A B}} = -\text{sin. C A B}.$$

$$\text{cos. C A E} = \frac{-\text{A G}}{\text{A E}} = -\frac{\text{A G}}{\text{A E}} = -\frac{\text{A C}}{\text{A B}} = -\text{cos. C A B}.$$

$$\left.\begin{aligned} \therefore \text{sin. } (180° + \text{A}) &= -\text{sin. A};\\ \text{cos. } (180° + \text{A}) &= -\text{cos. A}; \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots (30)$$

and the sine and cosine of an angle in the third quadrant are both negative.

If A E revolve further to A F in the fourth quadrant, making a (trigonometrical) angle C A F of more than 270°, but less than 360°, then, making C A F = C A B, and noting that E C is negative and A C positive, we find by precisely similar reasoning that

$$\left.\begin{aligned} \text{sin. } (360° - \text{A}) &= -\text{sin. A};\\ \text{cos. } (360° - \text{A}) &= \text{cos. A}. \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots (31)$$

Thus the sine of an angle in the fourth quadrant is negative, and the cosine positive.

Generally, therefore (omitting reference to sign), the function of an angle in the second quadrant is the function of its defect from two right angles; in the third quadrant, the function of its excess over two right angles; in the fourth quadrant, the function of its defect from two right angles. And since the further revolution of A F into the fifth or any succeeding quadrant will only involve a repetition of the calculations already gone into, we may still further generalise this statement, and say that *a function of any angle is the same function of the difference between it and the nearest even number of right angles.* Thus, taking into account the signs which affect the different quadrants, sin. 200° = sin. (200 − 180)° = − sin. 20°; sin. 275° = sin. (360 − 275)° = sin. − 85°; sin. 420° = sin. (420 − 360)° = sin. 60°, and so on.

Since $\tan. A = \frac{\sin. A}{\cos. A}$, and $\cot. A = \frac{\cos. A}{\sin. A}$, both tan. and cot. are + in the first and third quadrants, where sin. and cos. have the same sign, and − in the second and fourth, where sin. and cos. have different signs. And since $\sec. A = \frac{1}{\cos. A}$, and $\operatorname{cosec.} A = \frac{1}{\sin. A}$, sec. will have always the same sign as cos., and cosec. the same as sin.

It is clear from this section that if we know the signs of both sine and cosine of an angle, we know the quadrant to which it belongs.

VIII. *Value of Functions of* 0°, 90°, 180°, *and* 270°.—Let angle A = C A B in Fig. 6. Then $\sin. A = \frac{BC}{AB}$. Now if A = 0 (*i.e.*, represents no opening at all), A B must coincide with A C, and B C disappear altogether;

$$\therefore \sin. 0° = \frac{0}{AB} = 0.$$

The other functions of angles 180° and 270°, except as below stated, are easily obtained as before, and appear in the following table, which sums up the results of the last two sections:—

RATIO.	0 or 360°	In 1st Quadrant 0° to 90°.	90°.	In 2nd Quadrant 90° to 180°.	180°	In 3rd Quadrant 180° to 270°	270°	In 4th Quadrant 270° to 360°
Sine . . .	0	+ (0 to 1)	1	+ (1 to 0)	0	− (0 to 1)	−1	− (1 to 0)
Cosine . .	1	+ (1 to 0)	0	− (0 to 1)	−1	− (1 to 0)	0	+ (0 to 1)
Tangent .	0	+ (0 to ∞)	∞	− (∞ to 0)	0	+ (0 to ∞)	−∞	− (∞ to 0)
Cotangent.	∞	+ (∞ to 0)	0	− (0 to ∞)	−∞	+ (∞ to 0)	0	− (0 to ∞)
Secant . .	1	+ (1 to ∞)	∞	− (∞ to 1)	−1	− (1 to ∞)	−∞	+ (∞ to 1)
Cosecant .	∞	+ (∞ to 1)	1	+ (1 to ∞)	−∞	− (∞ to 1)	−1	− (1 to ∞)

Since 0 is the utter negation of all quantity, it is impossible to attach a sign to it. This accounts for the absence of the *minus* sign—evidently required by the symmetry of the above table—against sin. and tan. 180°, and cos. and cot. 270°. From this cause erroneous values (as regards sign) would be obtained for cosec. 180° and sec. 270° if we trusted in their case to formulæ (14) and (15), lately adverted to. To find cosec. 180°:

By (20), $\operatorname{cosec.} 180° = \frac{\sec. 180°}{\sqrt{\sec.^2 180° - 1}} = \frac{-1}{\sqrt{1-1}} = \frac{-1}{0} = -\frac{1}{0} = -\infty.$

To find sec. 270°. By (23), (10), and (24),

$$\sec. 270° = \frac{\operatorname{cosec.} 270°}{\operatorname{cosec.}^2 270° - 1} = \frac{-1}{1-1} = -\frac{1}{0} = -\infty.$$

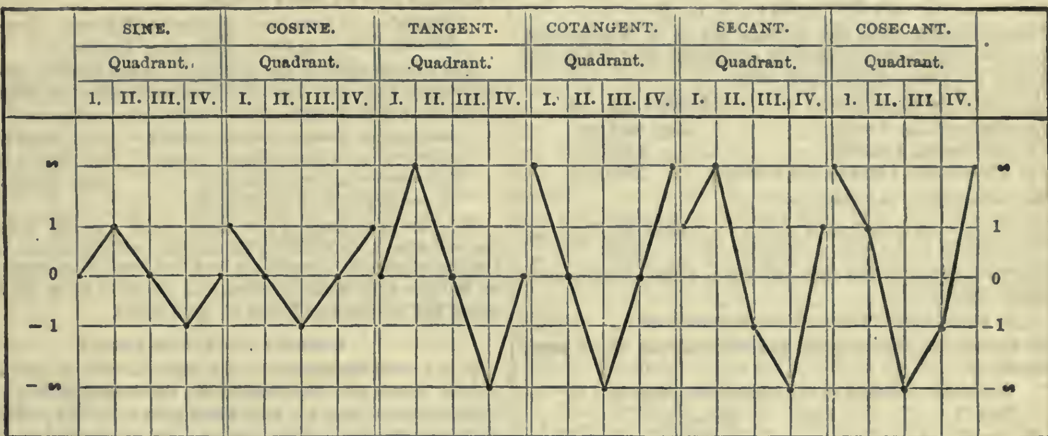


Fig. 7.—TABLE SHOWING THE VARIATION IN RATIO OF SINE, COSINE, TANGENT, ETC.

Again, $\cos. A = \frac{AC}{AB}$. But if A = 0, A C = A B.

$$\therefore \cos. 0° = 1.$$

Whence, by (11), $\tan. 0° = \frac{\sin. 0°}{\cos. 0°} = \frac{0}{1} = 0.$

And by (12), $\cot. 0° = \frac{\cos. 0°}{\sin. 0°} = \frac{1}{0} = \infty$ (infinity).

Similarly, by (14) and (15), sec. 0° = 1; cosec. 0° = ∞.

Now let A = 90°; then (referring to same figure), B C will plainly coincide with and be equal to A B, and A C disappear.

Then, $\sin. 90° = \frac{BC}{AB} = 1$; | $\cos. 90° = \frac{AC}{AB} = \frac{0}{1} = 0.$

Whence, by the formulæ above quoted—

tan. 90° = ∞, | sec. 90° = ∞,
cot. 90° = 0, | cosec. 90° = 1.

When, at 180°, A B (or A D) again coincides with A G, D G disappears, and

$$\sin. 180° = \frac{DG}{AG} = 0;$$

also $\cos. 180° = \frac{AG}{AD}$. But A G is negative;

$$\therefore \cos. 180° = -1.$$

If A B (represented now by A E) revolve further to 270°, E G coincides with A E, and A G disappears.

Then $\sin. 270° = \frac{EG}{AE} = -1$ (for E G is negative),

$$\cos. 270° = \frac{AG}{AE} = \frac{0}{AE} = 0.$$

This proves indirectly that sin. and tan. 180°, and cos. and cot. 270°, have merely lost their *minus* sign through the accident of being represented, as to value, by 0.

It will be observed in the above table that no ratio changes its sign except in passing through the values 0 or ∞.

The above curious diagram (Fig. 7) shows at a glance the fluctuations in the value of the several ratios in passing through the four quadrants, and will be more easily borne in mind by many than any written account. Its evident symmetry and completeness also indicate the justice of employing the signs + and − in the arbitrary manner before explained. The propriety of so using those signs in dealing with lines can, however, be proved mathematically. Trigonometry, in its higher form, has been defined as "the consideration of alternating or periodic magnitude," and these words will be more easily grasped by the pupil with this diagram before him.

IX. *Negative Angles.*—An angle starting from *below* the base-line A C in Fig. 6, by the movement of its free side in a direction contrary to the arrows, is called a *negative angle*, and takes the minus sign. Its four quadrants are, of course, reckoned the reverse way; whence it follows, since the first quadrant of a negative is the fourth of a positive angle, and the second of a negative is the third of a positive angle, that for any given quadrant of a negative angle the sine differs in sign from the corresponding quadrant of a positive angle, but the cosine is always the same. This is plain from inspection of Fig. 6. Thus we say, generally—

$$\left.\begin{array}{l} \textit{i.e.}\ \ \sin. (-A) = -\sin. A; \\ \text{but}\ \ \cos. (-A) = \cos. A. \end{array}\right\} \quad \ldots\ldots\ldots\ldots \ (32)$$

LESSONS IN GREEK.—XLIV.

THE VERBS IN μι.

THE chief peculiarity of the conjugation in μι consists in this, that the verbs which belong to it, in the present, the imperfect, and several in the second aorist active and middle also, take special person-endings different from those of the conjugation in ω, and in the indicative of the other tenses want the mood-vowel. The formation of all the other tenses, with a few exceptions, coincides with the formation of the verbs in ω.

Several verbs in μι which have a monosyllabic stem, take in the present and imperfect a reduplication, which consists in this, that when the stem begins with a single consonant or a mute and a liquid, the first consonant of the stem is repeated with ι, or if the stem begins with στ, πτ, or an aspirated vowel, an aspirated ι precedes the stem; as—

ΔΟ- δι-δω-μι, *I give.*	ΧΡΑ- κι-χρη-μι, *I lend.*
ΣΤΑ- ἱ-στη-μι, *I place.*	Ἑ- ἱ-η-μι, *I send.*

DIVISION OF VERBS IN μι.

The verbs in μι are divided into two chief classes :—

1. Such as append the person-endings immediately to the stem-vowels. The stem of this class ends

in α, as ἱ-στη-μι, *I place;*	stem ΣΤΑ.
„ ε, „ τι-θη-μι, *I set;*	„ ΘΕ.
„ ο, „ δε-δω-μι, *I give;*	„ ΔΟ.
„ ι, „ ει-μι, *I am going;*	„ Ι.

2. Those to whose stem the syllable ννῠ or νῠ is appended, and which receive the person-endings at the end of this syllable. The stem of the verbs of this class ends—

(*a*) In one of the three vowels α, ε, ο, and takes ννῠ; as

α- σκεδα-ννυ-μι, *I scatter;*	stem ΣΚΕΔΑ.
ε- κορε-ννυ-μι, *I satisfy;*	„ ΚΟΡΕ.
ο- στρω-ννυ-μι, *I spread out (strew);*	„ ΣΤΡΟ.

(*b*) In a consonant, and takes νῠ.

In a mute, as δεικ-νῠ-μι, *I show;*	stem ΔΕΙΚ.
In a liquid, as ομ-νῠ-μι, *I swear;*	„ ΟΜ.

Of this second class only the verb σβε-ννῠ-μι (ΣΒΕ), *I extinguish,* forms the second aorist.

1. THE FIRST CLASS OF THE VERBS IN μι.

In the active, the following are the terminations which mark the persons :—

1. *Person-Endings of the Indicative Present.*

Sing. 1.	μι	as	ἱ-στη-μι.
2.	ς	„	ἱ-στη-ς.
3.	σι(ν)	„	ἱ-στη-σι.
Dual 2.	τον	„	ἱ-στᾰ-τον.
3.	τον	„	ἱ-στᾰ-τον.
Plur. 1.	μεν	„	ἱ-στᾰ-μεν.
2.	τε	„	ἱ-στᾰ-τε.
3.	[ντι, νσι(ν)]	„	[ἱ-στᾰ-ντι, ἱ-στᾰ-νσι (ν)].

The termination of the third person plural, νσι, was changed into ᾱσι, and then contracted with the foregoing stem-vowel of the verb. The Attic dialect, however, admits the contraction only in the stems which end in α; thus, while from ἱ-στα-νσι was formed ἱ-στασι—

τι-θε-νσι	became τι-θεισι;	Attic	τι-θε-ᾱσι.
δι-δο-νσι	„ δι-δουσι;	„	δι-δο-ᾱσι.
δεικ-νυ-νσι	„ δεικ-νυσι;	„	δεικ-νυ-ᾱσι.

2. *Person-endings of the Indicative Imperfect and Second Aorist.*

Sing. 1. ν.	Imperf.	ἱ-στη-ν,	ε-τι-θην.
2. ς.		ἱ-στη-ς,	ε-τι-θης.
3. —		ἱ-στη,	ε-τι-θη.
Dual 2. τον.	2 Aor.	ε-στη-τον,	ε-θε-τον.
3. την.		ε-στη-την,	ε-θε-την.
Plur. 1. μεν.		ε-στη-μεν,	ε-θε-μεν.
2. τε.		ε-στη-τε,	ε-θε-τε.
3. σαν.		ε-στη-σαν,	ε-θε-σαν.

In the dual and plural of the optative imperfect the η is commonly dropped, and the termination of the third person plural, ησαν, is usually shortened into εν, as—

τιθει-ημεν = τιθειμεν.	ἱσται-ητε = ἱσταιτε.
τιθει-ησαν = τιθειεν.	διδοι-ησαν = διδοιεν.

In the optative second aorist of the verbs ἱστημι, τιθημι, διδωμι, on the contrary, the shortened forms are very rare, except the third person plural.

Person-endings of the Imperative Present and Second Aorist.

Sing. 2.	θι.	(ἱ-στα-θι)	(τι-θε-τι)	(δι-δο-θι).
3.	τω.	ἱ-στα-τω,	τι-θε-τω,	δι-δο-τω.
Dual 2.	τον.	ἱ-στα-τον,	τι-θε-τον,	δι-δο-τον.
3.	των.	ἱ-στα-των,	τι-θε-των,	δι-δο-των.
Plur. 2.	τε.	ἱ-στα-τε,	τι-θε-τε,	δι-δο-τε.
3.	τωσαν.	ἱ-στα-τωσαν	τι-θε-τωσαν	δι-δο-τωσαν
	or	ἱ-στα-ντων,	τι-θε-ντων,	δι-δο-ντων.

The second person singular imperative present throws away the ending θι, and in compensation the short characteristic vowel is lengthened—that is, α is changed into η, ε into ει, ο into ου, and ῠ into ῡ; thus—

ἱ-στα-θι becomes ἱ-στη.	τι-θε-τι becomes τι-θει.
δι-δο-θι „ δι-δου.	δεικ-νῠ-θι „ δεικ-νῡ.

The ending θι in the present is preserved in only very few verbs. In the second aorist of τιθημι, ἱημι, and διδωμι, the ending θι has been softened into ς: thus, θε-τι becomes θες; ἑ-θι = ἑς, δο-θι = δος. In the second aorist of ἱστημι, however, the termination θι remains, thus, στῆ-θι.

The termination of the infinitive in the present and second aorist is ναι. This syllable is in the present added to the short characteristic vowel, but in the second aorist is lengthened, as α into η, ε into ει; and ο into ου.

Present.	ἱ-στα-ναι,	τι-θε-ναι,	δι-δο-ναι,	δεικ-νυ-ναι.
Second Aor.	στη-ναι,	θει-ναι,	δου-ναι.	

The terminations of the participle in the present and second aorists are ντς, ντσα, and ντ, which unite with the characteristic vowel according to the ordinary rules :—

ἱ-στα-ντς = ἱ-στᾱς, ἱ-στασα, ἱ-σταν.	στας, στασα, σταν.
τι-θε-ντς = τι-θεις, τι-θεισα, τι-θεν.	θεις, θεισα, θεν.
δι-δο-ντς = δι-δους, ουσα, ον.	δους, δουσα, δον.
δεικ-νυ-ντς = δεικ-νυς, ῡσα, ῠν.	

The person-endings of the middle voice coincide with those of the verbs in ω, only that in the second person singular indicative and imperative of the present and imperfect they retain σαι and σο in their full forms; yet επιστω, ηπιστω; δυνω, ηδυνω; πριω, επριω, are the regular forms of good prose.

FORMATION OF THE TENSES.

In the tense-formation of the entire active, as well as of the middle future and first aorist, the short characteristic vowel is lengthened—α into η, ε into η and into ει (in the perfect active of τιθημι and ἱημι), also ο into ω; but is retained in the other tenses of the middle and in all the tenses of the passive ω, excepting the perfect and pluperfect of τιθημι and ἱημι, which receive the ει of the perfect active (τεθεικα, τεθειμαι, εἱκα, εἱμαι).

The first aorist active and middle of τιθημι, ἱημι, and διδωμι have for their tense-characteristic not σ but κ :—

ε-θη-κ-α, ἡ-κ-α, ε-δω-κ-α.

The forms of the first aorist active, εθηκα, ἡκα, and εδωκα, however, are used only in the indicative, and especially in the singular; in the other persons commonly, and always in the other moods and the participle, the forms of the second aorist are employed. So instead of the forms of the first aorist middle of τιθημι, ἱημι, and διδωμι, those of the second aorist middle are used. On the contrary, the indicative forms of the singular second aorist of τιθημι, ἱημι, and διδωμι (εθ-ην, ἡν, and εδων) are not to be employed.

The verb ἱστημι forms the first aorist active and middle like the verbs in ω, with the tense-characteristic σ, as ε-στη-σ-α, ε-στη-σ-αμην. The second aorist middle εσταμην is never used. Some other verbs, however, have the form, as επταμην, επριαμην.

The second aorist passive and the second future passive are wanting in these verbs; also the third future, except in ἱστημι—ἑστηξω, or ἑστηξομαι.

In regard to the signification of ἱστημι, observe that the present, imperfect, future, and first aorist active have the transitive import of *to place.* The second aorist, the perfect, and the pluperfect active, and the third future, on the contrary, have a reflex or intransitive meaning, *to place oneself,* or *to stand.*

2. THE SECOND CLASS OF THE VERBS IN μι.

The tense-formation of the second class of the verbs in μι has no difficulty. After cutting off the termination ννῡμι and νῡμι, add the tense-forms to the stem. The verbs in ο which lengthen this ο into ω in the present, retain the ω in all the tenses, as στρω-ννῦ-μι, ῥω-ννῦ-μι, ἑω-ννῦ-μι, χω-ννῦ-μι; future στρω-σω, ῥω-σω, ἑω-σω, χω-σω, and so on.

But the verbs whose stem ends in a liquid take for the formation of some tenses a theme ending in a vowel, as ομ-νῦ-μι, aorist ωμ-ο-σα, from the theme ΟΜΟΩ. The second aorist and second future passive are found in only a few verbs, as ζευγ-νυ-μι, aor. 2 pass. εζῠγην, fut. 2 pass. ζῠγησομαι.

Remarks on the Models.

In the dual and plural of the indicative, and in the other moods and the participle, for the first aorist active, the second aorist active is used.

Instead of the forms ε-θη-κα-μην, ε-δω-κα-μην, first aorist indicative middle, the Attic forms are used.

The middle optative forms of the imperfect and second aorist of the verbs in ε, namely, οι, as τιθοιμην, θοιμην, are preferred to those in ει, as τιθειμην, θειμην.

The perfect and pluperfect, ἑστηκα, ἑστηκειν (but not εἱστηκειν), form the dual and the plural immediately from the stem, as perfect, ἑ-στᾰ-τον, ἑ-στᾰ-μεν, ἑ-στᾰ-τε, ἑ-στᾶ-σι(ν); pluperfect, ἑ-στᾰ-τον, ἑ-στᾰ-την, ἑ-στᾰ-μεν, ἑ-στᾰ-τε, ἑ-στᾰ-σαν; instead of ἑστηκεναι, ἑστᾰναι is usually employed. The participle runs ἑστως, ῶσα, ως, gen. ῶτος, ωσης, as well as ἑστηκως, υῖα, ος, gen. οτος, υιας. With ἑστατον compare τετλαμεν (ΤΛΑ), and τεθναμεν, τεθνατε, τεθνᾶσι(ν), inf. τεθναναι, from τεθνηκα, θνησκω (ΘΝΑ).

KEY TO EXERCISES IN LESSONS IN GREEK.—XLIII.

Exercise 129.—Greek-English.

1. The soldiers will defend themselves against the enemy. 2. Do not be vexed when blamed for your faults. 3. The shepherd will feed the flock of goats on the mountains. 4. The soldiers wished to march against the enemy. 5. The soldiers will be in want of provisions in the enemy's country. 6. He is not the rich man who has much, but he who wants little. 7. Pollux did not wish to be even a god by himself, but preferred rather to be a demigod with his brother. 8. The barbarians, being pursued by the Greeks, were caught at the river.

Exercise 130.—English-Greek.

1. Ἡ λεια ενεμηθη. 2. Νεμῶ την λειαν. 3. Ἡ πολις τιμωρησει τους πολεμιους. 4. Ω παι, μη αχθεσθητι ὑπερ ὡν ημαρτανες ελεγχομενος. 5. Αγαθοι παιδες ουκ αχθονται ὑπερ ὡν ἡμαρτανον ελεγχομενοι. 6. Στρατευσομαι επι τας Αθηνας. 7. Οζουσι μυρων. 8. Ἡ ψυχη εις ουρανον αναπτησεται. 9. Αγαθοι επ᾽ αγαθῳ χαιρουσιν. 10. Τους στρατιωταις επιτηδειων δει. 11. Αγαθος των παιδων επι μελησεται, αγαθοι δε παιδες των τοκεων επιμελησονται.

Exercise 131.—Greek-English.

1. Even a slow man who is well advised can in pursuit catch a swift-footed man. 2. The Athenians chose Themistocles general in the Persian war. 3. Ulysses came to the great hall of Hades. 4. Whatever lot you may have taken, bear it and chafe not at it. 5. Do not trust very quickly before you exactly see the end. 6. Do not consider whether I am somewhat young to speak, but whether I speak the words of prudent men. 7. Mourn with moderation for friends who are dead, for they are not really dead, but they have gone before on the same road by which all must go.

Exercise 132.—English-Greek.

1. Οἱ Αθηναιοι πολλους στρατιωτας εἱλον. 2. Ἡ πολις Επαμεινονδαν ειλετο στρατηγον. 3. Θεμιστοκλης ὑπο των Αθηναιων στρατηγος ἡρεθη. 4. Ελθε, ω φιλε. 5. Ω αγαθοι φιλοι, ελθετε δευρο. 6. Εαν πεινης, τουτο ἡδεως εδει. 7. Ὁ παις ὁσον ειχεν εδηδοκεν.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER V.—FIRST COMMERCIAL PERIOD (*continued*)—PHŒNICIA—MARITIME OR COASTING TRADE.

Transport by sea, in lessening the labour, time, and cost of procuring commodities from distant countries, gave a new life to commerce, and indefinitely widened its scope. It was chiefly as carriers that the Phœnicians distinguished themselves. They were the earliest recorded sailors. They were already a nation when the Israelites entered the Promised Land. Homer refers to their seafaring habits, and their daring as traders and pirates, as facts established at a date of about 1,000 years before the Christian era. As we have already seen, they navigated the Arabian and Indian Seas, and brought to the ports of the Persian Gulf the products of Ceylon and Malabar, of the Indus and the Ganges, thus linking the elephant traffic of Hindostan with the caravan commerce through Babylon and Palmyra, and with the Arab caravans from Gerrha. Their vessels in the Red Sea coasted Arabia Felix and Ethiopia, exchanging the produce of both these countries at Elath and Ezion-geber, in return for the commodities brought overland through Edom. The rich countries just referred to were the ancient Ophir, with which the Jews also traded, and whence were obtained gold, silver, ivory, apes, and peacocks. Meanwhile the Mediterranean was being slowly explored. Eventually the persistence of the Phœnicians extorted from the rulers of Egypt limited rights to the navigation of the Nile, and they were assigned a part of Memphis for warehouses and offices.

It is recorded that they were the first who rounded the Cape of Good Hope about 600 B.C., having started from the Red Sea at the instance of Pharaoh Necho, and in three years circumnavigated Africa. This event is involved in considerable obscurity, though there seems little reason to doubt its occurrence; but, whether true or not, the discovery was turned to no account for many centuries.

That the Phœnicians first passed the Pillars of Hercules is undisputed. Before Saul, the first King of Israel, had begun to reign, they had already ventured out into the Atlantic; and the tin mines of Britain, and the amber lands of the Baltic, were probably visited by them before the days of Solomon. Long before this they had begun to frequent, and even to settle upon the isles of the Levant and the Ægean. Cyprus in particular (the ancient Chittim) could be seen from their shores, and to reach it was one of their earliest efforts. Keeping near the shore, and guided at night by the stars, they gradually extended the length of their voyages. In the course of time they improved their skill in navigation and ship-building. The acquisition of wealth, whether by just or unjust means, appears to have been the sole object of their traffic. It was the universal custom to sell as slaves prisoners taken in war. The Phœnicians were ever ready to purchase any number of captives, and they would, it is said, when the chance offered, kidnap Greek and Hebrew children. The Greeks, amongst whom the Phœnicians at the first had settlements, suffered from their piratical habits, but they afterwards became powerful rivals to Phœnician commerce. The Greek ports, and the isles of the Ægean, were closed against the Phœnicians, and, in alliance with the Etruscans, the Greeks expelled them from Southern Italy (*Magna Græcia*). But the desire for Oriental luxuries lessened the jealousies of trade, and Greece could not consistently deny herself Phœnician wares. In Sicily, Sardinia, and the Balearic Isles, the Phœnicians planted colonies, and successfully competed with the Etruscans. Colonies were gradually formed along the Mediterranean coasts. In Asia Minor and the Euxine, as well as Africa and the islands, the native tribes were taught husbandry, and thus to produce commodities valuable to Phœnician commerce. Carthage and Adramyttium, Great and Little Leptis, with several hundred smaller stations, arose in Africa.

Spain was literally a mine of wealth; for gold, lead, and iron abounded; and silver was so plentiful that the merchants are said to have ballasted their vessels with it, and to have made all their utensils, and even their anchors, of it. The profit was beyond compute. The natives gladly accepted Tyrian ornaments and glass trinkets for that upon which they set no value, and the Phœnicians disposed of this beautiful metal in the East, where it was held, comparatively, in higher estimation than gold. When the supply thus procured failed, the Phœnicians became the taskmasters of the natives, whom they enslaved and compelled to work in the silver mines. Thus these poor aborigines were the prototypes of the gentle Indians whom the Spaniards in after days forced to labour in the mines of Mexico. Spain also possessed rich resources in animal and vegetable produce. Fine wool, wax, and salt fish; corn, wine, oil, and luscious fruits were only second in value to the precious metals. A Phœnician origin can be assigned to nearly 200 Spanish towns. Cadiz, "on the most remote point of the world," is to this day an important commercial city. Hispalis (*Seville*), Carteïa, (*Cartaijo*), near Gibraltar, and Malaka (*Malaga*), are other examples. The Tarshish of Scripture was probably South Spain (*Tartessus*). From Spain, the Phœnicians set out for still more distant enterprises. It appears hardly possible that their vessels could have weathered the rough waters of the Bay of Biscay, yet it is certain that they obtained tin and lead from the Scilly Isles and Cornwall, and amber from the shores of the Baltic. They also visited, sooner or later, the Azores and the Madeira Isles. The secret of Phœnician commerce beyond the Pillars of Hercules was jealously guarded by the merchants, who retained it for many ages as a close monopoly.

Thus was the commerce of the known world in the possession of this enterprising people. They were not only merchants on their own account, but the universal carriers for other nations. Wealth poured into their cities in profusion. Colonies became a necessity with such a people, in order that when ships arrived cargoes might be in readiness at widely distant points, and interchange be made without delay. As the necessaries and comforts of life accumulated, the population also increased, and colonies were often the outpouring of numbers too cramped in the small territory of the mother-country. Political discontent, too, was an incentive to emigration, and to this cause the rise of Carthage, Tyre's great daughter colony, is said to have been due. Phœnician colonies continued to be established for a period of between 500 and 600 years, from 1100 B.C. to 550 B.C.

Although the parent state exercised little coercive authority over its colonies, yet commerce and religion formed a bond of union. The temples and deities of Phœnicia were everywhere revered, and offerings from all quarters were transmitted to the mother-country.

CHAPTER VI.—FIRST PERIOD (*continued*).—ETHIOPIA.

ETHIOPIA is the name given to the region of the Nile, above the first cataract at Assouan, and comprehends Nubia and Abyssinia. The name has also been applied to the whole of Africa south of Egypt, because of the colour of the inhabitants.

The ancient capital of Ethiopia, near Shendy, was Meroë, the remains of which, in the absence of written records, warrant the inference that the city was of great antiquity. Meroë was situated on a triangular island several hundred miles long, formed by the fork of the Blue and the White Nile. Scattered in profusion over the surface of this tract, are the ruins of pyramids, sepulchres, obelisks, and temples. Built of sandstone, their appearance shows more of the wear of ages than the syenite structures of Egypt, and but few of the hieroglyphics can be deciphered. These remains lend probability to the opinion held by many that Meroë was the birthplace of the arts and sciences, and the cradle of civilisation. On the other hand, some writers trace the civilisation of Meroë to the emigration of the discontented warrior caste of Egypt in the reign of Psammetichus. Whether Egypt was peopled from Nubia, or Nubia from Egypt, is an unsettled point. It is certain that Ethiopia was a powerful and civilised kingdom in ages very remote, and that no more than a nominal conquest of the kingdom was ever made. Many sovereigns of Ethiopian race, even entire dynasties, ruled over Egypt. While the terrible barrier of its deserts kept Ethiopia secure from invasion without, its capital was open to trade from all parts of the compass. Numerous wells, which might be called artesian, dug in the Libyan sands, attest the existence of a great caravan trade from the centre of Africa. The Meroëse also founded Ammonium in the same desert, and their king was priest of Ammon. The temple at this place was, like that of the Hall of Camels at Palmyra, part of a caravanserai, or encampment for traders. It was in an expedition against this city that the army of Cambyses was overwhelmed with sand. Napata, now Merawe, in Dongola, likewise owed its origin to the Meroëse.

The eastern trade of this great capital reached as far as India. There is a tradition of the existence of a canal which connected the Nile at Meroë with the Red Sea, and formed a great highway of trade. Certainly, camels traversed the space between the city and that part of the coast which Phœnician vessels visited. A caravan route across the Arabian desert connected the Red Sea with the Persian Gulf, where, as we have already seen, was a depôt of Indian and Asiatic produce. Caravan communication existed likewise with Carthage by way of Great Leptis, and with Egypt. The traffic was necessarily great. Meroë was therefore one of the chief commercial marts of its day. The kingdom reached its highest prosperity about seven or eight centuries before Christ.

In Ethiopia the Nile, bordered by high banks which prevent its overflow, consists of a series of rapids and cataracts which for 600 miles render it of very little use for navigation. Mountains approach the river closely on each side, and the width of the valley does not in parts exceed seven miles. The southern territory, at the foot of the Abyssinian high lands, is the most humid and fertile. Irrigation in the arid parts was effected by rude canals. Meroë was rich in timber and minerals, and gold mines were worked in the northern hills. The border tribes lived by ostrich and elephant hunting.

Five different nations have been enumerated as inhabiting Ethiopia, viz., the Meroëse, the Troglodytes, the Macrobii, the Nubians, and the Egyptian "Warrior Caste," of whom the first were in every respect the most civilised. They were the husbandmen, merchants, philosophers, priests, and seers, and worshipped Jupiter Ammon, to whom was consecrated the city of Ammonium in the Desert.

CHAPTER VII.—ETRURIA.

ETRURIA (the modern Tuscany), a great and civilised nation before the building of Rome, is an example of a powerful country whose literature is lost, and whose language is extinct, and almost undecipherable. Its history can therefore be gleaned only from occasional references in the writings of its foes; and its refinement, from its buried works of art.

By the Romans its people were called Etruscans; by the Greeks, Tyrrhenians. Amongst themselves they went by the name of Rasĕnæ. The accounts of their origin are speculative, for their language, the surest guide in such inquiries, cannot be employed to help us. There are a few indications of Asiatic origin, mingled, however, with evidences of a mixture of races, in which the Umbrian appears predominant.

In the infancy of Rome the Etruscans had extended their power from the base of the Alps to the Gulf of Taranto; and, when pressed back by hostile neighbours, they were still a flourishing and powerful people within Etruria proper. After a long struggle for their independence, they were compelled to yield to the rising power of Rome. In course of time they were enfranchised, when they soon dropped their language, and merged their nationality in the common character of Roman citizens.

Etruria was remarkable for its fertility. The soil yielded rich harvests of corn, wine, oil, and flax. Its maritime position gave the people the command of a great sweep of the Mediterranean, called after them the Tyrrhene Sea. The natural resources of the country provided in abundance materials for ship-building, the Apennines having their slopes clothed with timber, and their flax furnishing textures for sails. These advantages made commerce a natural development of Etruscan life. The inhabitants regarded themselves as exclusive masters of the Mediterranean, and were hostile to every nation disputing with them the rights of trade in its waters. The Greek colonists in Sicily, united under command of Gelo, tyrant or ruler of Syracuse, met the Etruscan fleet in battle, and defeated it 480 B.C. Enmities thus aroused being not lightly appeased, the Etruscans for a century after repeatedly made war against the Syracusans and other Sicilian Greeks. The Etruscans enriched themselves by husbandry and cattle-rearing, as well as by their piracy and trade. Corn was sent to Rome almost as soon as that city was founded. The people grew luxurious. They became fond of high living and sumptuous entertainments, drank out of silver cups, and wore costly embroidered garments.

The Roman satirists called them corpulent gluttons, and Virgil charged them with being addicted to all kinds of sensual pleasures. Nevertheless, the Romans borrowed some of their institutions, and sent the young nobility to them for instruction. Art and science were cultivated, and religion mingled in all affairs, domestic and national. Their mythology comprised the two classes of the Shrouded deities, never revealing themselves to mankind, and the Subject gods of a lower rank. The chief ports were Pisa, Populonium, Cære, Hadria on the coast south of the Po, and Spina.

To these ports were brought frankincense for use in sacrifice, ivory, and the precious metals for manufactures. The Etruscans were noted for all kinds of work in silver, gold, and other metals. Their pottery was in request in every part of Italy. The exquisite vases, found in so many of their tombs, appear, however, to have been the work of Greek colonists. The Etruscans, skilled in painting, sculpture, and architecture, were employed upon Roman buildings, and taught the Romans the use of the arch. The still extant figures of the She-Wolf and of the Orator are renowned as masterpieces of their bronze statuary in the opinion of some critics, though others refer these works to Greek artists. Their candelabra, of the same material, were prized by the Athenians as early as the age of Pericles.

RECREATIVE NATURAL HISTORY.

CADDIS WORMS AND FLIES.

Amongst the almost endless number of objects of interest which meet the eye of the searcher after brook and river treasures few will be found to reward his investigations more richly, or open up a wider field for study and reflection, than the genus of neuropterous insects (*Phryganea*), to which the so-called caddis-fly belongs. A vast number of species have been described by naturalists as inhabiting the rivers and brooks of England. Some of these families of insects are comparatively local, whilst others appear to be common wherever suitable conditions for their sustenance and support are met with. Not only do the perfect insects or flies of different species vary in colour, tint, etc., but the larvæ, who are accomplished builders in their way, adopt a style of architecture in accordance with the customs of the family to which the constructor belongs. *P. fluviacornis*, for example, from the moment he quits the egg dropped by the parent fly to the still deeps of the brook pool, turns his attention to the collection of tiny fresh-water shells and minute particles of shell-like substances. These, by a process allied to that by which the silkworm forms its cocoon, are, so to speak, spun together. The glutinous filaments of web, as they are given off by the insect, adapt themselves to every inequality of the substance to be secured at the point intended to be next the chamber or tube, in which, when smoothly and evenly lined, the industrious and deft worm will find an abiding place. Shell after shell and particle after particle are thus added step by step to the structure, and as the caddis-worm grows so he increases the bulk of his building materials, turning them with his ready claws until they are in a position to suit his requirements. But whilst we admire his constructive talent and skilful selection, truth compels us to state that *P. fluviacornis* is most dishonest and unscrupulous in his building operations. What should we say of a powerful potentate who, to build for himself a splendid mansion, seized on the dwelling-houses of other people, carried them off bodily, turned them upside down with the inhabitants in them, and then cemented one on the other until the tyrant's stronghold was complete? Such conduct, although highly reprehensive in the potentate, is most interesting and curious in a caddis-worm, who is perfectly indifferent as to whether the freshwater mollusk fixed on for building purposes is in his castle or not. If he is, he simply has to travel from place to place at the will of his captor; if not, the empty shell is taken immediate possession of, just as any other stray substance would be.

Caddis-worms kept in a state of confinement, and deprived of the materials which their instinct teaches them to use, will, without hesitation, employ such substances as may be placed before them. Some curious and interesting results have followed experiments tried on the building powers of the caddis-worm. One specimen was, we are informed, furnished with particles of clear, transparent glass, and, as this was the only substance to be obtained, he in a short time constructed his dwelling tube of it. Through the transparent case thus formed every movement of the worm could be closely observed, and at length, on the completion of the tiny coat of crystal armour, the wearer was, with other worms differently clad, placed in an aquarium with a number of hungry and inquisitive sticklebacks, who at once made an attack on the plump, succulent-looking morsel just fallen amongst them. Like a set of pirates, they dashed at the coveted prize, but, to their confusion, discovered that instead of an unarmed and easily subdued victim they had run their stems against a formidable armour-clad, bristling with spikes, and armed at all points. So the pigmy fleet backed astern, and then sheered off in consternation and disgust, to seek more profitable cruising-grounds. Coloured beads, fragments of stained glass, particles of pearl shells, etc., are by the caddis-worm, when restricted in the matter of building material, worked up into tubes, or caddis houses, of the most curious and pleasing character — in fact, they become, when vacated by the worm, natural history specimens which most persons desire to possess. Figs. 1, 2 in the annexed illustration represent specimens of *P. fluviacornis* which have made use of materials of their own selection for the construction of their dwellings.

Then we have another noteworthy member of the caddis family in *P. rombira*, who may be viewed in the light of a carpenter caddis. Sticks, fragments of bark, and strong splinters of wood, are his favourite materials. These he cleverly joins together, parallel to each other, forming a kind of Liliputian fagot in which to dwell. Hence it is that the term *fagot-worm* has not unfrequently been applied to the whole caddis family. Fig. 3 represents one of these Liliputian log-houses. Then, again, we find a most eccentric worker, whose tribe confine themselves entirely to the use of sharp thorn-like spines of river-side grass for the construction of their strongholds. These pointed and needle-like bars they lay transversely on each other, row after row and tier after tier, in such a way that, as the cavity in the centre is made even and comfortable to reside in, all the points are caused to protrude from the outside. An American log hut is built much after the manner of this peculiar kind of caddis tube, only that by the backwoodsman the ends of the logs are notched together and jointed, whilst by the worm the pointed spines are united by glutinous silk, and caused to stand roughly out most truly "like quills on the fretful porcupine;" and, fond as fish are of the inhabitants of these spiked castles, few care to risk being choked by interfering with them. Fig. 4 represents one of these spike-guarded dwellings.

Stratagem, as well as the art of fortification, appears to be brought to bear by other members of the ingenious family under consideration. If we search carefully amongst the water-weeds and lily-roots, we shall find some short thick cuttings of stout grass blades, joined at the edges, perfectly green, fresh, and as though snipped from the parent stem. Let us examine them closely, and we shall find that within these fragments of longitudinally-arranged grass blades is a tubular cavity, and in it a worm of retiring habits, who withdraws his head to the secret recess which he has formed for himself, and which no fish of ordinary intelligence would look twice at. Fig. 5 represents one of these grass tubes.

A search amongst the rough pebble stones will not unfrequently be rewarded by the discovery of a tiny trumpet-shaped caddis tube composed entirely of minute particles of river sand. A rare and beautiful example of this trumpet, or rather tusk-like form of tube, is to be found in the British Museum; it is known as the *Dentalium nigrum*, from its tooth or tusk-like form, and almost black colour. Fig. 6 represents one of these, whilst Fig. 7 shows the more common tusk-shaped tube found in most English rivulets and streams. We have found that the period passed in the larvæ or case-guarded stage varies considerably with species, and the conditions to which specimens are placed. Certain kinds manifest a marked partiality for vegetable food, whilst others freely consume animal substances, and will not hesitate to attack and destroy such weak and helpless water-insects or small mollusks as may come within their reach.

Those of our readers who live sufficiently near to a river or stream in which the caddis is found may without difficulty capture a number of kinds by fastening five or six large cabbage-stalks in a bundle, fixing a heavy stone at the bottom to give weight to the mass, and then casting the lure into a likely-looking pool in such a way that it may lie near enough to the bank to be, at the end of three or four days, drawn carefully and quietly out with a hook-ended stick. The worms within their cases will then be perceived in considerable numbers feeding on the cabbage-stalks.

Such specimens as are required for either bait for fishing or experimental purposes can be conveniently carried in a flannel bag well moistened with clean water. Thin slices of cabbage-stalk should be placed with the worms, and the bag dipped in water once per day, and then hung in a cool, shady place to drain. In this way the caddis may be preserved until it is placed in the aquarium. Fig. 8 gives a diminished view of a caddis trap prepared for throwing into the water.

When about to pass from the larva to the pupa stage, the worm proceeds to construct a sort of silk lattice-work or grating over the mouth of its tube. This, although fine enough to exclude intruders, admits of the free influx of water. Fig. 9 represents the worm on an enlarged scale after removal from the tube, and Fig. 10 a cross section of a tube, showing the form of reticulated work with which the mouth of a fagot-tube is stopped when the worm is about to undergo the change from larva to pupa: this view is also enlarged. About a fortnight or three weeks pass before the silken net-work is broken through by the pupa, which is represented on an enlarged scale at Fig. 11. This quaint and curious-looking creature, on quitting the case, struggles upwards to the surface, and is borne onwards by the stream, until some friendly branch of river-side tree, fragment of drift wood, or protruding rock, affords a resting for the water-borne waif. Here, dried and warmed by the spring sun, the pupa swells apace, becomes plump, and at last, like the harlequin in the transformation scene of a pantomime, severs the fastenings of this sombre garment, casts it on one side, and steps forth in all the pride of bright colours and beauty of form. Fig. 12 represents the perfect insect or caddis-fly, life size, after its change from the pupa stage; and Fig. 13 the insect with its wings extended in the act of flight. No food of any kind is taken by the perfect insect during the short period which passes between its birth, coupling, egg-depositing, and death.

Some of these flies swarm out abundantly during the day, whilst others are nocturnal in their habits. Both the *Perla* and *Nemoura* are at times confounded with the *Phryganea*, but they differ materially from the insects we have been describing in many marked respects. The common may-fly and stone-fly of the river-side are familiar and well-marked examples of the former families. Their larvæ do not construct cases in which to dwell, are carnivorous feeders, and either dwell in small communities amongst the hollow crevices of the river banks, or beneath the ledges of stones and pebbles. From these lurking-places they are at all times prepared to sally out for the purpose of attacking any water-insect less powerful than themselves. In every stage of their growth these insects afford vast quantities of nutritive and wholesome food for fish, and it is mainly from the absence of this and similar larvæ that many fish-ponds and streams are found to be unprofitable and uncongenial to the full development of the fish sought to be propagated in them. Other waters, although less promising in appearance, will be found to contain insects of many kinds, and in these it will be found as a rule that fish not only rapidly increase in number, but grow to a large size, and present to the eye of the angler that sturdiness of form and brightness of colour which he knows so well how to appreciate. The perfect insects of the *Perla* and *Nemoura* families are remarkable for the long hair-like spines or whisks which are attached to their tails. The latter shortly lose these forked appendages, but the former retain them during their short lives

The term *ephemera* has been applied to the family of may-flies. Ephemeral, too, are many of the fleeting joys and triumphs of human life. Hatched in the first rays of an early spring morning, the may-fly finds a partner and deposits its eggs before the sun sets, and, ere another sunrise, ceases to exist. It has been stated, on the authority of Reaumur, that it sometimes happens in the south of Europe that the bodies of dead ephemera cover the ground in such countless myriads as to lead to their being carted away for manure by the farmers of the neighbourhood through which the rivers watering the district flowed.

LESSONS IN LATIN.—LIII.

GOVERNMENT OF THE CASES.

If we look at the cases according to their applications, we find that the nominative (Latin, nomen, *a name*) is that case in which the name or noun stands when it is uninflected, and when it is the subject of the verb. The *nominative* answers to the question *who?* or *which?* as—

Naso dixit; quis? Naso.
Naso said (it); who (said it?) Naso.

The *genitive* (from gigno, *I beget;* genus, *a kind* or *race*) denotes the origin of a person or thing; as—

Patris filia est pulchra, *the father's daughter is fair;*

and hence possession in all its varieties. The genitive answers to the question *whose?* as—

Est *matris* domus; cujus? matris.
It is the mother's house; whose? mother's.

The *dative* (from do, dare, datum, *I give*) conveys the ideas implied in our *to* and *for*, and so is the case of giving or receiving. The dative answers to the question *to* or *for whom?* as in this example:—

Datur equus *militi;* cui? militi.
A horse is given to a soldier; to whom? a soldier.

The *accusative* (*ad* and *causa*) is the case of that which is caused or affected—more strictly, that which is affected—that is, affected by the verb; that which is the object of the verb's action. As denoting the object, this case is more significantly called in English the objective case. The accusative or objective case answers to the question *whom?* or *what?* as—

Misit *Robertum;* quem? Robertum.
He sent Robert; whom? Robert.

The *vocative* (voco, *I call*) is the case of calling—that is, of invocation or direct address; as—

Veni huc, *domine.* *Sir, come hither!*

The *ablative* (a and fero, ferre, tuli, *latum*) is the case of removing. As the dative denotes *giving to*, so the ablative denotes *taking from*. This seems to be the fundamental meaning of the ablative. Other significations, such as *by*, *with*, and *in*, are derivative. The ablative answers to the question *from* (or *by*) *whom* or *what?* as—

> Puer morsus est a cane; a quo? a cane.
> *A boy has been bitten by a dog; by what? a dog.*

The nominative and vocative are called the *direct cases*, and all the rest are called the *indirect* or *oblique cases*.

The oblique cases in Latin are not exactly identical in meaning with the corresponding cases in English. The Latin genitive is of much wider application than the English possessive, and not seldom implies relations which are commonly expressed by our *to* or *for*. The Latin ablative also embraces the varied significations of *from*, *by*, *through*, *in*, and *with*.

If you consider what verbs imply the relation indicated by *to* or *for*, you will ascertain the class of verbs which require their object to be in the dative. But here you must take difference of idiom into account. In English we say, *they obey me*, but the Latins said, *they obey* TO *me* (mihi obediunt). Hence arises what is called the rule, that in Latin *verbs of obeying and commanding are followed by a dative.* In English we say, *he approached the shore*, though the expression is elliptical, and *he approached* TO *the shore* was formerly used. In Latin, when *appropinquare* denotes motion it takes an accusative with *ad* (our *to*), or the dative without *ad;* the dative without *ad* is used when the verb denotes a position, a being or a lying near; as exemplified in the following sentences :—

> *Ad summam aquam* pisces appropinquant.
> *Fishes draw near (rise) to the top of the water.*
> *Munitionibus* appropinquant milites.
> *The soldiers approach the fortifications.*

Dare alicui aliquid is sometimes equivalent *to do something out of love or regard for;* as—

> Da hoc patriæ ut consilio tuo uti possit.
> *Give this to thy country that it may make use of thy counsel.*

After a similar manner are employed the verbs *donare*, *condonare*, *remittere*, *concedere*.

"To marry," in English, has a construction corresponding with the Latin accusative. Thus we say, *she married him*, *he married her*. But nubo, *I marry*, in Latin commonly requires a dative. Nubo is used of the female, thus, nupsit Chloe Claudio, *Chloe married Claudio*. The reason why *nubere* requires a dative is found in its derivation. *Nubo* has for its stem *nub*, which is the base of nubes, *a cloud*, also *a veil*. Now the bride came to her husband veiled. Accordingly, she was said to veil herself to or for—that is, to marry—her husband. On his part the male was said, ducere uxorem, *to lead or conduct a wife* (that is, domum) *home*.

THE DATIVE.

The verb *esse*, when it signifies possession, being equivalent to our word *have*, puts in the dative the noun which denotes the possessor; as—

> Est *mihi* timor, *I am afraid* (I have fear).

The dative of the possessor is distinguished from the genitive of the possessor in this—that the former is used when you ask for what is possessed, and the latter when you ask who is the possessor; as—

1. Regi est ager. *The field belongs to the king.*	2. Ager est regis. *The field is the king's.*

In No. 1 you ask, "What belongs to the king?" Answer, "The field." In No. 2 you ask, "Whose is the field?" Answer, "The king's."

Adjectives which involve the idea of *to* or *for* take a dative. Such adjectives are those which signify *useful*, *useless*, *suitable*, *unsuitable*, *known*, *friendly*, etc.; namely, *utilis*, *inutilis*, *salutaris*, *damnosus*, *gratus*, *carus*, *aptus*, *accomodatus*, *idoneus*, *facilis*, *difficilis*, *notus*, *ignotus*, *proprius*, *alienus*, *amicus*, *æquus*, *iniquus*, *infestus*, *infensus*, *iratus*, *fidus*, *fidelis*, etc. So with the adverbs *convenienter*, *constanter*, *amice*.

Some of these adjectives admit of another construction, namely, *ad* with the accusative, as, utilis ad rem; or *erga* with the accusative, as, benevolus erga aliquem; or again, the genitive without a preposition, as, alienus alicujus rei, *foreign to a matter*, that is, having nothing to do with it, knowing nothing of it. *Alienus* may be also constructed thus, alienus aliquâ re, or ab aliqua re. *Proprius* may have a genitive, as, proprius alicujus, *peculiar to some one*, or some thing. Amicus, *friendly;* inimicus, *unfriendly;* familiaris, *intimate with;* and superstes, *surviving*, are often used as substantives, and consequently take their object in the genitive. *Aptus* and *idoneus*, if used of a thing, are generally constructed with an accusative, and *ad*, if of a person, simply with a dative.

The dative is also used with adjectives signifying *like*, *unlike*, *near*, *related*, etc., such as *par*, *impar*, *dispar*, *æqualis*, *inequalis*, *similis*, *dissimilis*, *contrarius*, *propinquus*, *propior*, *proximus*, *finitimus*, *vicinus*, *affinis*, *cognatus*, *communis*, etc.

Æqualis, *affinis*, *vicinus*, *propinquus*, are employed and constructed as nouns.

Propior and *proximus* may have an accusative, but only as referring to place; thus, *propior hostem*, but not *propior clementiam*, instead of which you must say *propior clementiæ*. Probably the former construction is to be explained by the ellipsis or omission of *ad*.

Similis and *dissimilis* take a genitive as well as a dative; a genitive when the likeness or unlikeness is mental, a dative when it is physical.

Idem may be constructed with a dative; as—

> Invitum qui servat idem facit occidenti, *he who saves a person unwilling (to be saved) does the same as one who kills (another).*

Certain exclamations govern a dative, as, væ tibi! *alas for thee!* hei misero mihi! *ah, me miserable!*

THE ACCUSATIVE.

The simplest form of the accusative case, as governed by verbs, is that which is found in connection with transitive verbs of the active voice, in which the action indicated by the verb passes directly from the subject to the object; as—

> Deus CREAVIT MUNDUM, *God created the world.*

Practice, aided by rule, will teach the student what verbs in Latin take an accusative case; but he has need to be on his guard against mere English analogy. *To fly from* in English would not give him the idea that the corresponding Latin verb required its object in the accusative case; yet so it does, as, for example—

> Andromeda *aufugiens aspectum* mœsta parentis,
> *Sad Andromeda flying from the sight of her father.*

Intransitive verbs become in some sort transitive by taking a noun of the same meaning as the action which they signify; as, ludere ludum, *to play a play*. This form of construction is known as the *cognate accusative*.

The noun may be similar in meaning instead of the same; thus, aleam ludere, *to play* (at) *dice*. Hence arise some forms which require special attention; for example—

> Bacchanalia vivere, *to live in a bacchanalian manner.*
> Vincere judicium, *to succeed in a law-suit.*

Intransitive verbs may have an accusative of the neuter pronoun; as, hoc lætor, *I am glad of that.*

Verbs in themselves intransitive acquire a transitive acceptation by receiving a preposition into combination; thus, latrare, *to bark*, is intransitive, but adlatrare, *to bark at*, is transitive.

Intransitive verbs in general cannot be used in the passive voice; but those intransitive verbs which are made transitive by prepositions may be used in the passive voice; as, fossa transilitur, *the ditch is leaped over.*

The preposition found in the verb is sometimes repeated with the noun for the sake of emphasis; as, *ad* urbem advolavit, *he flew to the city.*

Occasionally there is a difference of meaning between the verb with and the verb without the second preposition; thus, "adire ad regem" is *to go to the king*, but "adire regem" is *to address, to entreat the king.*

Two accusatives are found with transitive verbs. The first instance is where one of the accusatives is an adjective; as—

> Euphrates efficit *Mesopotamiam fertilem*,
> *The Euphrates renders Mesopotamia fertile.*

The verb *efficit* governs *Mesopotamia*. It does more—its force extends to *fertilem*. *Fertilem* here is not a mere epithet, as you may learn by so rendering it in the passive voice—*the fertile Mesopotamia is produced by the Euphrates.* This is not the sense; what is meant is that the Euphrates causes Mesopotamia to be fertile; and as in this English sentence the verb *causes* has two objects, namely, *Mesopotamia* and *to be*, so the Latin sentence has two objects, namely, *Mesopotamiam* and *fertilem*. The phrase and the construction are different from what appears in "laudo discipulum diligentem," where *diligentem* is an epithet simply qualifying *discipulum*. If, however, we write "efficio discipulum diligentem," *diligentem* becomes a second accusative.

Verbs which signify *to teach*, *to learn*, *to ask*, as doceo, disco, rogo, take two accusatives, one of the person, the other of the thing. In the passive voice these verbs have one accusative; though this construction is exceptional, and seldom used but by the poets:—

Active.—Doceo TE ARTEM, *I teach thee an art.*
Passive.—Ars *te* docetur, *an art is taught thee.*
Passive.—Tu doceris ARTEM, *thou art taught an art.*

Celo, *I conceal*, *hide from*, has the same construction.

The accusative is used after verbs of motion to denote the place whither a person proceeds. The construction may be without a preposition, or with a preposition; first, without a preposition, when the place or object is the name of a city or a small island, or when the noun is *domus* or *rus*; thus, eo Athenas, *I go to Athens*; eo domum, *I go home*; eo rus, *I go into the country*; eo Delum, *I go to* (the island) *Delos*. In all other cases a preposition is required to denote the place whither you go—such as *ad*, *in*, *versus*, *adversus*, *contra*, *ob*, *sub*, *subter*, *circum* and *circa*, *extra*, *intra*, *ultra*, *trans*.

A double accusative is found also with verbs compounded with the prepositions *trans* and *circum*:—

Copias flumen transduxit Cæsar, *Cæsar led his forces over the river.*
Pompeius *eos* omnia sua præsidia circumduxit, *Pompey led all his forces round them.*

From the use of an accusative to signify direction towards an object comes the use of an accusative to signify breadth, or the distance through which you pass in making your way to an object. This is called the *accusative of breadth*; it answers to the question *how far?* and may be equally used of length or distance; as—

Milites aggerem latum *pedes trecentos* exstruxerunt.
The soldiers raised a mound three hundred feet broad.

As length of place, so length of time is expressed by the accusative; as—

Alexander Magnus *tredĕcim annos* regnavit.
Alexander the Great reigned thirteen years.

The accusative case is also used in exclamations and direct addresses; as—

Me cæcum, qui hæc ante non viderim!
Blind that I am not to have seen these things before!

The accusative, perhaps, is produced by the effect of words now no longer in use, and the construction may be looked upon as an ellipsis. *Me miserum!* may originally have been *me miserum dico!* It is more probable that the accusative is used as being the natural objective case.

The vocative also is employed in exclamation; as—

O miser, quod non sentis, quam miser *sis!*
O wretched man, in that thou knowest not how wretched thou art!

The nominative, too, may be employed when it suffices to mention an object in order to refer to it; as—

O fortunata *mors*, quæ pro patriâ *est* reddita.
O fortunate death which is undergone for one's native land.

After *en* and *ecce* (= ence) the nominative generally stands:—

Ecce tuæ *litteræ!* | En *dextra* fidesque!

More seldom the accusative occurs with *en* and *ecce*. "En quatuor aras! ecce duas tibi, Daphne!" are found in Virgil, and "ecce me! eccillum! eccum! eccos!" are common in the comic poets.

The dative may accompany an exclamation when the object is a personal one to whose advantage or disadvantage anything happens; as—

Væ *tibi!* hei misero *mihi!* *Woe to thee! alas, wretched one!*

LESSONS IN ENGLISH LITERATURE.—XVII.

MILTON.

THE one supremely great name in the literature of the period now under review, the period of the Civil War and the Commonwealth, is that of Milton. Milton is as completely the type and representative of the literature of his own age as Shakespeare was in the preceding generation. That intense earnestness of purpose, that thoroughness both in thought and in learning, and that profoundly religious spirit which characterised the greatest writers of that day; and, not less, the delicacy and refinement of taste and feeling, and the keen sense of harmony, which were the special merits of its lesser poets:—all these qualities Milton possessed above all other men; while, in addition to all this, he was gifted with an intellectual greatness and a commanding genius, which place him among the greatest poets of all time.

John Milton was born in the year 1608. He was sprung of an old family; but his father, having adopted the tenets of the Puritan party, had become separated from his family, and had maintained himself and his family, and earned a competent fortune, by pursuing the business of a scrivener, a term which, in his day, denoted one employed in the responsible office of negotiating investments for money. Though his great son followed the Puritan views of his father, the family were not unanimously upon this side in the contests of the day. The poet's younger brother, Christopher Milton, was a zealous Royalist, became eminent as a lawyer, and was for a short time one of the judges of the Court of Common Pleas under James II. The future poet was born in London, but his childhood and early youth were passed for the most part at his father's country-house at Horton, in Buckinghamshire. His father was himself a man of education and taste, and an accomplished musician; a Puritan in religion, and with, no doubt, those political sympathies which distinguished the Puritans as a party from their religious opponents. From him we may presume that Milton received his earliest education. He was then at St. Paul's School, in London; and from thence he passed to Christ's College, Cambridge. Of the details of Milton's life at the university we know little. But though the tales upon which his earlier biographers delighted to dwell—of humiliating punishments undergone, and expulsion incurred by him at the hands of the authorities of his college—rest upon no satisfactory evidence, and may probably be rejected, there can be little doubt that he found the tone of the place uncongenial; and one passage in particular, in one of his Latin poems, shows that he looked back upon his university with but little affection. Although, however, Milton was all his life a student, and with him, more than with most men, it would be inaccurate to speak of any one period as distinctively the period of his education, he must have made abundant use of the years he passed at Cambridge, and must even at that time have acquired an extent of learning rare in a rarely learned age. For Milton was one of that small number of men of the highest order of genius, whose powers have shown themselves at an extremely early age. Almost from boyhood he was a great poet, as well as a great scholar; and almost from boyhood he seems to have been fully conscious of his own extraordinary powers. After leaving Cambridge, Milton spent some years at his father's house. The cause of his passing this period of seeming inaction is not far to seek. Milton had originally been designed for, and himself contemplated, entering upon holy orders; but he was deterred from carrying out this intention by a repugnance for the intellectual restraints which such a course would have imposed upon him. And we can easily imagine that, to a mind as keenly alive as Milton's to the responsibilities of life, the choice of a new course was not the work of a day. Upon some such ground he himself afterwards explained the seeming loss of these years. They were not years, however, of idleness, but of profound study. In 1638 Milton went abroad, and spent more than a year in the enjoyment of the society, and in cultivating the friendship, of the most eminent men of letters of the Continent, and especially of Italy.

This visit to the Continent forms the close of the first period of Milton's literary history. He was by this time known as a man of extraordinary learning. Of the ancient languages and literature he was a consummate master; nor was he less familiar with the living tongues. In Italy, the most cultured nation of

Europe, his poems, both Latin and Italian, excited general surprise and admiration. But it is as an English author that, in these lessons, we have specially to do with him.

There are few poets whose works more clearly reflect the life of their author than Milton's. Not that his works, his poetical works at any rate, contain many direct references to himself or his history; such notices are few. But the spirit and character of his works change with the changes in the spirit and circumstances of the man. The period of Milton's life which we have been hitherto describing was one of tranquillity and repose. His toils were those of the student. He had not yet been drawn into the vortex of religious and political controversy. His works of this period are exclusively poetical. They have all the music which belongs to everything he ever wrote: he shows the same learning, and the same mastery over his learning, as in later writings; the same pure and severe morality, and the same spirit of reverence. But in these earlier poems the whole tone is different from that of the later ones. The prevailing spirit is a keen enjoyment of the beautiful. They have a light-heartedness which for Milton never returned. He still had leisure for—

> "Such sights as youthful poets dream
> On summer eves by haunted stream."

He had not yet learned the Puritan horror of the stage. Even in his pensive mood he would—

> "Sometime let gorgeous Tragedy
> In sceptred pall come sweeping by,
> Presenting Thebes or Pelops' line,
> Or the tale of Troy divine."

Unlike the Milton of later days, who was too rigid, too self-contained to join in the public services of any religious body, he could still write—

> "But let my due feet never fail,
> To walk the studious cloisters pale;
> And love the high embowed roof,
> With antique pillars massy proof;
> And storied windows richly dight,
> Casting a dim religious light.
> There let the pealing organ blow,
> To the full-voiced quire below,
> In service high and anthems clear,
> As may with sweetness, through mine ear,
> Dissolve me into ecstasies,
> And bring all heaven before my eyes."

We can only briefly mention Milton's poems of this, his first period. Passing by a few very early works, in some of which the influence of Spenser—who, of English poets, seems to have been more than any other Milton's model—is very apparent, we come to the great Ode on the Nativity. This magnificent ode is said to have been written by Milton at the age of twenty-one.

To the same period belongs the exquisite poem of "Lycidas." It was written upon the death of an intimate college friend of Milton, Edward King, who was drowned in the Irish Channel, while upon his voyage from Chester to Dublin. The death of this young man produced a strong impression at the time, and gave rise to a number of poems, which were published in a collected form, but of which Milton's was the only one of remarkable merit. This poem has something of the artificial character and unreality which might be expected in one composed under such circumstances. It is pastoral in form: the young man whose death is lamented is a fellow-shepherd of the writer.

> "Together both, ere the high dawn appeared,
> Under the opening eyelids of the morn,
> We drove a-field."

The poet introduces all that incongruous mixture of imagery, and peoples his stage with that variety of sacred and mythological personages, Christian and heathen, to which we are accustomed in pastoral poetry. The poem has no passion in it, and little that appeals to the emotions. But for beauty of imagery and perfect harmony of numbers there are few poems which can be placed on the same level.

The "Masque of Comus" was founded upon a trivial incident which occurred in the family of the Earl of Bridgewater, who, as Lord President of the Welsh Marches, had his residence at Ludlow Castle. His daughter, with her two brothers, lost their way in a wood; and this slight circumstance gave rise to the beautiful poem of "Comus." This graceful poem is framed upon the model of the Masques of Jonson and Fletcher, of which we have already had occasion to speak. It differs from its predecessors in the peculiar elevation of tone, the moral dignity, which Milton has thrown into it, as into everything else that he ever wrote. This piece was acted at Ludlow Castle by members of the noble family upon whose adventures it was founded. The music was composed by the celebrated musician Lawes, who also acted a part in the piece. The keynote of this beautiful poem is the beauty of virtue and purity, its superiority to circumstances, and the divine protection which attends it.

> "Virtue could see to do what Virtue would,
> By her own radiant light, though sun and moon
> Were in the great sea sunk."

Upon this subject Milton lavishes the richest and most varied eloquence, interspersed with songs of a "Doric delicacy" which is marvellous.

The "Masque of Arcades" is somewhat similar in character to "Comus," but it is as inferior to it in merit as it is shorter in length. "Arcades" is probably the earlier work of the two.

But of the poems of this, the first period of Milton's career, the most remarkable, and probably the most universally enjoyable, are the companion pieces, "L' Allegro" and "Il Penseroso," the one a description of the tastes and pursuits of the cheerful man, the other of the pensive man. It would be difficult to find in any language the same amount of poetical beauty compressed into the same space as in these two short poems. Every word conveys a picture, and the rhythm of every line conduces to the impression which is to be produced. The cheerful man's first pleasure is—

> "To hear the lark begin his flight,
> And singing startle the dull night,
> From his watch-tower in the skies,
> Till the dappled dawn doth rise."

A little later we have him—

> "Walking not unseen,
> By hedge-row elms on hillocks green,
> Right against the eastern gate,
> Where the great sun begins his state."

Then his eye catches—

> "Russet lawns and fallows grey,
> * * * * *
> Meadows trim with daisies pied.
> * * * * *
> Towers and battlements it sees,
> Bosomed high in tufted trees,
> Where perhaps some beauty lies,
> The Cynosure of neighbouring eyes."

In what contrast with these pictures are the nightly pleasures of the cheerful man:—

> "Towered cities please us then,
> And the busy hum of men,
> Where throngs of knights and barons bold
> In weeds of peace high triumphs hold,
> With store of ladies, whose bright eyes
> Rain influence and judge the prize."

There are few things in the whole range of poetry more beautiful than the description of cheerful music at the close of "L' Allegro." Milton was an enthusiast in music:—

> "Soft Lydian airs
> Married to immortal verse,
> Such as the meeting soul may pierce,
> In notes, with many a winding bout
> Of linked sweetness long drawn out,
> With wanton heed and giddy cunning,
> The melting voice through mazes running;
> Untwisting all the chains that tie
> The hidden soul of harmony."

The pensive man would

> "Walk unseen
> On the dry smooth-shaven green,
> To behold the wandering moon
> Riding near her highest noon,
> Like one that had been led astray
> Through the heavens' wide pathless way,
> And oft, as though her head she bowed,
> Stooping through a fleecy cloud."

He hears—

> "The far-off curfew sound
> Over some wide-watered shore
> Swinging slow with sullen roar."

The night having been passed in pursuits appropriate to a pensive and contemplative nature,—

"Thus Night, oft see me in thy pale career,
Till civil-suited Morn appear,
Not tricked and frounced as she was wont,
With the Attic boy to hunt,
But kerchiefed in a comely cloud,
While rocking winds are piping loud,
Or ushered with a shower still,
When the gust hath blown his fill,
Ending on the rustling leaves,
With minute drops from off the eaves."

One is tempted to linger over these exquisite poems; but we must leave them, for we have now to regard Milton in a very different character. When he returned to England, after his short sojourn abroad, it was no longer to enjoy the peaceful repose of the scholar and poet. From henceforth we have to do with him for some years as a prose-writer, one of the most eager and most bitter combatants in the controversies which then stirred men so profoundly. Milton's sympathies as a Puritan would naturally have been on the side of the Parliament and against the King, on the side of the Nonconformists and against the bishops. But Milton was no mere partisan of any of these causes. He was the champion of liberty—liberty of thought, liberty of speech, liberty of worship, liberty of action. Liberty was the passion of his life. "Liberty's defence, my noble task," was his work in life. He resisted the dogmatism of the "new presbyter" as strongly as of the "old priest;" and resented the intolerance of popular opinion as keenly as that of the State.

We cannot examine Milton's prose writings in any detail; but the student ought to understand something of their general character, and we treat of them now as a class because most of them belong to this period, though several are of a later date. The greater part of them relate to three great subjects of controversy, in which Milton took an active part—the controversy as to Church government; that as to divorce; and that as to the right or wrong of putting the king to death. In the first of these controversies he engaged almost immediately after his return from abroad. Several Presbyterian ministers had published a treatise bearing upon Church government, under the title of Smectymnuus, a name formed from the initial letters of their own names; and in the controversy which ensued, Milton fought eagerly in their defence and against episcopacy, his chief antagonists being Archbishop Usher and Bishop Bramhall.

Into the divorce controversy Milton was led through the circumstances of his own domestic history. His first wife was Mary Powell: their marriage was an unhappy one; and at last the lady left her husband and returned to her father, and only came back to her home when it was plain that Milton thought of acting upon those very liberal views as to the liberty of divorce and re-marriage which he consistently maintained.

In the third main controversy in which Milton engaged he appeared as the champion of the people of England, to defend their conduct in putting Charles I. to death; his chief opponent being the celebrated scholar La Saumaise, or, in the Latinised form, Salmasius.

These controversial labours, however, by no means represent the whole fruits of Milton's labours during this period of his life. For some years after his return to England he supported himself by keeping a school for boys in London. In 1649 he was appointed to the important office of Latin secretary to Cromwell, and in this capacity conducted the diplomatic correspondence of the Commonwealth.

There still remain a few isolated prose works of Milton, not relating to any of the great controversies of the day, which must not pass unnoticed. The most important of these are, an unfinished "History of England," a Tractate or treatise on Education, and especially the "Areopagitica," a speech for the liberty of unlicensed printing. This last is the greatest of Milton's prose works, and one which every student of English literature ought to study, for it exhibits the characteristics of his style in a peculiar degree. That style is always dignified, always rhythmical, though sometimes a little unwieldy and above his subject. But its great peculiarity is the occurrence, from time to time, of bursts of eloquence which no English writer has ever equalled. We can only give two examples:—

"Truth indeed came once into the world, with her divine Master, and was a perfect shape most glorious to look on; but when He ascended, and his apostles after him were laid asleep, then straight arose a wicked race of deceivers, who, as the story goes of the Egyptian Typhon with his conspirators,—how they dealt with the good Osiris, took the virgin Truth, hewed her lovely form into a thousand pieces, and scattered them to the four winds. From that time, ever since, the sad friends of Truth, such as durst appear, imitating the careful search that Isis made for the mangled body of Osiris, went up and down, gathering up limb by limb still as they could find them. We have not yet found them all, Lords and Commons, nor ever shall do, till her Master's second coming; He shall bring together every joint and member, and shall mould them into an immortal feature of loveliness and perfection."

The other passage we give refers to the national revival of thought and liberty in which Milton bore so great a part:—

"Methinks I see in my mind a noble and puissant nation, rousing herself like a strong man after sleep, shaking her invincible locks; methinks I see her as an eagle, muing her mighty youth, and kindling her undazzled eyes at the full mid-day beam; purging and unsealing her long-abused sight at the fountain itself of heavenly radiance."

LESSONS IN FRENCH.—LXXXII.

§ 114. Use of the Tenses.—The Present of the Indicative.

(1.) This tense denotes what exists, or is taking place at the time we speak:—

Je lis; vous parlez.	*I read; you speak.*

(2.) The French have only one form of the indicative present:—

Je parle means, therefore, *I speak, do speak*, or *am speaking.*

(3.) The indicative present is used in French, as well as in English, for expressing ideas or facts which are and will always be true:—

Dieu **est** éternel, sa puissance **est** sans bornes, et sa clémence **est** grande. GIRAULT DUVIVIER.	*God is eternal, his power is boundless, and his clemency is great.*

(4.) It is often used to express a proximate future:—

Je **suis** de retour dans un moment. MOLIÈRE.	*I shall be back in a moment.*
Si Titus a parlé, s'il **l'épouse**, je **pars**. RACINE.	*If Titus has spoken, if he marries her, I go (will go).*

(5.) The present is frequently used for the past, to awaken attention, and place the event, as it were, before the reader:—

J'ai vu, Seigneur, j'ai vu votre malheureux fils, Traîné par les chevaux que sa main a nourris: Il **veut** les rappeler, mais sa voix les **effraie**. RACINE.	*I saw, my lord, I saw your unfortunate son dragged by the horses which his own hand has fed; he wishes to recall them, but his voice frightens them.*

§ 115.—The Imperfect.

(1.) The imperfect, or simultaneous past, is used to express something which was in progress while another thing was taking place. It leaves the beginning, duration, and end of an action undetermined:—

J'**écrivais**, quand je reçus votre lettre.	*I was writing, when I received your letter.*

(2.) The French imperfect, as may be seen in the above example, represents the English tense formed of the past tense of the auxiliary *to be*, and the participle present of a leading verb.

(3.) The imperfect is also used to express repeated or customary action. It is then rendered in English by the infinitive of the verb preceded by *used to*:—

Lorsque **j'étais** à Londres, **j'allais** me promener le matin, ensuite je **dînais**, et je **passais** le reste de la journée à lire et à écrire.	*When I was in London, I walked (used to walk) in the morning, afterwards dined (usually dined), and spent (usually) the remainder of the day in reading and writing.*

(4.) The use of this tense will be further explained in the next paragraph.

*

§ 116.—The Past Definite.

(1.) The past definite indicates an action performed at a time entirely past:—

J'allai à Londres, où je **vis** votre père; je **finis** mes affaires dans cette ville, et **revins** aussitôt ici.	*I went to London, where I saw your father; I finished my business in that city, and returned hither immediately.*
M. un tel **écrivit** hier au soir un sixain à Mademoiselle une telle. MOLIÈRE.	*Mr. such-a-one wrote last evening six verses to Miss such-a-one.*

(2.) The past definite can only be used, as we have seen above, when the time at which an action took place is entirely elapsed. We cannot, therefore, use it in connection with the words *to-day, this morning, this week, this month, this year,* etc. [*See* § 117, Past Indefinite.] We may use it in speaking of *yesterday, last week, last year,* etc.:—

Je vous envoie, mon chère frère, une lettre que j'**écrivis** hier pour Madame de Laval. FÉNELON.	*I send you, my dear brother, a letter which I wrote yesterday for Madame de Laval.*

(3.) The imperfect may be rendered in English by the participle present of the leading verb and the past tense of the auxiliary *to be;* or by placing "*used to*" before the present of the infinitive. The preterite definite can never be so rendered.

(4.) The imperfect might be called the *descriptive* past tense of the French.

(5.) The past definite might be called the narrative tense. It expresses that which took place at some time fully past. We will endeavour to illustrate this difference between these two tenses.—A traveller has entered a wood and discovered a retired cottage; he wishes to describe what he saw there, and makes use of the imperfect or descriptive tense; he says:—

Un vieillard se **promenait** sous les arbres; il **tenait** un livre à la main; de temps en temps, il **levait** les yeux vers le ciel, ou les **couvrait** de la main, et **semblait** s'abîmer dans une profonde rêverie. Devant la porte de la cabane **était** assise une femme qui **berçait** un enfant sur ses genoux; elle **était** pâle; ses cheveux **flottaient** au gré du vent; des larmes **coulaient** le long de ses joues, &c.	*An old man was walking under the trees; he was holding a book in his hand; from time to time he raised his eyes towards heaven, or concealed them with his hand, and seemed to sink into a profound reverie. Before the door of the hut was sitting a female, who was rocking a child on her knees; she was pale; her hair was waving at the mercy of the wind; tears were flowing down her cheeks.*

The traveller has here drawn a picture of what presented itself to his eyes as he approached the cottage. Not content with representing merely the then present situation of things, he wishes also to narrate what took place. He has described the theatre on which the occurrence took place which he is going to relate; he now proceeds to the narrative, and uses the past definite or narrative tense:—

Je m'**approchai** du vieillard; lorsqu'il m'**aperçut**, il s'**avança** vers moi, me **salua** et me **pria** de ne pas troubler cette paisible retraite du malheur. Il **retourna** à la cabane, **prit** l'enfant des bras de la femme, et **rentra**; elle le **suivit**, etc.	*I approached the old man; when he perceived me he came towards me, greeted me, and besought me not to disturb this peaceful retreat of the unfortunate. He returned to the cottage, took the child from the woman's arms, and went in; she followed him.*

Another example might be taken from La Fontaine's well-known fable:—

LE CORBEAU ET LE RENARD.	THE RAVEN AND THE FOX.
Maître corbeau sur un arbre perché, **Tenait** en son bec un fromage; Maître renard, par l'odeur alléché, Lui **tint** à peu près ce langage.	*Master raven perched upon a tree, was holding in his beak a cheese; master fox, attracted by the smell, addressed him nearly in the following words.*

Here the poet uses the imperfect of **tenir** in describing the situation in which the fox found the raven, but in relating the action of the fox, La Fontaine uses the narrative tense of the same verb.

§ 117.—The Past Indefinite.

(1.) The past indefinite expresses an action entirely completed, but performed at a time of which some part is not yet elapsed, as *to-day, this month, this year,* etc.:—

Le roi m'**a nommé** aujourd'hui archevêque de Cambray. FÉNELON.	*The king appointed me to-day archbishop of Cambray.*
Ce matin **j'ai trouvé** le pavé si glissant, que **j'ai pensé** que si je venais à tomber sur le bras droit, je serais tout à fait désemparé. BERNARDIN DE ST. PIERRE.	*This morning I found the street so slippery, that I thought in case I happened to fall on my right arm, I should then be completely helpless.*
Je **t'ai defendu** (*see* (2.) *below*) cent fois de racler ton méchant violon; cependant, je **t'ai entendu ce matin**.—Ce matin? Ne vous souvient-il pas que vous me le **mites** [§ 116 (2.)] hier en pièces? PALAPRAT.	*"I have forbidden thee a hundred times to scrape thy wretched violin; nevertheless, I heard thee this morning." "This morning! Do you not recollect that you broke it to pieces yesterday?"*

(2.) The past indefinite is also used with regard to a time entirely past, but not specified:—

Les fruits de la terre **ont été** la première nourriture des hommes. GIRAULT DUVIVIER.	*The fruits of the earth were the first aliments of mankind.*
Les Français **ont gagné** la bataille de Marengo.	*The French gained the battle of Marengo*

(3.) When the time is specified and entirely elapsed, the past indefinite is by many of the best French writers used indifferently with the past definite:—

Past Definite.	*Past Indefinite.*
Huit jours après son départ, il m'**écrivit** une lettre. BERNARDIN DE ST. PIERRE.	Je vous **ai écrit**, il y a quinze jours. THE SAME.
A week after his departure, he wrote me a letter.	*I wrote to you a fortnight ago.*
Je **fus** bien fâché hier, ma chère cousine, de vous avoir quittée avec tant de précipitation. FÉNELON.	Hier en travaillant à mon quatrième dialogue, **j'ai éprouvé** un vrai plaisir. MIRABEAU.
I was very sorry yesterday, my dear cousin, for having left you in so much haste.	*Yesterday, while working at my fourth dialogue, I experienced real pleasure.*

(4.) When the first verb of a sentence is put in the past indefinite, every other verb of that sentence, and of the sentences referring to it, should be in the same tense.

§ 118.—The Pluperfect.

(1.) The pluperfect marks a past event which was completed before another event, also past, took place, both events being independent from one another:—

J'avais déjeuné, quand vous vîntes me demander. GIRAULT DUVIVIER.	*I had breakfasted, when you came to inquire for me.*

(2.) The pluperfect, having as its auxiliary the imperfect of the verbs **avoir** or **être**, partakes of the signification of that tense. It is, therefore, used to denote a customary action, which used to take place after another customary action, in which case the latter is expressed by the imperfect:—

Dès que **j'avais lu** quelques pages, je me **promenais.**	*As soon as I had read a few pages, I used to take a walk.*

§ 119.—The Past Anterior.

The past anterior expresses an event which took place *immediately* before another event which is also past: the latter event being the result of, or, as to its beginning, dependent upon, the former:—

Quand **j'eus reconnu** mon erreur, je **fus** honteux des mauvais procédés que j'avais eus pour lui. GIRAULT DUVIVIER.	*When I had perceived my error, I was ashamed of my bad conduct towards him.*
Dès que **j'eus lu** quelques pages, je **sortis.**	*As soon as I had read a few pages, I went.*

NOTE.—The pluperfect may be used with the imperfect, or the past definite, or the past indefinite; whilst the past anterior can be used only with the past definite.

*

PAINTING IN WATER-COLOURS.—V.

TREATMENT OF HIGH LIGHTS, ETC.

We promised in the first lesson to take up again the method of producing or picking out high lights; we resume the subject in order to show how in sepia drawings brilliant and harmonious effects may be obtained by tinting the whole paper first with a moderate tone of sepia, then painting the subject upon it, and afterwards rubbing out the high lights with india-rubber. Many artists use Chinese white for the same purpose; this pigment is very durable, but must be used with judgment; it frequently requires the addition of a light tone, either cool or warm as the case may be, to make it harmonise with the ground upon which it is laid; otherwise it will have a chalky effect. Being an opaque medium, it is of great advantage when employed with colours; sometimes the colouring tint is mixed with the white before it is used, or else the white is laid on the picture in its pure state, and then, when dry, a very light glaze or wash is passed over it, composed of Indian yellow and yellow ochre, or either of these alone, according to the tone of the surrounding parts near which it is laid. If a sepia drawing is made upon a grey paper, the white may be used alone. These remarks refer more especially to the brightest and most prominent lights; therefore we wish it to be understood that we do not intend here to include the broad lights, those parts which receive the general rays of the sun or any other luminary, but only those brilliant or sparkling effects which emanate with greater force from the projecting parts of polished surfaces, such as metal and glass; we may also include the reflection of light upon water and the masses of light clouds. To use Chinese white properly, and to prevent a flat and heavy appearance, it must be judiciously disposed, for if too liberally spread about the picture, the result will be a series of spots which destroy breadth and repose. Again, when any portion of the broad lights have become dirty through frequent washing, Chinese white is useful for preparing a fresh ground to receive a second painting with purer colour. Sometimes figures and cattle are painted with white after the picture is finished, the colours being mixed with the white, or the whole made out with white, and the colours glazed or washed over it.

We recommend our pupils to try the method of rubbing out the lights first upon a sepia drawing; there will be no difficulty afterwards in applying the same process to a coloured one. When, with regard to colours, the other method—that is, the use of white as a body colour—is employed, the previous remarks will sufficiently explain all that is necessary for the use of it.

First, the sepia drawing (Fig. 6). Draw the outline first upon white paper, and determine the extent of the picture by ruling lines for a boundary. Then with a middle tint of sepia cover the whole within the boundary lines, commencing at the top, the picture being placed in an inclined position: the outline must not be heavily drawn, it should be faintly but sufficiently seen through the sepia; the drawing must be very correct, as the wash of sepia will set the pencil marks so that it will be difficult to erase them for alterations. Commence the arrangement of the foreground with the same colour with which the paper was covered, that is, make out the grassy slope of the embankment, with all its broken details, above A A: the execution must be in short, sharp, careful touches to give character to the herbage, the brush being held in an upright position, so as to have a thorough command of the point and power of moving it in any direction; draw the brush across the darker parts of the water, to represent the reflections of the trees; paint in the masses of the trees, especially the lights, being very particular that their forms are carefully preserved; observe the same with regard to the wall, that is, go round it close to its edges, and introduce some of the principal tones upon its surface; all this is to be done with the colour left after the paper was tinted. Our object in using the same tint is to give a little more time and attention to the arrangement of particulars; as it is light, no very great injury can be done, and the forms and drawing generally may be greatly improved; it also provides a semi-tone for many of the details, which may afterwards be left as the work progresses, by introducing the darker parts about them. Now make the colour a little darker, and put in the broad masses of shadow, viz., those about the semi-lights which were left with the last tint, to give them relief. Make the first tint a little lighter, and paint in the distance; at the same time break it about on the road and on some of the lightest parts of the water, leaving the light side of the post and its reflection. Increase the strength of the colour, and make out the darker particulars of the trees at *c*, also the broad masses of the large tree, and give a few additional touches to the bank and surface of the water. Care must be observed that all the lighter forms, not necessary to be rubbed, are left, and the pupil must be particularly careful to preserve the character of the drawing, by which we mean a close and studied attention to form throughout, such as the projecting branches of the tree at *d*, portions of the foreground, and

Fig. 6.—TREATMENT OF HIGH LIGHTS, ETC.—OUTLINE SKETCH FOR SEPIA AND COLOURS.

similar places upon which light falls. We will now rub out the lights in the sky and on the water; use a well-pointed brush, perfectly clean, and not too wet; commence with the water by drawing it horizontally over those parts which are to have the greatest brilliancy (do a small portion at a time); after waiting a moment or two, to allow the wet to sink a little into the coloured ground, press it with the blotting-paper, and rub the parts wetted with a piece of india-rubber sharply and in the direction in which they are damped; also in the same way rub out the forms of the light clouds, and afterwards with a light tint make out their shadows on the under parts away from the sun. By this method of treating the high lights, we gain more transparency and atmosphere than can be obtained by the use of Chinese white, which is so liable to make the effect heavy and "painty." Lastly, all the darkest parts may now be attended to, by commencing with the dark tall tree, and bringing down the colour with sharp bright touches on the wall, the sides of the posts, the lines on the road, and the details of the foreground. The iron railings on the wall are to be left, by which we mean *the tone of the tree to be seen between the bars* is to be painted. If at any time the pupil should put on a tone or colour too dark, or too brilliant for its position, it is easily taken up with the blotting-paper before it is allowed to become dry.

We will now endeavour to give an exposition of the process of painting the same subject in colours. In undertaking this we acknowledge the difficulty we have to contend with, in stating the exact gradations and strength of the tints. However minute we may be in our explanation, there will still be much that must be left to the judgment of the pupil. His first attempts will probably be in many respects exaggerated; that is, he may through his inexperience begin the picture with too powerful tints—some may be too hot, some too cold; but there will be no cause for discouragement if he should make such mistakes, so long as he recognises them and sees the side upon which he has erred—in short, he must expect to fail; but there is this encouragement accompanying failures, that when they are understood they will gradually become less frequent; it is those who cannot perceive their faults who never improve. As we can only give principles even whilst expounding the minutest details, we depend upon our pupil's persevering practice of those principles which must eventually produce results terminating in success. Should he, for instance, commence by making his sky too blue, he can sponge it out (it must be done without much rubbing, or he will destroy the surface of his paper), and try again; probably the colour left after the sponging will be sufficiently near the mark: the same observation may be made and applied where there is any other similar mistake in the picture. We advise him then, at first, to begin lightly, as the same parts can be easily gone over again with another careful wash; not to be in a hurry, and especially attend to the drawing. Thus after a few repeated trials, he will soon begin to see his way, and discover that the tints he mixes in his experiments are without difficulty recognised in Nature; afterwards he will be prepared to repeat them with greater confidence, and apply them to the several parts of his picture at once, up to their proper strength, until at length he will make his picture his palette by uniting the requisite colours, taken fresh from the box, in their proper places while wet, or by glazing the pure colours over one another when the under colours are dry.

We particularly advise the pupil to paint the subject of this lesson in sepia first, according to the previous instructions: he is little aware how much he will gain by it in the execution, and how greatly his judgment will be improved; he will thus be better prepared to imitate the depths and tones with the colours. Place the paper on an inclination, and commence from A A (Fig. 6) with a moderate tint of cobalt blue, making it a graduated tint towards the horizon as far as B B; if it is not intended to rub out the light clouds, as explained in the sepia drawing, they must be left by dragging the blue colour loosely, having regard to the forms of the clouds, over that part of the sky where they are situated; pass the same colour over the water; when dry, wash a light tint of yellow ochre over the road, the wall, the banks on both sides of the river, and over the lights of the tree—the distance must not be touched with this colour. When the sky is dry, mix a tint of cobalt, a little lake, and very little sepia for a grey with which to paint the clouds; add a little more cobalt and lake to the last tint, and make out the principal shadows and darker details of the foreground, those on the opposite bank, the wall, and the broad shadows on the trees, principally representing all the deeper tones which were produced in the sepia drawing and marked *c c* in Fig. 6. Prepare a tint of gamboge yellow ochre and a little indigo, and pass over the lights on the grass, on the sides of the banks on both sides of the river, and the lights on the trees at *s s*; this may be horizontally and sparingly repeated on the surface of the water at *c c*, as there would be a reflection of the bank on the water. The worn path at *g*, made out with the grey tint, must be left and painted with broken touches, where it is

Fig. 7.—TREATMENT OF HIGH LIGHTS, ETC.—EFFECT OF FINISHED DRAWING.

bare of grass, with the same colour as the road, that is, with a mixture of yellow ochre and a little Indian red; a broken tint of light grey (the same that was used for the clouds) dragged over the darker parts of the road at *h h*, will cool it; at the same time this grey may be employed to particularise parts and details in the foreground (posts, etc.), also the darker parts of the water at *k k*. A very light wash of terre-verte and lake may be passed over some of the shadows or reflections on the water: this transparent grey, if not overdone, will be found exceedingly useful in toning down many parts not having any direct light cast upon them. The lights of the tall dark tree may be made with brown pink and a little indigo; this colour regulated with indigo may be employed in making out the shadows of all the trees, carefully preserving the lights; as there are different degrees of shadows, so different tones of this colour may be used in some of the depths with the addition of a little lake. The sand bank at *m* to be covered with yellow ochre broken here and there with a little Indian red, and the shadows made out with the grey of the clouds; the distance *n*, cobalt and lake with a little terre-verte to neutralise the purple produced by the lake with the blue. Afterwards the herbage in the foreground may be slightly glazed with burnt sienna; any of the other parts of the picture already painted may be glazed with some warm colours if the greys are too powerful, though care must be taken not to make them dirty.

LESSONS IN SPANISH.—XVI.

LIST OF IRREGULAR, DEFECTIVE, AND IMPERSONAL VERBS.

THE following list contains all the irregular verbs in the Spanish language. Each verb is to be conjugated in its irregular tenses like the verb under which it is arranged alphabetically; that is, each one is irregular in the same tenses and persons, and in the same manner, as the verb under which it is placed. In the tenses and persons which are not irregular, each verb is to be conjugated like the regular verb of the same conjugation; those ending in *ar* like *amar*, those in *er* like *comer*, and those in *ir* like *vivir*. The verbs marked § are impersonal, and, of course, to be used only in the third person singular of each mood and tense.

Every verb not included in this list is regular, and must be conjugated like the model verbs *amar*, *comer*, or *vivir*, according as it ends in *ar*, *er*, or *ir*.

The figures after model verbs, as *tentar* (5), etc., refer to the order of the irregular verbs in Lessons XIV., XV.

FIRST CONJUGATION.

Like *contar* (2) are conjugated the following:—

Acordar.	Costar.	Encontrar.	Resonar.
Acostar.	Degollar.	Encordar.	Revolar.
Agorar.	Demostrar.	Engrosar.	Revolcarse.
Almorzar.	Denostar.	Enrodar.	Rodar.
Amolar.	Desacordar.	Esforzarse.	Rogar.
Aporcar.	Desaprobar.	Estercolar.	Solar.
Aportar.	Descolgar.	Forzar.	Soldar.
Apostar.	Descollar.	Holgar.	Soltar.
Aprobar.	Desconsolar.	Hollar.	Sonar.
Asolar.	Descontar.	Mostrar.	Soñar.
Asoldar.	Desengrosar.	Poblar.	Tostar.
Asonar.	Desflocar.	Probar.	Trascolar.
Atronar.	Desforgarse.	Recordar.	Trascordarse.
Avergonzarse.	Desolar.	Recostar.	Trasoñar.
Colar.	Desollar.	Reforzar.	Trocar.
Colgar.	Desovar.	Regoldar.	Tronar.
Comprobar.	Despoblar.	Renovar.	Volar.
Concordar.	Destrocar.	Reprobar.	Volcar.
Consolar.	Desvergonzarse.	Rescontrar.	
Consonar.	Emporcar.	Resollar.	

Like *tentar* (5) are conjugated the following:—

Acertar.	Arrendar.	Atestar.*	Cerrar.
Acrecentar.	Asentar.	Atravesar.	Cimentar.
Adestrar.	Aserrar.	Aventar.	Comenzar.
Alentar.	Asestar.	Bregar.	Concertar.
Apacentar.	Atentar.	Calentar.	Confesar.
Apretar.	Aterrar.	Cegar.	Decentar.

* When *attest* means *to fill, to cram,* it is irregular; when it means *attest*, it is regular.

Decimentar.	Desplegar.	Fregar.	Regar.
Denegar.	Desterrar.	Frezar.	Remendar.
Derrengar.	Dezmar.	Gobernar.	Renegar.
Desacertar.	Emendar.	Helar.	Replegar.
Desalentar.	Empedrar.	Herrar.	Requebrar.
Desapretar.	Empezar.	Insertar.	Retemblar.
Desasosegar.	Encensar.	Invernar.	Retentar.
Desatentar.	Encerrar.	Manifestar.	Reventar
Desconcertar.	Encomendar.	Mentar.	Segar.
Desempedrar.	Encubertar.	Merendar.	Sembrar.
Desencerrar.	Ensangrentar.	Negar.	Sentarse.
Desenterrar.	Enterrar.	Nevar.§	Serrar.
Deshelar.	Escalentar.§	Pensar.	Sosegarse.
Desherrar.	Escarmentar.	Perniquebrar.	Soterrar.
Desmembrar.	Espresar.	Plegar.	Temblar.
Despedrar.	Estar.	Quebrar.	Trasegar.
Despernar.	Estregar.	Recomendar.	Tropezar.
Despertar.			

The following are conjugated like the model regular verb *amar*:—

Constar.	Granizar.§	Llovinzar.§
Escarchar.	Importar.§	Relampaguear.§

SECOND CONJUGATION.

Like *tener* are conjugated the following:—

Atenerse.	Detener.	Mantener.	Retener.
Contener.	Entretener.	Obtener.	Sostener.

Like *caer* (8) are conjugated *decaer, recaer.*

Like *hacer* (9) are conjugated *contrahacer, deshacer, rehacer, satisfacer.*

Like *mover* (10) are conjugated the following:—

Absolver.	Destorcer.	Moler.	Resolver.
Cocer.	Devolver.	Morder.	Retorcer.
Condoler.	Disolver.	Promover.	Revolver.
Conmover.	Doler.	Recocer.	Solver.
Demoler.	Envolver.	Remorder.	Torcer.
Desenvolver.	Escocer.	Remover.	Volver.

Like *parecer* (12) are conjugated the following:—

Abastecer.	Desentorpecer.	Enmohecerse.	Guarnecer.
Aborrecer.	Desfallecer.	Enmudecer.	Humedecer.
Acaecer.	Desflaquecerse.	Ennegrecer.	Magrecer.
Acontecer.	Desguarnecer.	Ennoblecer.	Mecer.
Adolecer.	Desobedecer.	Enrarecer.	Merecer.
Adormecerse.	Desplacer.	Enriquecer.	Mohecerse.
Agradecer.	Desvanecerse.	Ensoberbecerse.	Mollecer.
Amanecer.	Embebecerse.	Entallecer.	Nacer.
Amortecerse.	Embravecerse.	Enternecer.	Negrecer.
Anochecer.	Embrutecerse.	Entomecer.	Obedecer.
Aparecer.	Emplumecer.	Entontecerse.	Obscurecer.
Apetecer.	Empobrecer.	Entorpecerse.	Ofrecer.
Bermejecer.	Encabellecer.	Entristecerse.	Pacer.
Canecer.	Encalvecer.	Entullecer.	Padecer.
Carecer.	Encallecer.	Entumecer.	Perecer.
Compadecerse.	Encanecer.	Envejecer.	Pertenecer.
Comparecer.	Encarecer.	Enverdecer.	Prevalecer.
Complacer.	Encrudecerse.	Escarnecer.	Reconocer.
Conocer.	Encruelecer.	Esclarecer.	Reconvalecer.
Convalecer.	Endentecer.	Espavorecer.	Recrecer.
Crecer.	Endurecer.	Establecer.	Reflorecer.
Desabastecer.	Enflaquecer.	Estremecerse.	Remanecer.
Desadormecer.	Enfurecerse.	Fallecer.	Remecer.
Desaparecer.	Engrandecer.	Favorecer.	Renacer.
Descaecer.	Enloquecer.	Fenecer.	Restablecer.
Desconocer.	Enmocecer.	Fortalecer.	Reverdecer.

Like *poner* (14) are conjugated the following:—

Anteponer.	Disponer.	Oponer.	Reponer.
Componer.	Esponer.	Preponer.	Sobreponer.
Deponer.	Imponer.	Presuponer.	Suponer.
Descomponer.	Indisponer.	Proponer.	Trasponer.

Like *tender* (17) are conjugated the following:—

Ascender.	Defender.	Entender.	Reverter.
Atender.	Desatender.	Estender.	Trascender.
Cerner.	Descender.	Heder.	Verter
Condescender.	Desentenderse.	Hender.	
Contender.	Encender.	Perder.	

Like *traer* (18) are conjugated the following:—

Abstraer.	Contraer.	Distraer.	Retrotraer.
Atraer.	Desatraer.	Estraer.	Sustraer.
	Detraer.	Retraer	

Like *valer* (19) are conjugated *equivaler.*

Like *ver* (20) are conjugated *antever, prever, rever.*

THIRD CONJUGATION.

Like *bendecir* (23) conjugate *maldecir*.
Like *decir* (24) are conjugated *contradecir, desdecirse, predecir.*
Like *dormir* (25) conjugate *morir*.
Like *incluir* (27) are conjugated the following :—

Argüir.	Destruir.	Imbuir.	Prostituir.
Atribuir.	Disminuir.	Instituir.	Recluir.
Concluir.	Distribuir.	Instruir.	Restituir.
Constituir.	Excluir.	Luir.	Retribuir.
Construir.	Fluir.	Muir.	Sustituir.
Contribuir.	Huir.	Obstruir.	

Like *lucir* (29) conjugate *deslucir, enlucir, entrelucir, relucir.*
Like *oir* (30) conjugate *entreoir.*
Like *producir* (31) are conjugated the following :—

Conducir.	Inducir.	Reducir.	Traducir.
Deducir.	Introducir.	Seducir.	

Like *salir* (32) conjugate *sobresalir.*
Like *sentir* (33) are conjugated the following :—

Adherir.	Deferir.	Hervir.	Preferir.
Adquerir.	Desconsentir.	Inadvertir.	Presentir.
Advertir.	Desmentir.	Inferir.	Proferir.
Arrepentirse.	Diferir.	Ingerir.	Referir.
Asentir.	Digerir.	Invertir.	Requerir.
Aterirse.	Divertir.	Investir.	Resentirse.
Conferir.	Envestir.	Mentir.	Sugerir.
Consentir.	Herir.	Pervertir.	Zaherir.
Controvertir.			

Like *servir* (34) are conjugated the following :—

Apercibir.	Derretir.	Estreñir.	Reir.
Arrecirse.	Desceñir.	Espedir.	Rendir.
Ceñir.	Descomedirse.	Freir.	Reñir.
Colegir.	Deservir.	Gemir.	Repetir.
Comedirse.	Desleir.	Impedir.	Reteñir.
Competir.	Despedir.	Medir.	Revestir.
Concebir.	Desteñir.	Pedir.	Seguir.
Conseguir.	Elegir.	Perseguir.	Sonreirse.
Constreñir.	Embestir.	Proseguir.	Teñir.
Corregir.	Engreirse.	Regir.	Vestir.
Convertir.			

Like *venir* (35) are conjugated the following :—

Avenirse.	Desavenir.	Provenir.
Contravenir.	Intervenir.	Revenir.
Convenir.	Prevenir.	Sobrevenir.

Like the model regular verb, *vivir*, conjugate *concernir.*§

LIST OF VERBS WITH IRREGULAR PAST PARTICIPLES.

Some verbs of those in the preceding list of irregular verbs, and some which are otherwise regular, have the past participle irregularly formed. The following list contains all these verbs with the irregular participle. Those marked R have also their past participles regularly formed. Thus, *ingerir* has both *ingerto* and *ingerido.*

Abrir,	abierto.
Absolver,	absuelto.
Ahitar, R.,	ahito.
Anteponer,	antepuesto.
Antever,	antevisto.
Bendecir, R.,	bendito.
Compeler, R.,	compulso.
Componer,	compuesto.
Confundir, R.,	confuso.
Contradecir,	contradicho.
Contrahacer,	contrahecho.
Convencer, R.,	convicto.
Cubrir,	cubierto.
Decir,	dicho.
Deponer,	depuesto.
Descomponer,	descompuesto.
Descubrir,	descubierto.
Desdecirse,	desdicho.
Desenvolver,	desenvuelto.
Deshacer,	deshecho.
Despertar, R.,	despierto.
Disolver,	disuelto.
Disponer,	dispuesto.
Elegir, R.,	electo.
Encubrir,	encubierto.
Envolver,	envuelto.
Escribir,	escrito.
Espeler, R.,	espulso.
Esponer,	espuesto.
Freir, R.,	frito.
Hacer,	hecho.
Imponer,	impuesto.
Imprimer, R.,	impreso.
Incurrir, R.,	incurso.
Indisponer,	indispuesto.
Ingerir, R.,	ingerto.
Insertar, R.,	inserto.
Invertir, R.,	inverso.
Manifestar, R.,	manifesto.
Morir,	muerto.
Omitir, R.,	omiso.
Oponer,	opuesto.
Oprimir, R.,	opreso.
Poner,	puesto.
Predecir,	predicho.
Prender, R.,	preso.
Preponer,	prepuesto.
Prescribir, R.,	prescrito.
Presuponer,	presupuesto.
Prever,	previsto.
Proponer,	propuesto.
Proscribir,	proscrito.
Proveer, R.,	provisto.
Recluir, R.,	recluso.
Rehacer,	rehecho.
Reponer,	repuesto.
Resolver,	resuelto.
Rever,	revisto.
Revolver,	revuelto.
Romper, R.,	roto.
Satisfacer,	satisfecho.
Sobreponer,	sobrepuesto.
Soltar, R.,	suelto.
Suponer,	supuesto.
Suprimir, R.,	supreso.
Trasponer,	traspuesto.
Ver,	visto.
Volver,	vuelto.

Some participles are used sometimes as verbal adjectives; thus, *mirado* means, as a participle, *beheld*, and as an adjective, *considerate; leido* means as a participle *read*, and as an adjective *book-learned; partido* means *divided*, and *liberal; sabido* means *known*, and *well-informed.* In all such cases the student will find the word, in his Spanish dictionary, defined as an adjective. He will be able, from the sense of the context, to determine whether to employ it as a participle or adjective, just as in English he would know which is the adjective and which the participle in the sentences, "a known event," and "a person whom he has known."

Some changes have taken place in the verb-ending of the second person plural in all the tenses and conjugations. This anciently had its termination in *des* — as *amades, amábades, amástedes, amarédes, amédes*, etc., for *amais, amábais, amásteis, amaréis, ameis.*

Soy, doy, voy, sois, caigo, oigo, valgo, cupo, hubo, puso, etc., were formerly *so, do, vo, sódes, cayo, oyo, valo, copo, ovo, poso.*

THE ADVERB.

Adverbs are either primitive or derivative : the *primitive* being those which are simple or uncompounded of any other word; as, no, *not;* ya, *already;* hoy, *to-day;* allá, *yonder;* and the *derivative*, those that are formed from other words (chiefly adjectives, participles, or other adverbs) by the addition of *mente;* as, *brevemente, confusamente, ciertamente.*

The Spanish language, like the English, contains numerous terms composed of more than one word, and used adverbially, hence called adverbial phrases; as, por cierto, *for certain;* por lo comun, *in general;* de un modo, *in such manner.*

THE CONJUNCTION.

Conjunctions are *simple;* as, y, *and;* ó, *or;* que, *that;* si, *if;* ni, *nor;* porque, *because;* como, *as;* mas, *but;* pero, *but:* or *conjunctive phrases;* as, con tal que, *provided that;* pues, *then;* pues que, *since;* para que, á fin de que, *to the end that, in order that.*

The conjunction *ó* is changed into *ú* when it comes before a word beginning with *o;* as, lacre ú obléa, *sealing-wax or wafer.*

THE PREPOSITION.

Prepositions are *simple;* as, con, *with;* de, *of;* and *compound;* as, á pesar de, *in spite of;* cosa de, *about, the matter of;* para con, *as to;* por entre, *through.*

The following list comprehends the principal simple prepositions in Spanish :—

A', *to, at, for.*	De, *of, from.*	Para, *for.*
Ante, *in presence of, before.* [*to.*	Desde, *from.*	Por, *by, through, of.*
A'ntes, *before, previous*	Detras, *behind.*	Segun, *according to.*
Con, *with.*	En, *in, into, on.*	Sin, *without.*
Contra, *against, opposite to.*	Entre, *between, among.*	Sobre, *upon, over.*
	Hácia, *towards.*	Tras, *behind.*
	Hasta, *unto, till.*	

Prepositions do not always correspond in Spanish and in English; that is, *de* is not always to be translated *of*, or *á* by *to*, etc.; as—

Los valles abundan de trigo, *the valleys abound with wheat.*
Ella pide perdon á Dios, *she asks pardon from God.*

THE INTERJECTION.

The interjections are *simple* and *compound;* as, ¡ah! *oh;* ¡chito! *hush;* and ¡pobre de mi madre! *O my poor mother!*

The following list comprehends the principal simple interjections :—

Ah, *ah!*	Ea, *ha! go on! good!*	Hola, *halloo! ho there!*
Ay, *ah! alas!*	Ete, *see! behold! lo!*	O, *oh! ho!*
Ce, *here! go on!*	Fu, *pshaw! fie! tush!*	Ta, tate, *take care! stop!*
Chito, chitou, *hush! silence!*	Ha, *ah! oh!*	
	He, *eh! hist! hark!*	

TERMS USED IN COMMERCE.—V.

LAC.—A term used in India, denoting a sum of 100,000. One hundred lacs equal one *crore*, or 10,000,000.

LANDING ACCOUNT.—An account taken by the various dock companies and wharfingers of all goods landed, with their weights and other particulars requisite to the importers, accompanied by remarks as to the condition of the packages or merchandise.

LANDING WAITER.—A Customs' officer, whose duty it is to examine and take account of all goods liable to duty, on their being weighed after landing from the ship.

LAY DAYS.—The number of days allowed for unloading or loading ships, as stipulated between their owners and the charterers or freighters.

LAZZARETTO.—An establishment in which quarantine is performed, and in which the goods landed from ships in quarantine are fumigated previous to their introduction to the markets.

LEASE or TACK.—A conveyance for a term of years (which term is always less than that which the lessor holds for) of houses, land, or any other description of property. The person granting the lease is termed a *Lessor*, and the person to whom it is granted a *Leaseholder* or *Lessee*.

LETTER OF CREDIT.—A letter from a banker or mercantile house, requesting their agent to pay money to a third party—the bearer of the letter.

LETTER OF LICENCE.—An agreement signed by the creditors of an insolvent or embarrassed trader, permitting him to carry on business for a certain time without satisfying their claims.

LETTER OF MARQUE.—Letters granted by a Government to its subjects, authorising them to fit out ships (called privateers) to prey upon the commerce of a rival country.

LEVARI FACIAS.—A writ of execution, commanding a sum of money to be levied upon the effects of a defendant.

LIABILITIES.—The debts and pecuniary responsibilities of any person or company.

LIEN.—A conditional right of claim upon property, such as is voluntarily granted by its owners as a means of affording security in monetary transactions.

LIGHTERAGE.—The amount of freight or hire of a lighter or barge.

LIMITATIONS.—The periods fixed by law for the recovery of debts. Those of an ordinary character become void in law after a lapse of six years, unless a written acknowledgment and promise to pay has been made during that period. For bonds, deeds, and judgment debts, twenty years are assigned.

LIMITED LIABILITY.—In Joint-Stock Companies the limitation of the liabilities of each member for the debts of the company, to the nominal amount of his shares.

LIQUIDATION.—A course of settlement or winding-up.

LLOYD'S.—Subscription rooms in the Royal Exchange, where the underwriters (marine insurers) attend for the transaction of their business.

LLOYD'S BONDS.—An acknowledgment of indebtedness by a railway company, originally given to a contractor for a portion of the line. They are in excess of the amount of debentures allowed by the Act of Parliament of the company granting them, and derive their name from the originator, who devised them as a plan for giving security to the builder of the line. Having the nature of a mortgage, and being for a portion of the original plant, they were supposed to be a first charge on the property of the company, but their legality has been called into question, and now they cannot be readily negotiated in the money market.

LOG BOOK.—A book containing a minute record of a ship's progress, and every incident occurring to her or on board of her during the voyage.

MANDATE.—A delivery of goods to a person who is to do some act in connection with them entirely without reward. He who delivers the goods is styled the *Mandator*, and the receiver the *Mandatory*.

MANDAMUS.—A writ issuing from the Court of Queen's Bench, requiring the performance of certain specified acts. It is a writ of a most extensive remedial nature, and issues in all cases where the plaintiff has a right to have anything done, and has *no other legal means* of compelling its performance.

MANIFEST.—A statement made out by the master of a vessel previous to leaving port, specifying the whole of the cargo, ports of destination, etc.

MASTER.—The person entrusted with the care and navigation of a merchant ship.

MAXIMUM.—The greatest quantity or part of anything. Plural, *Maxima*.

MEASUREMENT GOODS.—Merchandise on which freight is paid by measurement instead of weight. A ton consists of 40 cubic feet, and the solid contents in measurement of each package is ascertained by taking its length, breadth, and depth.

MERCHANT.—One who trades with foreign countries; an importer and exporter of goods and produce.

MINIMUM.—The least quantity or part of anything. Plural, *Minima*.

MONOPOLY.—A privileged or other absorption of an entire trade or branch of industry.

MORTGAGE.—A pledge of land or property by deed as security for money lent or owing. The person pledging is the *Mortgager;* the one in whose favour the deed is executed the *Mortgagee*.

MUSTER.—An average sample or collection of samples.

NEGOTIABLE DOCUMENT.—A document which in its transfer from one person to another conveys to the possessor a legal right to the money or property specified.

NET.—That which remains after the deduction of all charges, outlay, or allowances of any description.

NOTARY (PUBLIC).—A specially authorised person who attests, copies, or translates certain documents, proves their validity for the purpose of giving them effect abroad, and whose province it is to *note*, and issue *protest* against, the non-acceptance or non-payment of bills.

LESSONS IN ALGEBRA.—XXXVI.

RATIO AND PROPORTION.

THE design of mathematical investigations is to arrive at the knowledge of particular quantities, by comparing them with other quantities, either *equal* to, or *greater*, or *less* than those which are the objects of inquiry. This end is most commonly attained by means of a series of *equations* and *proportions*. When we make use of equations, we determine the quantity sought, by discovering its *equality* with some other quantity or quantities already known.

We have frequent occasion, however, to compare the unknown quantity with others which are *not equal* to it, but either greater or less.

Unequal quantities may be compared with each other in two ways :—

1. We may inquire *how much* one of the quantities is greater than the other; or,

2. We may inquire *how many times* one quantity contains the other.

The *relation* which is found to exist between the two quantities compared, is called the *ratio* of the two quantities.

RATIO *is of two kinds, arithmetical and geometrical.* It is also sometimes called *ratio by subtraction*, and *ratio by division*.

ARITHMETICAL RATIO *is the* DIFFERENCE *between two quantities or sets of quantities.* The quantities themselves are called the *terms* of the ratio, that is, the terms between which the ratio exists. Thus 2 is the arithmetical ratio of 5 to 3. This is sometimes expressed by placing two points between the quantities, thus, $5 \cdot\cdot 3$, which is the same as $5 - 3$. Indeed, the term *arithmetical ratio*, and its notation by points, are almost needless, and are seldom used. For the one is only a substitute for the word *difference*, and the other for the sign $-$.

If both the terms of an arithmetical ratio be *multiplied* or *divided* by the same quantity, the *ratio* will, in effect, be multiplied or divided by that quantity.

Thus, if $a - b = r$,
Then multiply both sides by h (Ax. 3), $ha - hb = hr$,
And dividing by h (Ax. 4), $\frac{a}{h} - \frac{b}{h} = \frac{r}{h}$.

If the terms of one arithmetical ratio be added to, or subtracted from, the corresponding terms of another, the ratio of their sum or difference will be equal to the sum or difference of the two ratios.

$$\left.\begin{array}{l}\text{If } a - b \\ \text{And } d - h\end{array}\right\} \text{are the two ratios,}$$

Then $(a+d)-(b+h)=(a-b)+(d-h)$; for each $= a+d-b-h$.

And $(a-d)-(b-h)=(a-b)-(d-h)$; for each $= a-d-b+h$.

Thus the arithmetical ratio of $11 \,..\, 4$ is 7,
And the arithmetical ratio of $5 \,..\, 2$ is 3.

The ratio of the *sum* of the terms $16 \,..\, 6$ is 10, which is also the sum of the ratios 7 and 3.

The ratio of the *difference* of the terms $6 \,..\, 2$ is 4, which is also the difference of the ratios 7 and 3.

GEOMETRICAL RATIO *is that relation between quantities which is expressed by the* QUOTIENT *of the one divided by the other.*

Thus the ratio of 8 to 4 is $\frac{8}{4}$ or 2; for this is the quotient of 8 divided by 4. In other words, it shows how often 4 is contained in 8.

The two quantities compared are called a *couplet*. The *first* term is the *antecedent*, and the *last* the *consequent*.

Geometrical ratio is expressed in *two ways.*

1. In the form of a *fraction*, making the *antecedent* the *numerator*, and the *consequent* the *denominator;* thus the ratio of a to b is $\frac{a}{b}$. And

2. By placing a *colon* between the quantities compared; thus, $a : b$ expresses the ratio of a to b.

Of these three, the antecedent, the consequent, and the ratio, any *two* being given, the other may be found.

Let $a =$ the antecedent, $c =$ the consequent, $r =$ the ratio.

By definition $r = \frac{a}{c}$; that is, the ratio is equal to the antecedent divided by the consequent.

Multiplying by c, $a = cr$; that is, the antecedent is equal to the consequent multiplied into the ratio.

Dividing by r, $c = \frac{a}{r}$; that is, the consequent is equal to the antecedent divided by the ratio.

If two couplets have their antecedents equal, and their consequents equal, their ratios must be equal.

If in two couplets the ratios are equal, and the antecedents equal, the consequents are equal; and if the ratios are equal and the consequents equal, the antecedents are equal.

If the two quantities compared are *equal*, the ratio is a unit, *or a ratio of equality.* The ratio of $3 \times 6 : 18$ is a unit, for the quotient of any quantity divided by itself is 1.

If the antecedent of a couplet is *greater* than the consequent, the ratio is greater than a unit. For if a dividend is greater than its divisor, the quotient is greater than a unit. Thus the ratio of $18 : 6$ is 3. This is called a ratio of *greater inequality.*

On the other hand, if the antecedent is *less* than the consequent, the ratio is less than a unit, and is called a ratio of *less inequality*. Thus, the ratio of $2 : 3$ is less than a unit, because the dividend is less than the divisor.

INVERSE *or* RECIPROCAL RATIO *is the ratio of the reciprocals of two quantities.*

Thus, the reciprocal ratio of 6 to 3 is $\frac{1}{6}$ to $\frac{1}{3}$; that is, $\frac{1}{6} \div \frac{1}{3}$.

The direct ratio of a to b is $\frac{a}{b}$; that is, the antecedent divided by the consequent.

The reciprocal ratio is $\frac{1}{a} : \frac{1}{b}$; or, $\frac{1}{a} \div \frac{1}{b} = \frac{1}{a} \times \frac{b}{1} = \frac{b}{a}$; that is, the consequent b divided by the antecedent a.

Hence a reciprocal ratio is expressed by *inverting the fraction* which expresses the direct ratio; or when the notation is by points, by *inverting the order of the terms.*

Thus, a is to b inversely, as b to a.

COMPOUND RATIO *is the ratio of the* PRODUCTS *of the corresponding terms of two or more simple ratios.*

Thus the ratio of	$6 : 3$, is 2,
And the ratio of	$12 : 4$, is 3.
The ratio compounded of these is	$72 : 12 = 6$.

Here the compound ratio is obtained by multiplying together the two antecedents, and also the two consequents of the simple ratios. Hence it is equal to the product of the simple ratios.

Compound ratio is not different in its *nature* from any other ratio. The term is used to denote the origin of the ratio in particular cases.

If in a series of ratios the consequent of each preceding couplet is the antecedent of the following one, *the ratio of the first antecedent to the last consequent is equal to that which is compounded of all the intervening ratios.*

Thus, in the series of ratios, $a : b$,
$b : c$,
$c : d$,
$d : h$,

the ratio of $a : h$ is equal to that which is compounded of the ratios of $a : b$, of $b : c$, of $c : d$, and of $d : h$. For the compound ratio by the last article is $\frac{ab\,cd}{bc\,dh} = \frac{a}{h}$, or $a : h$.

A particular class of compound ratios is produced by multiplying a simple ratio in *itself*, or into another *equal* ratio. These are termed *duplicate, triplicate, quadruplicate,* etc., according to the number of multiplications.

A ratio compounded of *two* equal ratios, that is, the *square* of the simple ratio, is called a *duplicate* ratio.

One compounded of *three*, that is, the *cube* of the simple ratio, is called *triplicate*, etc.

In a similar manner the ratio of the *square roots* of two quantities is called a *subdupticate* ratio; that of the *cube roots* a *subtriplicate* ratio, etc.

Thus, the simple ratio of a to b is $a : b$.
The duplicate ratio of a to b is $a^2 : b^2$.
The triplicate ratio of a to b is $a^3 : b^3$.
The subduplicate ratio of a to b is $\sqrt{a} : \sqrt{b}$.
The subtriplicate ratio of a to b is $\sqrt[3]{a} : \sqrt[3]{b}$, etc.

N.B. The terms *duplicate, triplicate,* etc., must not be confounded with *double, triple,* etc.

The ratio of 6 to 2 is	$6 : 2 = 3$.
Double this ratio, that is, *twice* the ratio, is	$12 : 2 = 6$.
Triple the ratio, *i.e., three times* the ratio, is	$18 : 2 = 9$.
The *duplicate* ratio, *i.e.,* the *square* of the ratio, is	$6^2 : 2^2 = 9$.
The *triplicate* ratio, *i.e.,* the *cube* of the ratio, is	$6^3 : 2^3 = 27$.

That quantities may have a ratio to each other, it is necessary that they should be so far of the same nature, that one can properly be said to be either equal to, or greater, or less than the other. Thus a foot has a ratio to an inch, for one is twelve times as great as the other.

From the mode of expressing *geometrical ratios* in the *form* of a *fraction*, it is obvious that the *ratio* of two quantities is the same as the *value* of a fraction whose numerator and denominator are equal to the antecedent and consequent of the given ratio. Hence,

To multiply or divide both the antecedent and consequent by the same quantity, does not alter the ratio. To multiply or divide the antecedent alone by any quantity, multiplies or divides the ratio; to multiply the consequent alone, divides the ratio; and to divide the consequent, multiplies the ratio. That is, *multiplying* and *dividing* the antecedent or consequent has the *same* effect on the *ratio*, as a similar operation, performed on the numerator or denominator, has upon the *value* of a fraction.

If to or from the terms of any couplet, two other quantities having the same ratio be added or subtracted, the sums or remainders will also have the same ratio. Thus the ratio of $12 : 3$ is the same as that of $20 : 5$. And the *ratio* of the *sum* of the *antecedents* $12+20$, to the *sum* of the *consequents* $3+5$ is the same as the ratio of either couplet. That is,

$$12+20 : 3+5 :: 12 : 3 = 20 : 5, \text{ or } \frac{12+20}{3+5} = \frac{12}{3} = \frac{20}{5} = 4$$

So also the *ratio* of the *difference* of the *antecedents* to the *difference* of the *consequents* is the same. That is,

$$20-12 : 5-3 :: 12 : 3 = 20 : 5, \text{ or } \frac{20-12}{5-3} = \frac{12}{3} = \frac{20}{5} = 4.$$

If in several couplets the ratios are equal, *the sum of all the antecedents has the same ratio to the sum of all the consequents. which any one of the antecedents has to its consequent.*

$$\text{Thus the ratio } \left\{ \begin{array}{l} 12 : 6 = 2. \\ 10 : 5 = 2. \\ 8 : 4 = 2. \\ 6 : 3 = 2. \end{array} \right.$$

Therefore the ratio of $(12+10+8+6) : (6+5+4+3) = 2$

Exercise 67.

1. Which is the greater, the ratio of 11 : 9, or that of 44 : 35?
2. Which is the greater, the ratio of $a + 3 : \frac{1}{6}a$, or that of $2a + 7 : \frac{1}{3}a$?
3. If the antecedent of a couplet be 65, and the ratio 13, what is the consequent?
4. If the consequent of a couplet be 7, and the ratio 18, what is the antecedent?
5. What is the ratio compounded of the ratios of 3 : 7, and $2a : 5b$, and $7x + 1 : 3y - 2$?
6. What is the ratio compounded of $x + y : b$, and $x - y : a + b$, and $a + b : h$?
7. If the ratios of $5x + 7 : 2x - 3$, and $x + 2 : \frac{1}{2}x + 3$ be compounded, will they produce a ratio of greater inequality, or of less inequality?
8. What is the ratio compounded of $x + y : a$, and $x - y : b$, and $b : \frac{x^2 - y^2}{a}$?
9. What is the ratio compounded of 7 : 5, and the duplicate ratio of 4 : 9, and the triplicate ratio of 3 : 2?
10. What is the ratio compounded of 3 : 7, and the triplicate ratio of $x : y$, and the subduplicate ratio of 49 : 9?

PROPORTION.

When four quantities are related to one another in such a manner that the first divided by the second is equal to the third divided by the fourth—in other words, when the ratio of the first to the second is equal to the ratio of the third to the fourth, the four are said to be in direct proportion. From this definition it will be seen that proportion is simply the equality of ratios. Though we have only spoken of two equal ratios, there may be any number, and in all cases the terms of these ratios are said to be in direct proportion.

Care must be taken not to confound *proportion* with *ratio*. This caution is the more necessary, as in common discourse the two terms are used indiscriminately, or rather, proportion is used for both. The expenses of one man are said to bear a greater proportion to his income than those of another. But according to the definition which has just been given, one *proportion* is neither greater nor less than another. For *equality* does not admit of degrees. One *ratio* may be greater or less than another. The ratio of 12 : 2 is greater than that of 6 : 2, and less than that of 20 : 2. But these differences are not applicable to *proportion*, when the term is used in its technical sense. The loose signification which is so frequently attached to this word, may be proper enough in *familiar language;* for it is sanctioned by general usage. But for scientific purposes, the *distinction* between *proportion* and *ratio* should be clearly drawn and cautiously observed.

Proportion may be expressed, either by the common sign of equality, or by four points between the two couplets.

$$\text{Thus}\begin{cases} 8 \cdot\cdot 6 = 4 \cdot\cdot 2, \text{ or } 8 \cdot\cdot 6 :: 4 \cdot\cdot 2 \\ a \cdot\cdot b = c \cdot\cdot d, \text{ or } a \cdot\cdot b :: c \cdot\cdot d \end{cases}\text{are arithmetical proportions.}$$

$$\text{And}\begin{cases} 12 : 6 = 8 : 4, \text{ or } 12 : 6 :: 8 : 4 \\ a : b = d : h, \text{ or } a : b :: d : h \end{cases}\text{are geometrical proportions.}$$

The latter is read, "the ratio of a to b equals the ratio of d to h;" or more concisely, "a is to b as d to h."

The first and last terms are called the *extremes*, and the other two the *means*. *Homologous* terms are either the two antecedents or the two consequents. *Analogous* terms are the antecedent and consequent of the same couplet.

As the ratios are equal, it is manifestly immaterial which of the two couplets is placed first.

If $a : b :: c : d$, then $c : d :: a : b$. For if $\frac{a}{b} = \frac{c}{d}$, then $\frac{c}{d} = \frac{a}{b}$.

The *number* of *terms* in a proportion must be at least *four.* For the equality is between the ratios of *two couplets;* and each couplet must have an antecedent and a consequent. There may be a proportion, however, between *three quantities;* for one of the quantities may be *repeated*, so as to form two terms. In this case the quantity repeated is called the *middle term*, or a *mean proportional* between the two other quantities, especially if the proportion is geometrical.

Thus the numbers 8, 4, 2, are proportional. That is, 8 : 4 :: 4 : 2. Here 4 is both the consequent in the first couplet, and the antecedent in the last. It is therefore a mean proportional between 8 and 2.

The *last* term is called a *third proportional* to the two other quantities. Thus 2 is a third proportional to 8 and 4.

Inverse or *reciprocal* proportion is an equality between a *direct* ratio and a *reciprocal* ratio.

Thus $4 : 2 :: \frac{1}{3} : \frac{1}{6}$; that is, 4 is to 2 *reciprocally*, as 3 to 6. Sometimes, also, the order of the terms in one of the couplets is inverted, without writing them in the form of a fraction.

Thus 4 : 2 :: 3 : 6 inversely. In this case, the *first* term is to the *second*, as the *fourth* to the *third;* that is, the first divided by the second, is equal to the fourth divided by the third.

When there is a series of quantities, such that the ratios of the first to the second, of the second to the third, of the third to the fourth, etc., are *all equal*, the quantities are said to be in *continued proportion*. The consequent of each preceding ratio is then the antecedent of the following one.

N.B. Continued proportion is also called *progression.*

In the preceding articles of this section, the general properties of ratio and proportion have been defined and illustrated. It now remains to consider the principles which are peculiar to each kind of proportion, and attend to their practical application in the solution of problems.

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XXXV.

Exercise 66.

1. 18 and 6.
2. £160 and £40.
3. 2 and 4.
4. 40 and 16.
5. 15 pieces at 45 crowns.
6. A 9 miles, and B 6 miles.
7. 1 and 7.
8. A relieved 60; B, 20. A gave £13; B, £18.
9. 7 and 3.
10. 7 persons.
11. 75 yards at 16s.
12. £9 12s. and £5 8s.
13. 18 yards of the finer, 20 of the coarser, and the prices were 20s. and 16s.
14. 36 gals. of Teneriffe wine at 18s. per gallon.
15. 16.
16. 12 gallons and 17 gallons, at 2s. per gallon.
17. 6.
18. 16.
19. 14 and 10.
20. 20 and 40.
21. 121 and 25.
22. 18 and 2.
23. $\frac{1}{2}$ and $\frac{1}{3}$.
24. 5 and 20.
25. 7 at first.
26. 16.
27. 24 by 18.
28. 15 and 8.
29. 8.
30. 7 rods.
31. 10 by 15.
32. 144.
33. 14 by 10.
34. 9 feet = width; plot, 72 by 54; area = 3,888 sq. ft.
35. 118 and 177.
36. 3 inches.
37. 4 miles per hour.
38. £30.
39. 45·100040033 feet.
40. A, 13 days at 9 miles; B, 13 days at 10 miles.
41. A £1,200, and B £800.
42. 27 yards at 12s.
43. 10 gallons.
44. Pepper, 10s. per lb.; ginger, 5s.

ACOUSTICS.—I.

DIFFERENCE BETWEEN SOUND AND NOISE—SOUND PRODUCED BY VIBRATIONS—HOW CONVEYED TO THE EAR—CONDUCTION OF SOUND—TELEPHONIC CONCERT—CAUSES AFFECTING INTENSITY.

The science of Acoustics, on the study of which we are now about to enter, is concerned with inquiries as to the nature and properties of sound, and the vibrations of elastic bodies. In the human body a special nerve, called the *auditory nerve*, is given off from the brain, and spreads out into a number of minute filaments, which are distributed over the surface of one of the cavities of the ear. When any elastic substance is put in rapid vibration, it causes certain tremors or vibrations of the air around; these are conveyed to the ear, and acting upon this nerve give rise to the sensation of sound.

These sounds are very varied in character, and the science of Music treats of the different effects they produce upon the emotions. Acoustics is merely occupied with ascertaining the nature and causes of these differences.

Whenever the air or any elastic body is set in vibration, a sound will be produced, provided that the vibrations be sufficiently rapid: if they be too slow, the ear will be unable to distinguish the sound; different ears have, however, different powers in this way, as will be explained shortly. The simplest illustration of this fact is seen by fixing one end of a string to a hook (Fig. 1), and suspending a weight from its lower end, at the same time limiting the motion of the cord by means of a ring, A. If now the cord be plucked near the middle by the finger and thumb it will be set in vibration, forming the curves shown by the dotted lines; at the same time a distinct musical note or *tone* will be produced. These vibrations will gradually diminish in amplitude, and the sound will become weaker and weaker till it ceases. The pitch of the note depends upon various causes which will hereafter be explained.

Frequently, however, a sound is produced which is not a musical tone, but is called a noise, as, for instance, when we rattle pieces of metal in a box, or let a weight fall to the ground. What, then, is the difference between the two? When the vibrations succeed one another in a regular and uniform manner, as in the case first mentioned, a perfect sound or tone is produced; but when the vibrations are not isochronous, or when a single explosive disturbance of the air is produced—as, for instance, by a sudden blow or the report of a pistol—or when several sounds interfere with one another so as to produce confused waves in the air, in any such cases a noise is the result.

If we examine a few sounding bodies we can easily satisfy ourselves that in every case their particles are thrown into a state of rapid vibration.

In a sounding cord (Fig. 1), or the wire of a piano, these vibrations are easily seen by the eye, and in cases where a flat surface is made to sound they may be rendered manifest by sprinkling a little light powder, as, for instance, lycopodium, on it. The motion will thus be at once rendered visible by the agitation of the dust.

A much more elegant plan of showing the same effect is by means of the apparatus represented in Fig. 2. A hemispherical bowl of thin glass is fixed to a stand, and directly over it is suspended a small frame of six arms, from which hang as many threads, each carrying a small ivory ball. This is so arranged that the balls shall just rest against the rim of the glass.

Now let a violin bow be rubbed with a lump of resin, and then drawn steadily over the edge of the glass. A clear musical note will be produced, but the vibrations of the glass will scarcely be perceived by the eye. The ivory balls will, however, at once act as tell-tales, for they will be violently agitated and swing away from the glass, and the louder the note produced, the greater will be the amount of their oscillation.

We must now see in what way the vibrations which are thus produced are propagated through the air, so as to reach our auditory nerves. The particles of air immediately around the vibrating body are not driven right away so as to strike the tympanum of the ear. Each one is moved a slight distance from its original position, to which, however, it immediately returns, and then recedes almost as far in the other direction. These particles, however, impart a similar oscillating movement to those lying beyond them, which in their turn communicate the movement, and thus the waves produced are conveyed from particle to particle, and travel widely and rapidly.

If we fix one end of a long rope or cord to a staple in a wall, and holding the other end in the hand, shake it, waves will appear to travel from the hand to the staple and back again. We know, however, that in reality each portion of the cord merely moves up and down in an almost straight line, and the successive movements of the single portions produce the appearance of a wave. This affords a good idea of the mode in which sound-waves are propagated by the oscillations of different layers of air.

By standing at the head of a pier, and watching the waves rise and fall in the sea, we get a further illustration of the same fact. They appear to be travelling along and coming ashore in rapid succession; but if we drop a piece of wood on the surface in a part where it is not affected by the breaking of the waves against the pier, we shall find that it scarcely moves along at all, but merely rises and falls on their surface.

So, too, if we drop a stone into the middle of a pond of water whose surface is quite calm, we shall see the waves produced by it gradually enlarging and spreading in all directions towards the sides. As, however, they recede and become wider, they diminish in height, till in a large pond they are quite lost. In just the same way a bell or any sounding body produces waves in the air around it, which extend further and further, diminishing in intensity as they travel, till at last they become too faint to affect the ear, or else are overpowered by the multitudes of other vibrations which exist in the air.

By taking a shallow rectangular vessel of water, and watching the waves produced in it when we touch its surface, we shall be able to understand many things in connection with the diffusion and reflection of sound that would otherwise appear difficult.

A moment's consideration will easily show us why it is that a sound diminishes so rapidly in intensity as we recede from the sounding body. Since the waves are propagated equally in all directions, it is clear that the mass of air set in vibration increases very rapidly; the original vibration has therefore to be spread over a much larger area, and its intensity is diminished in the same proportion.

From this we see that it is necessary to have some substance to convey the vibrations from the vibrating body to the ear. If the atmosphere were entirely removed, no sound would ever reach us; all would be continual unbroken silence. We can easily obtain an experimental illustration of this fact. An alarum (Fig. 3), made so as to continue striking for some little time, is placed under the receiver of an air-pump, a layer of wadding being placed between it and the pump-plate to prevent the vibrations being communicated to the air in that way. It is now set in action, and the pump rapidly worked; as the air under the receiver becomes more and more rarefied the sound becomes feebler and feebler, till at last it almost entirely ceases, though we can see by the eye that the hammer still continues to strike on the bell. A better way of performing the experiment is to suspend the alarum by means of threads from four supports, as in this way all the vibrations are kept from the pump-plate. A rod is then made to pass air-tight through the top of the receiver, and by pressing this down a detent can be moved, so as to stop or start the bell at pleasure. When a nearly perfect vacuum is attained, no sound whatever will be heard even when the ear is applied closely.

Now admit hydrogen gas into the receiver in place of common air, and allow the alarum to strike as before; the sound will be heard, but it will be faint and peculiar in tone. If we inhale hydrogen gas (which for this purpose must be quite pure), and then attempt to speak, the voice likewise will be found greatly changed in character, having become hollow and thin, at the same time being considerably higher than usual, so as to resemble a squeak. We see then that the intensity of any sound depends upon the density of the air in which it is generated and not of that in which it is heard.

When at great elevations on the sides of mountains, all sounds are wonderfully diminished in intensity in consequence of the rarefied state of the air. Saussure says that on the summit of Mont Blanc the report of a pistol was not louder than that of an ordinary cracker, and the travellers were obliged to speak in a louder tone than usual in order to be heard.

The rate at which the sound-wave travels through the air does not depend at all upon the intensity or the pitch. If it did, music when heard at a little distance would be quite changed into discord, since the louder notes would outstrip the others.

In the case, however, of extremely loud sounds, such as, for instance, the report of a heavy piece of ordnance, there seems to be a slight departure from this law.

Sound is conducted by liquids or solids, as well as by gases. When two stones are struck together under water, the sound is conveyed a considerable distance. Divers, too, can communicate with those on the surface by striking the sides of the diving-bell with a hammer or stone. If a watch be laid upon one end of a plank, and the ear applied to the other end, the ticking will be heard much further off than it would otherwise be. In a similar way the earth acts as a conductor of sound, for if the ear be applied to its surface, the footsteps of men or horses approaching may be heard at a very great distance. So, too, by laying the ear upon the metal rails, the sound of a train can be heard much further off than it can by any person merely standing up and listening.

Many very interesting experiments can be tried to illustrate the conduction of sound. One of the simplest is to suspend a common poker by a piece of string or list. Wind the ends of this round the forefinger of each hand, and, having put the fingers in the ears, make the poker swing so as to strike against the fender or some piece of metal. Instead of the sound usually heard we shall now hear one almost resembling that of a church bell. The vibrations are conveyed so much more plentifully along the string than through the air, that the sound is very greatly increased in intensity, and is heard for a longer period.

In a similar way we can easily conduct sound from place to place. Let a thin wooden rod some twelve or fifteen feet long be rested on the tips of the fingers of two people, and against one end of it let there be held a thin sounding-board, or a box of thin wood, or, better still, a violin. Now strike a tuning-fork, and place it against the other end of the rod. The sound will at once fill the room, but will appear to proceed, not from the tuning-fork, but from the sounding body at the other end of the rod. Every vibration of the former is conveyed along the rod, and accurately reproduced at the other end. It is heard much more distinctly there because it is distributed over the surface of a large sounding body, and thus the waves of sound produced are much more distinct. If two forks sounding different notes be struck and placed together at the end, both sounds will be conveyed along the rod, the vibrations of the one appearing not to interfere with those caused by the second.

A very interesting modification of this experiment was introduced by Professor Wheatstone at the London Polytechnic Institution some years ago, and has been many times repeated since. It was an arrangement known as the Telephonic Concert.

Long deal rods were made to pass up from the basement of the building through the different ceilings to the floor of the lecture hall, above which they projected a little distance. The lower ends of these were made to rest upon various musical instruments; the end of one being pointed and made to rest upon the sounding-board of a piano, while another was in contact with a violin, and so on. On the upper ends of these harps were placed, so that the rods were in contact with their sounding-boards. They were, however, so arranged that they could very easily be removed from the rods when necessary. A gentle tap conveyed to the performer below intimation that all was ready, and every sound emanating from the instruments was faithfully conveyed along the rods, and appeared to issue from the harps resting upon them. It can easily be understood what a strange effect was produced by the sound of a piano, violin, or other musical instrument appearing in this way to issue from a harp, especially as no performers could be seen. If the harp were moved at all, so as to break the contact between it and the rod, every sound at once ceased, though the performers still continued to play upon the various instruments. On renewing contact, the sound continued as before. The experiment is a very remarkable one, all the different vibrations produced by the various wires of the piano being conveyed along the one rod without interfering at all with one another.

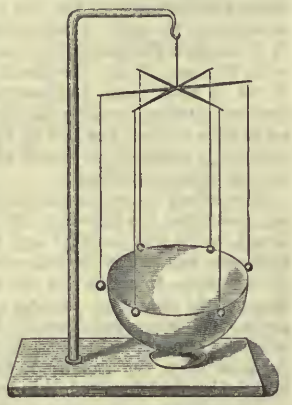


Fig. 2.

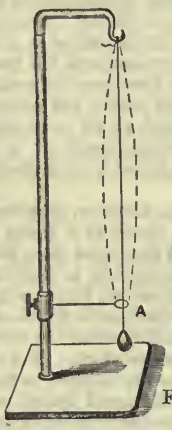


Fig. 1.

Fig. 5.

This experiment has been carried even further than this. The attempt was made to convey the music of the human voice in the same way. The performers were placed with their mouths very close to a sounding-board connected with the rod, and, as they sung, the music was conveyed along the rod, and produced the remarkable phenomenon of a singing harp. The success of this experiment was even more complete than could have been anticipated. The performers were obliged to be so close together, and to remain in such a ludicrous and confined position, that often they bumped their heads together, and the music ended in a peal of laughter, which was, of course, reproduced by the harp, to the no small astonishment of the audience.

This experiment is rather difficult and costly to repeat in a private house. A very similar one, showing fully the principle on which it depends, and creating much astonishment, may, however, easily be tried with a small musical box. Let a box be procured large enough to contain the musical box, with plenty of room all round it. In the top of this make a small hole through which the rod may pass. If two boxes can be procured, one of which can go inside the other, the musical-box being placed in the inner one, the result will be still more satisfactory. Now line or pack them carefully with wadding or baize, so as completely to drown the sound of the music, taking care, however, to leave room for the rod to pass quite down to the box, and also to arrange for winding it up, when required. No sound will now be heard, the vibrations being completely muffled by the non-conducting materials employed. If, however, we insert the rod, and place on it a thin piece of board, the music will become distinctly audible. A spiral spring placed on the board, as shown in Fig. 4, will increase the sound considerably. A violin, being specially constructed for the purpose of spreading sound, answers the purpose still better, and may be used in place of the thin wood.

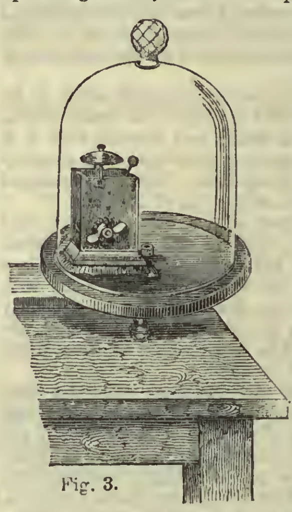


Fig. 3.

Another point illustrated by these experiments is the effect of sounding-boards in increasing the volume of sound produced by musical instruments. It is well known that the sound of a tuning-fork will be heard much more distinctly if its end be placed upon a thin box or piece of wood. In stringed instruments this is especially important. If the cord be merely fixed to firm supports, and set in vibration, the note will be faint and indistinct; but if a thin piece of board be connected with it, or, better still, if the cord be stretched on one side of a hollow wooden case, as is done in a violin, the volume of sound is immensely increased. For this reason a sounding-board is placed in the harp, the piano, and most other stringed instruments.

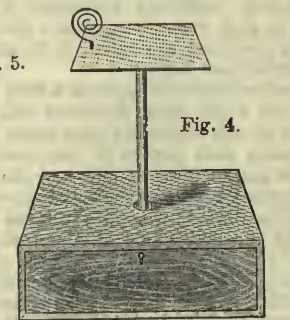


Fig. 4.

We may now collect and review the main causes which influence the intensity of any sound.

The first, as has already been explained, is the distance of the sounding body from the ear, the sound being found to diminish in intensity inversely as the square of the distance; that is, a sound when heard at double the distance has only one-fourth the intensity.

Another cause is the density of the air in which the sound is produced. This is shown by the bell under the exhausted receiver. As air is gradually admitted, the sound becomes more and more distinct; and if the receiver be filled with carbonic acid gas, the density of which is half as great again as that of air, the sound will be rendered much more intense.

The intensity of any sound is further dependent upon the amplitude or extent of the vibrations of the sonorous body. When a stretched cord is first plucked or struck, its vibrations are much more extensive than they are when the sound grows fainter. So, too, if a tuning-fork (Fig. 5) be violently struck the sound will gradually become feebler as the vibrations of the limbs become more and more limited.

The next cause to which we must refer is the motion of the atmosphere and the direction of the wind. On a calm day sound is always conveyed better than when the air is disturbed. A gentle wind, too, causes the sound to be more intensely heard in the direction in which it is blowing.

The proximity of a sonorous body also serves to increase the power of sound. Illustrations of this have been given in the case of musical instruments, and we shall meet with several others as we proceed.

VOLTAIC ELECTRICITY.—XII.

APPLICATIONS OF THE ELECTRO-MAGNET—THE ELECTRIC BELL—ELECTRO-MOTORS—MAGNETO-ELECTRIC MACHINES OF THE OLD TYPE.

In our last lesson we learnt how a piece of iron can be converted into a powerful magnet, by making it the core of a coil of wire through which an electric current can be made to flow. The applications of the electro-magnet are endless; indeed, we may broadly state that there are no contrivances, be they big or little, which depend for their efficiency upon the power of electricity, which do not in some form or other employ electro-magnets. In the electric organ, for instance, magnets are employed to open the valves to admit wind to the pipes, instead of the usual mechanism; and although such organs are rarely built, they are useful in situations where the key-board is placed at some distance from the body of the instrument. In Clowes's type-composing machine, electro-magnets control the ejection of the metallic letters from their receptacles. But to come to more ordinary uses of the electro-magnet, we find in the electric bell, now so common in large buildings and modern houses of the better class, a good illustration of its successful employment.

In Fig. 76 is shown a form of electric bell which, perhaps, better exhibits its mode of working than if we gave one of more modern and compact construction: T is the gong, and K the hammer, which is urged against it by being attracted by the electro-magnet *e*. This bell is of the common form known as a trembler, for instead of giving a single stroke, the hammer is caused to vibrate to and fro, so that an incessant ringing is produced so long as the current is in action. This is managed in the following way: The current is carried to the hammer, the lower part of which forms an armature to the magnet, by the spring *g*. But directly it moves to the magnet, it is drawn away from the spring, and therefore the circuit is broken. It immediately flies back to its original position, to be again attracted as soon as it once more touches the connecting spring. In this way it is kept moving to and fro, striking the bell at every advance towards the magnet. In the illustration, a horse-shoe form of magnet is shown, but it is now usual to make one like Fig. 77, which is in reality much the same thing, but is far more convenient in practice. It takes up less room, and the bobbins can be wound separately and with great speed on a lathe. But beyond these minor uses for the electro magnet, we find others of far greater importance, which are, perhaps, destined at no distant date to cause a great revolution in many arts and manufactures.

Fig. 77.

Fig. 79.

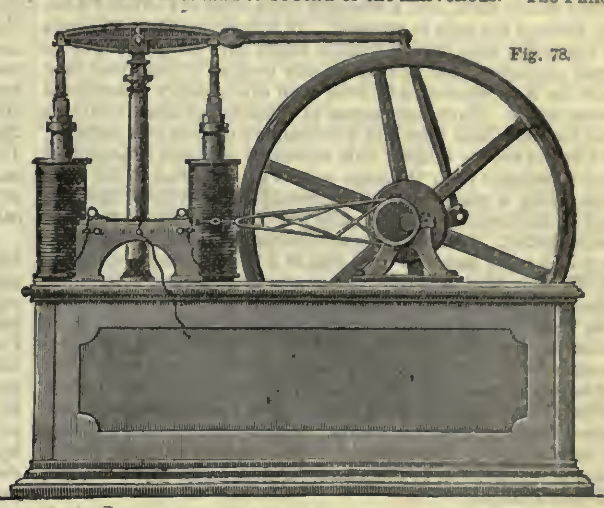


Fig. 78.

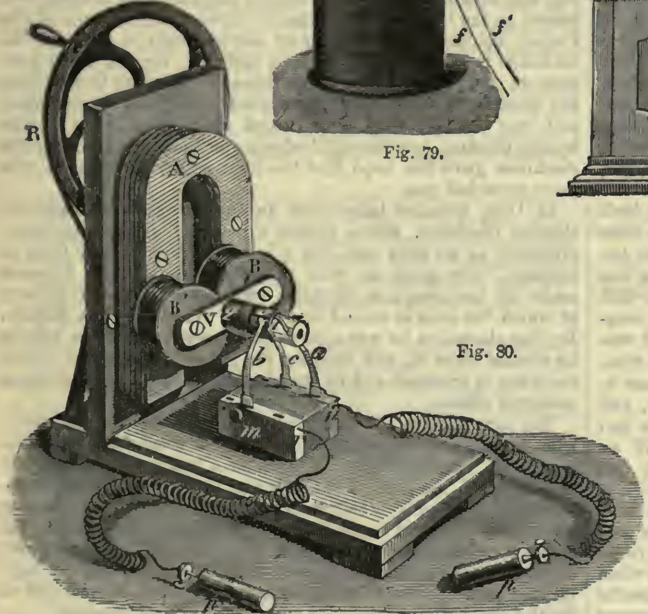


Fig. 80.

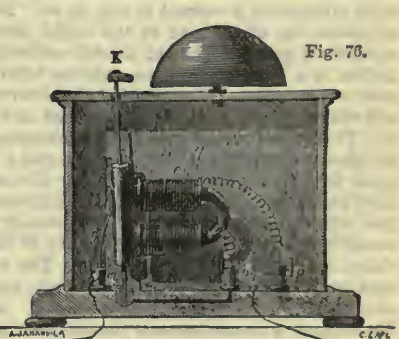


Fig. 76.

It is natural to man to be fond of the marvellous. The Philosopher's Stone which was to change the baser metals into gold, the search for which was the ruin of so many ardent workers, finds its counterpart in many branches of science. The discovery of that *ignis fatuus* called "perpetual motion" was the dream of numbers of mechanics before science taught the grand doctrine that energy, whether it take the form of motion, heat, chemical action, or what not, can neither be created nor destroyed. We can easily imagine that when the first experiments were made with the electro-magnet—when it was shown that immense weights could, under certain conditions, be supported by a comparatively small piece of iron—when it was found that the magnetism ceased directly the circuit was broken, and could be instantly renewed when contact with the battery was once more made good—there were numerous dreamers who saw before them the means of gaining something very much akin to perpetual motion. Hence, in looking back to the past history of mechanical contrivances, we find an important place assigned to those machines which their inventors hoped would one day supplant the steam engine.

The simplest in construction of these electro-motors is that of Froment, in which a revolving drum, armed with bars of iron (armatures), moves in front of a fixed electro-magnet. The current supplied to this magnet is cut off just before each armature approaches the poles, so that the attractive force of the magnet causes each armature in turn to approach it, and pass it by. Were the current to remain unbroken, of course the nearest armature would take up a position close to the magnet, and would remain there. Another means of obtaining rotary motion from a magnet is taken advantage of in the machine constructed by M. Bourbouze, which, it will be seen from Fig. 78, has much the appearance of an ordinary beam-engine. But the cylinders are represented by hollow coils of wire, which exert an attractive force upon plungers loosely fitting within them, and a repellent force when the current flowing through the coils is reversed. It is quite within the bounds of possibility that these machines might have been brought to great perfection, but it very quickly became evident that they were far more expensive to work than even a badly constructed steam motor. No cheaper means of obtaining an electric current was then available than the consumption of zinc in a battery; and as the energy evolved only amounted to about one-tenth of that obtainable from the same weight of coal, coal at the same time being a much cheaper material, it was evident that the cost of maintenance must be quite out of proportion to the work accomplished. Setting these considerations aside, it is evident that it is much easier to burn coal in a furnace, and to maintain its efficiency, than it is to consume zinc in a battery, with all its attendant troubles and difficulties, which are by no means few. The idea of superseding steam by electricity has once more come to the front, but the question now stands upon quite another footing. The electric battery for such purposes is cast aside (we leave out of consideration for the present the modern accumulator, or secondary battery), and the electricity is obtained from quite another source. To understand the significance of this change in the aspects of the matter, we must devote some little attention to the labours of that brilliant philosopher, Michael Faraday.

The marvellous power exerted by the magnet naturally took a hold of the great mind of Faraday, and he is reported to have expressed the opinion that the more he pondered over it, the more mysterious it seemed to him to be. Notwithstanding this admission, he, of all men in the world, knew most about that mysterious power. That an electric current could invoke magnetism in a piece of iron was known before his day. It was reserved to him to point out that the converse of this is true, and that a magnet can arouse a current in a wire placed near to it. This is one of the greatest achievements of Faraday, and we shall presently see what an important bearing it has had upon the advancement of electrical science. In Fig. 79 we have an illustration of the famous experiment by which this discovery was demonstrated. A permanent magnet, by which is meant an ordinary steel magnet, either of the bar or horse-shoe shape, is plunged into a coil of wire. The two ends of this coil, seen on the right hand side of the figure, are supposed to be in connection with a delicate galvanometer. At the moment when the magnet is thrust towards the coil, the galvanometer needle is deflected, showing in the most conclusive way that a current of electricity has traversed the wire. The needle immediately returns to its normal position, thus showing that the current is but transient. But upon withdrawing the magnet from the coil, the needle once more moves, but this time in the opposite direction. Another transient current has been induced in the wire by the magnet, but in the reverse direction to the first one. So we see that by the simple approach to or recession from a coil by a magnet, currents can be induced in that coil, but in opposite directions. Such is the nature of that grand discovery known as magnetic induction.

We may be quite sure that as soon as it was generally made known that Faraday had indicated a method of invoking a current of electricity by such apparently simple means, there were plenty of inventors ready to turn it to some practical account. The first idea which was broached was the natural one of causing the magnet to move towards and from coils of wire by means of mechanism. So that we find the pioneer machine to be simply a couple of coils supported on a frame, with a permanent horse-shoe magnet held poles upwards, so that they all but touch the coils above them. This magnet was made to turn rapidly by cog-wheel attachments and a handle, and the alternating currents so induced in the coils followed one another so rapidly, that a comparatively large amount of electricity was poured forth. This machine was due to Pixii.

In Clarke's machine (Fig. 80), which followed it, we have a similar arrangement, but in a far more compact form. Here the heavy magnet A is wisely a fixture, and the comparatively light coils of wire, B B, are made to revolve close to its poles. By means of a belt across the fly-wheel, R, the motion, too, is much accelerated, and the efficiency of all these machines depends in a remarkable manner upon the speed at which they are driven. Another improvement exhibited by Clarke's machine is in the attachment of a device called a commutator, by which the alternating currents are turned into one direction, so as to resemble the current from a battery. This commutator consists of a block, *m*, from which project three springs, *a*, *b*, *c*, which rub against a little shaft which turns with the coils. The shaft is made of some non-conducting material, such as ivory, but has fixed upon it some pieces of metal which cause currents of one direction only to be gathered up by the springs *a* and *c*, whilst the spring *b* will only collect those of the reverse direction. These currents are carried to the handles *p p*. Exactly the same arrangement as this, except that the magnet lies on its side, is exhibited by those little electric machines sold for medical purposes in the present day.

After the production of this machine by Clarke, others rapidly followed, some being of vast size, and containing an enormous number of bobbins of wire and stationary magnets. A large one was constructed by M. J. Nollet, and has since become well known as the "Alliance machine." It was used in some of the French lighthouses to produce an electric light in place of the oil lamps formerly employed; and later on, for the same purpose, at our South Foreland lighthouse. Previous to this time the electric light had been attempted merely for special uses, and was scarcely ever seen except on a small scale in the lecture theatre; but the rapid advance in these magneto-electric machines gave the hope that the light might be brought into more extended use.

In 1854 Siemens introduced an improvement in magneto-electric machines, which marks a point of distinct advance. Hitherto, as we have seen, the wires were wound in the form of bobbins, very much as reels of cotton are wound. Siemens made the important modification known as Siemens' armature, in which the wire is wound lengthwise, like a weaver's shuttle. By this alteration he was able to cause the shuttle-like coil to be rotated close to, and between, the poles of the magnet, where the force is greatest, and by its adoption he secured much more powerful effects.

The next notable advance was made by Wilde, of Manchester, who, for the first time in the history of these machines, employed an electro-magnet as well as a battery of permanent magnets. In the jaws of the latter he caused a Siemens' armature to be rotated by a belt from a steam engine, but the current so obtained was not immediately utilised, but was carried to the coils of a large electro-magnet, between the poles of which another Siemens' armature revolved. It was the greatly augmented current from this second armature which was carried off for the production of light, or any other purpose required.

The term "permanent," which, as we have seen, is applied to all ordinary steel magnets, of which the horse-shoe of the toy shops may be taken as the type, is rather misleading; for such magnets, as a matter of common experience, are not permanent. They gradually lose a certain proportion of their original power. Thus, at some of the lighthouses where machines like the "Alliance" are still in use, the light given is found to be very much short of what it used to be, and this loss of light agrees very nearly with the loss of power experienced by the magnets, amounting, in some cases, to 20 per cent. Still the word permanent is of use as distinguishing that form of magnet from the electro-magnet.

Wilde's machine, which presented such a notable improvement upon those which had before been made, had scarcely been given to the world when another important link in the history of these machines was brought forward simultaneously by two indefatigable workers, Wheatstone and Siemens. They pointed out that the permanent magnets used in Wilde's machine were not really required, because iron always has some residual magnetism in it, which can, by proper precautions, be raised to any amount of intensity. The core of an electro-magnet which has once been magnetised is especially rich in this residual magnetism, and sufficient exists to induce a current in a revolving coil, or armature placed in proper relation to it. The current so induced can then be carried to the coils surrounding the magnetic core, and in this way one part of the machine can react upon the other until both are saturated with magnetism. The first machine introduced on this new principle was that of Ladd, an illustration and description of which is given in many of the text-books of electricity. The other machines we have adverted to will also be found more fully described there. Although these old machines have now merely an historical interest, they afford us the means of following the steps which led up to the modern dynamo-electric machine, a full consideration of which will form the subject of our next lesson.

LESSONS IN GREEK.—XLV.

VERBS IN μι TREATED IN DETAIL.

HAVING given the general form of the verbs in μι, we will now pass them in review, dividing them into certain classes, and thus affording aid to fix them, with their several parts, firmly in the memory. First of all come

VERBS in μι WHICH SET THE PERSON-ENDINGS IMMEDIATELY TO THE STEM-VOWEL.

Verbs in α, as ἵ-στη-μι (ΣΤΑ).

1. κι-χρη-μι, *I lend* (ΧΡΑ-), κιχραναι, fut. χρησω, aor. εχρησα; mid. *I borrow*, fut. χρησομαι (aor. εχρησαμην was in this sense avoided by the Attics). To the same theme belongs
2. χρη, *it is necessary*, *it behoves* (*oportet* in Lat.), stem ΧΡΑ and ΧΡΕ; subj. χρῇ, inf. χρῆναι, part. (το) χρεων, imperf. εχρῆν or χρῆν, opt. χρειη (from ΧΡΕ-), fut. χρησει.
3. αποχρη, *it is sufficient* (Lat. *sufficit*), else formed regularly from ΧΡΑΩ; αποχρῶσιν; inf. αποχρῆν; part. αροχρῶν, -ῶσα, -ῶν; imperf. απεχρη; fut. αποχρησει; aor. απεχρησε(ν); mid. αποχρῶμαι, *I consume, I waste*. αποχρῆσθαι follows χραομαι.
4. ονινημι (with acc.), *I am useful, I benefit* (ΟΝΑ-), inf. ονιναναι (the imperfect is wanting); fut. ονησω; aor. ωνησα; mid. ονιναμαι, *I have an advantage*, fut. ονησομαι; aor. ωνημην, -ησο, -ητο, and so on; imper. ονησο; part. ονημενος, opt. οναιμην, -αιο, -αιτο, inf. ονασθαι; aor. pass. ωνηθην, less frequently ωνημην. The other parts are supplied by ωφελειν, *to benefit*.
5. πι-μ-πλη-μι (ΠΛΑ-), *I fill*; inf. πιμπλαναι; imperf. επιμπλην; fut. πλησω; perf. πεπληκα; aor. επλησα; mid. *I fill for myself*, πιμπλαμαι, πιμπλασθαι; imperf. επιμπλαμην; fut. πλησομαι; aor. επλησαμην, perf. mid. or pass. πεπλησμαι; aor. pass. επλησθην.
   (The μ in the reduplication of this and the following verb is commonly dropped in combination when a μ comes before the reduplication, as εμπιπλαμαι, but ενεπιμπλαμην.)
6. πιμπρημι, *I burn* (transitive), quite like πιμπλημι; πρησω, επρησα, πεπρηκα, πεπρησμαι, επρησθην, πεπρησομαι.
7. ΤΛΗΜΙ, *I bear* (the present and the imperfect are wanting, for which are used ὑπομενω, ανεχομαι), aor. ετλην, τλῶ, τλαιην, τλῆθι, τλῆναι, τλας; fut. τλησομαι, perf. τετληκα; verb. adj. τλητος. In Attic prose this verb is rarely found.
8. φη-μι, *I say* (ΦΑ), is formed thus—

Active.

PRESENT.		IMPERFECT.	
Ind. *Sing.* 1.	φημι.	Ind. *Sing.* 1.	εφην.
2.	φης.	2.	εφης, commonly εφησθα.
3.	φησι(ν).	3.	εφη.
Dual. 2.	φᾰτον.	*Dual.* 2.	εφᾰτον.
3.	φᾰτον.	3.	εφᾰτην.
Plur. 1.	φᾰμεν.	*Plur.* 1.	εφᾰμεν.
2.	φᾰτε.	2.	εφᾰτε.
3.	φᾱσι(ν).	3.	εφᾰσαν.

Subj. φῶ, φῇς, φῇ, φῆτον, φῶμεν, φῆτε, φῶσι(ν).
Opt. φαιην, φαιης, φαιη, φαιητον and φαῖτον. φαιητην and φαῖτην. φαιημεν and φαῖμεν, φαιητε and φαῖτε, φαῖεν.
Imperat. φᾰθι, φᾰτω, φᾰτον, φατων, φᾰτε, φᾰτωσαν, and φαντων.
Inf. φηναι.
Fut. φησω.
Part. (φας, φᾶσα, φαν; G. φαντος, φασης, etc., not Attic.)
Aor. εφησα.

Passive.

Perf. Imp. πεφασθω, *let it be said*. Verb. Adj. φατος, φατεος.

In compounds we have αντιφημι, *I speak against*; συμφημι, *I speak with, agree*; third pers., αντιφησι, συμφησι, and so forth; συμφαθι, συμφατον, etc.; but αντιφῃς, συμφῃς; subj. αντιφῶ, αντιφῇς, and so on; opt. συμφαῖμεν, and so on. This verb has a double meaning—first, *to say*, in general, and then to say *yes to affirm* (in Lat. *aio*, I say ay).

Here belong the following deponents:—

1. αγαμαι, *I admire*; imperf. ηγαμην, aor. ηγασθην, fut. αγασομαι.
2. δυναμαι, *I am able, I can*; subj. δυνωμαι; imper. δυνασο; inf. δυνασθαι; part. δυναμενος; imperf. εδυναμην and ηδυναμην, εδυνω, etc.; opt. δυναιμην, δυναιο; fut. δυνησομαι; aor. εδυνηθην, ηδυνηθην, and εδυνασθην; perf. δεδυνημαι; verbal adj. δυνατος, *being able* and *possible*.
3. επισταμαι, *I know, I understand*, επιστασαι, etc.; sub. επιστωμαι; imper. επιστω, etc.; imperf. ηπισταμην, ηπιστω, etc.; opt. επισταιμην, επισταιο, etc.; fut. επιστησομαι; aor. ηπιστηθην; verbal adj. επιστητος.
4. εραμαι, *I love* (in the pres. and imperf. ερ(α)ω is used in prose); aor. ηρασθην (Lat. *amavi*), *I have loved*; fut. ερασθησομαι (*amabo*), *I shall love*.
5. κρεμαμαι, *I hang, depend* (Lat. *pendeo*); subj. κρεμωμαι, imperf. εκρεμαμην, opt. κρεμαιμην, -αιο, -αιτο; aor. εκρεμασθην; fut. perf. κρεμασθησομαι, *I shall be hanged*; fut. mid. κρεμησομαι, *I shall hang* (Lat. *pendebo*).
6. πριασθαι, *to buy*, επριαμην, 2 pers. επριω, a defective aorist middle employed by the Attics instead of the aorist of ωνεομαι, namely, εωνησαμην, which they did not use; subj. πριωμαι; opt. πριαιμην, -αιο, -αιτο; imperat. πριω, part. πριαμενος.

VERBS IN ε, AS τι-θη-μι (ΘΕ).

Ἱ-η-μι (Η instead of Ἑ), *I send*. Many forms of this verb occur only in compounds.

Active.

Pres. Ind. ἱημι, ἱης, ἱησι(ν), ἱετον, ἱεμεν, ἱετε, ἱᾶσι(ν).
Subj. ἱῶ, ἱῇς, ἱῇ, ἱῆτον, ἱῶμεν, ἱῆτε, ἱῶσι; αφιῶ, αφιῇς, etc.
Imp. ἱει, ἱετω, etc.; inf. ἱεναι; part. ἱεις, ἱεισα, ἱεν.

Imperf. Ind. ἱουν (from ἹΕΩ), αφιοῦν (less frequently ηφιουν), (rarely ἱειν, προΐειν), ἱεις, ἱει, ἱετον, ἱετην, ἱεμεν, ἱετε, ἱεσαν. Opt. ἱειην.

2 Perf. Act. εἱκα, αφεικα; pluperf. εἱκειν; fut. ἡσω; aor. 1 ἡκα, αφηκα; the indic. sing. is supplied by the first aorist; D. εἶτον, αφεῖτον, εἱτην; plur. εἶμεν, καθεῖμεν, εἶτε; ανεῖτε, εἶσαν, αφεῖσαν; subj. ὡ, αφῶ, ᾑς, αφῇς, etc.; opt. εἱην, εἱης, εἱη; εἶτον, αφεῖτον, εἱτην; εἶμεν, αφεῖμεν, εἶτε, αφεῖτε, εἶεν, αφεῖεν; imperat. ἑς, αφες, ἑτω; ἑτον, αφετον, ἑτων; ἑτε, αφετε, ἑτωσαν and ἑντων; inf. εἱναι, αφεῖναι; part. εἱς, εἶσα, ἑν; G. ἑντος, εἱσης; αφεις, αφεῖσα, αφεν, αφεντος, etc. The augment of αφιημι follows the analogy of those verbs in which the two compounds have coalesced so as to produce one idea.

Middle.

Pres. Ind. ἱεμαι, ἱεσαι, ἱεται, etc.; subj. ἱωμαι, αφιῶμαι, ἱῇ, αφιῇ, etc.
Imp. ἱεσο or ἱου; inf. ἱεσθαι; part. ἱεμενος, -η, -ον.

Imperf. ἱεμην, ἱεσο, etc.; opt. ἱοιμην (ἱειμην), ἱοῖο, αφιοῖο.

2 Aor. Ind. ειμην; εἶσο, αφεῖσο; εἶτο, αφεῖτο; subj. ὡμαι, αφωμαι, ᾑ, αφῇ, ἡται, αφῆται; opt. προοιμην, -οῖο, -οῖτο, -οιμεθα, etc.; imper. οὗ (αφοῦ, προοῦ), ἑσθω, etc.; 2 plur. ἑσθε (αφεσθε, προεσθε); εἱμεθα, etc.; inf. ἑσθαι; part. ἑμενος, -η, -ον.

Perf. εἶμαι, μεθεῖμαι; inf. εἶσθαι, μεθεῖσθαι; plup. εἱμην, εἶσο, αφεῖσο, etc.; fut. ἡσομαι; aor. 1 ἡκαμην only in the indic., and rarely.

Passive.

1 Aor. εἱθην, ἑθηθ, ἑθηναι, etc.; fut. ἑθησομαι; verbal adj. ἑτεος, αφετος.

Εἰμι (stem ΕΣ-), *I am*, and εἶμι (stem Ι-), *I go*.

Present.

	INDICATIVE.	SUBJUNCTIVE.	FUTURE.	SUBJUNCTIVE.
Sing. 1.	εἰμι, *I am.*	ὦ, *I may be.*	εἶμι, *I will go.*	ἴω, *I may go.*
2.	εἶ.	ᾖς.	εἶ.	ἴῃς.
3.	ἐστί(ν).	ᾖ.	εἶσι(ν).	ἴῃ.
Dual. 2.	ἐστόν.	ἦτον.	ἴτον.	ἴητον.
3.	ἐστόν.	ἦτον.	ἴτον.	ἴητον.
Plur. 1.	ἐσμεν.	ὦμεν.	ἴμεν.	ἴωμεν.
2.	ἐστέ.	ἦτε.	ἴτε.	ἴητε.
3.	εἰσί(ν).	ὦσι.	ἴᾱσι(ν).	ἴωσι(ν).

Observe that parts of these two verbs are distinguished only by the accentuation.

	Imperat.		*Imperat.*	
Sing. 2.	ἴσθι.	*Inf.* εἶναι.	ἴθι, πρόσιθι.	*Inf.* ἰέναι.
3.	ἔστω.	*Part.* ὤν, οὖσα, ὄν, G. ὄντος, οὔσης (παρών, παροῦσα, παρόν, G. παρόντος).	ἴτω.	*Part.* ἰών, ἰοῦσα, ἰόν, G. ἰόντος, ἰούσης (παριών, παριοῦσα, παριόν, G. παριόντος).
Dual. 2.	ἔστον.		ἴτον, πρόσιτον.	
3.	ἔστων.			
Plur. 2.	ἔστε.		ἴτων.	
3.	ἔστωσαν (less freq. ἔστων).		ἴτε, πρόσιτε. ἴτωσαν or ἰόντων.	

Imperfect.

	INDICATIVE.	OPTATIVE.	INDICATIVE.	OPTATIVE.
Sing. 1.	ἦν, *I was.*	εἴην, *I might be.*	ᾔειν or ᾖα (παρῆα), *I went.*	ἴοιμι or ἰοίην.
2.	ἦσθα.	εἴης.		
3.	ἦν.	εἴη.	ᾔεις or ᾔεισθα.	ἴοις.
Dual. 2.	ἦστον.	εἴητον.	ᾔει.	ἴοι.
3.	ἤστην.	εἰήτην.	ᾔειτον, commonly ᾖτον.	ἴοιτον.
Plur. 1.	ἦμεν.	εἴημεν.	ᾐείτην, „ ᾔτην.	ἰοίτην.
2.	ἦτε.	εἴητε.	ᾔειμεν, „ ᾖμεν.	ἴοιμεν.
3.	ἦσαν.	εἴησαν and εἶεν (παρεῖεν).	ᾔειτε, „ ᾖτε.	ἴοιτε.
			ᾔεσαν,	ἴοειν.

1 Fut. ἔσομαι, ἔσῃ, ἔσται, etc. Opt. ἐσοίμην. Inf. ἔσεσθαι. Part. ἐσόμενος.

Vocabulary.

Απειμι, I am away from, I am distant.
Απειμι, I go from, I go away.
Αρκεομαι (in aor. pass., with dat.), I satisfy myself.
Αφιημι, I send forth, allow to go, set free, cease, omit, give up.
Δεον (from δεῖ), το, what is due, duty.
Δῆθεν, namely (in Lat. *scilicet*, *scire licet*, that is to say).
Διογενης, -ους, ἡ, Diogenes.
Εισειμι, I go in, I come in.
Εμβροχιζω, I drive into a snare, a net (βροχος, a snare).
Εξιημι, I send out; (of a river) to pour forth, fall into.
Επειτα, afterwards, in the second place.
Ερυμανθιος, -α, -ον, Erymanthine.
Εφιημι, I send to, I send for; mid. (with gen.), I desire.
Καθιημι, I let down.
Καρτερος, -α, -ον, strong, powerful.
Κραυγη, -ης, ἡ, a cry.
Λιθος, -ου, ὁ, a stone.
Μεθιημι, I send after, I loose.
Νεῖλος, -ου, ὁ, the Nile.
Παρασκευαζω, I prepare; mid., I prepare myself.
Παριημι, I send by.
Πεδη, -ης, ἡ, a fetter (πους, a foot).
Πλεονακις, often.
Προσειμι, I go to, I approach.
Στομα, στοματος, το, mouth, mouth of a river.
Τιμωρεω, I help; mid. (with acc.), I help myself, I avenge myself on.
Φανερος, -α, -ον, manifest, known.
Χιων, χιονος, ἡ, snow.

Exercise 133.—Greek-English.

1. Οἱ αγαθοι ου δια τον ὑπνον μεθιασι τα δεοντα πραττειν. 2. Αφεις τα φανερα μη διωκε τα αφανη. 3. Πολλοι ανθρωποι ἐφιενται πλουτου. 4. Πεδας λεγουσιν εις τον Ἑλλησποντον καθειναι Ξερξην, τιμωρουμενον δηθεν τον Ἑλλησποντον. 5. Ουτ' εκ χειρος μεθεντα καρτερον λιθον ῥᾳον κατασχειν, ουτ' απο γλωττης λογον. 6. Ἡρακλης τον Ερυμανθιον καπρον διωξας μετα κραυγης εις χιονα πολλην παρειμενον ενεβροχισεν. 7. Ὁ Νειλος εξιησιν την θαλατταν ἑπτα στομασιν. 8. Ἁττα επειτ' ἐσται, ταυτα θεοις μελει. 9. Ει θνητος ει, βελτιστε, θνητα και φρονει. 10. Μεμνησο νεος ὠν, ὡς γερων ἐσῃ ποτε. 11. Δικαιος ἰσθ', ἱνα και δικαιων τυχῃς. 12. Βιας παρουσης, ουδεν ισχυει νομος. 13. Ευδαιμων ειην και θεοις φιλος.

Exercise 134.—English-Greek.

1. Be thou. 2. Let him go. 3. I may be. 4. I might be. 5. Desiring. 6. Going. 7. Let them be. 8. Let them go. 9. Do you go. 10. Be thou good. 11. Be ye good. 12. Let them be good. 13. I send out. 14. You let down. 15. They approached. 16. I will go. 17. They will go. 18. Thou wentest. 19. They two went. 20. The good man will never omit to do his duty. 21. Many desire the unknown, giving up the known. 22. Xerxes let fetters down into the Hellespont. 23. Not by the tongue but by deeds may a man become my friend. 24. Be ye just, that ye may obtain justice. 25. The friend cares for the friend even when absent. 26. When the enemies came into the city, the citizens fled. 27. Begone, O boys. 28. The soldiers must leave the city. 29. Two armies came into our native land.

LESSONS IN FRENCH.—LXXXIII.

§ 120.—The Two Futures.

(1.) The future simple is used to signify what will be, or will take place, at a time not yet come :—

Votre frère **partira** demain.	*Your brother will go to-morrow.*

(2.) The future is used, in French, after the adverbs of time **quand, dès que, aussitôt que**, when futurity is implied, in which case the English use the present of the indicative :—

Quand vous **viendrez**, vous apporterez mon livre.	*When you come, you will bring my book.*

(3.) The future anterior is used to express an action which will be completed, finished at some future period; it is also used after the adverbs of time mentioned above, when the perfect definite is used in English :—

Quand **j'aurai fini** mes affaires, j'irai vous voir. GIRAULT DUVIVIER.	*When I have finished my affairs, I will go and see you.*

§ 121.—The Two Conditionals.

(1.) The conditional present denotes what would take place under a certain condition :—

Nous **goûterions** bien des jouissances, **si** nous savions faire un bon usage du temps. GIRAULT DUVIVIER.	*We should have many enjoyments, if we knew how to make a good use of time.*

(2.) The conditional past denotes what would have taken place, at a time past, if the condition on which it depended had been fulfilled :—

Il **serait allé** à la campagne, **si** le temps le lui avait permis.	*He would have gone into the country if the weather had allowed him.*

(3.) The two futures and the two conditionals cannot, in in French, follow the conjunction **si**, meaning *if, in case that.* When the verb of the principal clause is in the future, the verb following **si** must be in the present indicative :—

J'irai vous voir demain, **si j'ai** le temps.	*I will call on you to-morrow, if I have time.*

When the verb of the principal clause is in the conditional, the verb following **si** must be in the imperfect indicative :—

J'irais vous voir demain, **si j'avais** le temps.	*I would call on you to-morrow, if I had time.*

(4.) However, **si**, having the force of *whether*, admits of being followed by the future and the conditional :—

Je ne sais **si j'aurai** le temps d'aller vous voir demain.	*I do not know whether I shall have time to call on you to-morrow.*
Je ne savais pas **si j'aurais** le temps d'aller les voir.	*I did not know whether I should have time to call on them.*

§ 122.—The Imperative.

The imperative is used to express a command, exhortation, permission, or entreaty :—

Connais-moi tout entière. CORNEILLE.	*Know me entirely.*
Ah! **demeurez**, seigneur, et **daignez** m'écouter. RACINE.	*Ah! remain, my lord, and deign to listen to me.*
Ne **tardons** plus, **marchons**, et s'il faut que je meure, **Mourons.** RACINE.	*Let us tarry no longer; let us proceed; and, if I must die, let us die.*

§ 123.—The Subjunctive.

(1.) The subjunctive is the mode of doubt :—

Obéis si tu veux qu'on **t'obéisse** un jour. VOLTAIRE.	*Obey, if thou wishest that one day others may obey thee.*

(2.) The use of the subjunctive is not wholly and solely a matter of grammar: the same verb, used in the same manner, may, or may not, be followed by the subjunctive, according as the speaker wishes to express or not to express doubt :—

Je ne **pense** pas qu'il **vienne.**	*I do not think he will come.*
Je ne **pense** pas qu'il **vient.**	*I do not think he is coming.*

*

(3.) When the principal clause of the sentence is interrogative or negative, and expresses doubt, the verb of the subordinate clause is put in the subjunctive :—

Pensez-vous que vous **réussissiez** dans cette affaire?	*Do you think that you will succeed in this affair?*
Je ne voudrais pas assurer qu'on le **doive** écrire. BOILEAU.	*I would not affirm that it should be written.*
Croyez-vous qu'il **vienne**?	*Do you believe he will come?*

(4.) Most verbs expressing *consent, command, doubt, desire, pleasure, grief, surprise, want, duty, exhortation, necessity, fear, apprehension*, require the subjunctive :—

Je **permets**, je **souhaite**, je **doute**, je **veux**, **j'ordonne**, je suis **surpris**, que vous **veniez**.	*I permit, I wish, I doubt, I desire, I order, I am surprised, that you may* or *should come.*
Dès ce même moment, ordonnez que je **parte**. RACINE.	*Order, that I may depart this very moment.*
Tu veux qu'en ta faveur nous **croyions** l'impossible. CORNEILLE.	*Thou wishest that for thy sake we may believe in impossibilities.*
Je suis **ravi** que nous **logions** ensemble. DESTOUCHES.	*I am delighted that we happen to live together.*

(5.) When the first verb expresses fear or apprehension, the verb in the subjunctive must be preceded by **ne** :—

Je crains, je tremble, j'appréhende, j'ai peur, qu'il **ne vienne**. GIRAULT DUVIVIER.	*I fear, I tremble, I apprehend, I am afraid he may come.*

(6.) The pronouns **qui, que, lequel, dont, où**, should be followed by the subjunctive, when that part of the sentence which precedes them expresses an interrogation, or implies a wish, a doubt, or a condition. They must also be followed by the verb in the subjunctive when they are preceded by a superlative relative, or such adjectives as have the import of a superlative; as, **seul, premier, dernier**, etc. :—

Y a-t-il quelqu'un **qui** ne **respecte** le malheur?	*Is there any one who does not respect misfortune?*
La **meilleure** chose que vous **puissiez** faire.	*The best thing that you can do.*
Choisissez une retraite **où** vous **soyez** tranquille.	*Choose a retreat in which you may enjoy repose.*
C'est le **seul** que je **connaisse**.	*He is the only one I know.*

(7.) A verb preceded by one of the impersonal verbs **falloir, importer, convenir, suffire, valoir mieux**, or by the verb **être**, used impersonally in connection with the adjectives **fâcheux, juste, injuste, surprenant, possible**, or with **à propos, temps, à désirer, à souhaiter**, etc., must be put in the subjunctive [*see* Sec. 73, R. 1.] :—

Il **faut** que vous **veniez**.	*You must come,* or *it is necessary that you should come.*
Il **est temps** que vous **partiez** pour Rome.	*It is time that you should start for Rome.*
Il ne me **plaît** pas que vous **alliez** là. L'ACADÉMIE.	*It does not please me that you should go there.*
Il **n'est** pas certain que vous **ayez** raison.	*It is not certain that you are right.*

(8.) After the expressions **quelque . . . que, quel que, si . . . que, quoi que**, the verb is always put in the subjunctive :—

Quelque effort **que fassent** les hommes, leur néant paraît partout. BOSSUET.	*Whatever effort men may make, their nothingness appears everywhere.*
Qui que ce **soit**, parlez et ne le craignez pas. RACINE.	*Whoever he may be, speak, and do not fear him.*
Si mince **qu'il puisse** être, un cheveu fait de l'ombre. VILLEFRÉ.	*However thin it may be, a hair has a shadow.*

For the conjunctions which require the subjunctive, see § 140.

§ 124.—THE INFINITIVE.

(1.) The infinitive represents the being or doing in an indefinite manner, and without number or person :—

Vouloir tromper le ciel, c'est folie à la terre. LA FONTAINE.	*To wish to deceive heaven, is folly in men.*
L'ardeur de **vaincre** cède à la peur de **mourir**. CORNEILLE.	*The ardour of conquest (to conquer), yields to the fear of death (to die).*
Haïr est un tourment. SÉGUR.	*To hate is a torment.*

(2.) The infinitive is often used substantively :—

Ou plutôt, que ne puis-je au doux **tomber** du jour? LAMARTINE.	*Or rather, why can I not at the sweet close of the day?*

(3.) The infinitive present is used in French after certain verbs, which are, in English, joined to other verbs by the conjunction *and* :—

Allez **chercher** mon père.	*Go and fetch my father.*

(4.) A verb immediately preceded by another verb (**avoir** and **être** excepted), is put in the present of the infinitive when both verbs have the same subject, or when the object of the first is the subject of the second. With the exception of **en**, prepositions require the present or the past of the infinitive :—

Tout ce qu'elle s'imaginait **tenir**, lui échappait tout-à-coup. FÉNELON.	*All that she fancied that she held, escaped her suddenly.*
Vos raisons sont trop bonnes d'elles-mêmes, **sans etre** appuyées de ces secours étrangers. RACINE.	*Your reasons are too good in themselves to need that foreign assistance.*
Vous pensez tout **savoir**. PIEYRE.	*You think that you know everything.*
Je les vois **venir**.	*I see them coming.*
J'entends votre ami **chanter**.	*I hear your friend singing.*
Ils parlent de **partir**.	*They speak of going away.*
Après avoir dit cela, il s'assit.	*After having said that, he sat down.*

(5.) The French language preferring the active to the passive voice, requires the use of the active verb in the following and similar cases wherein the English use the passive voice :—

Cette dame est bien **à plaindre**.	*That lady is much to be pitied.*
Cette maison est **à vendre**.	*This house is to be sold.*
La chose est de trop peu de conséquence pour la **traiter** sérieusement. VOLTAIRE.	*The matter is of too little consequence to be treated seriously.*

§ 125.—GOVERNMENT OF VERBS.

Some verbs are in English governed by prepositions different from those which connect or govern the same verbs in French. Some, again, which are in English joined by prepositions, require none between them in French. We give below lists of verbs with the appropriate prepositions, according to the best French authorities.

§ 126.—VERBS REQUIRING NO PREPOSITION BEFORE ANOTHER VERB IN THE INFINITIVE.

Accourir, *to run to.*	Nier, *to deny.*
Aimer mieux, *to prefer.*	Observer, *to notice, to observe.*
Aller, *to go.*	Oser, *to dare.*
Apercevoir, *to perceive.*	Paraître, *to seem.*
Assurer, *to assure.*	Penser, *to think, to fancy.*
Avouer, *to confess.*	Pouvoir, *to be able.*
Compter, *to intend.*	Préférer, *to prefer.*
Confesser, *to confess.*	Prétendre, *to pretend.*
Courir, *to run.*	Rappeler (se), *to remember.*
Croire, *to believe.*	Rapporter, *to report.*
Daigner, *to deign.*	Reconnaître, *to acknowledge.*
Déclarer, *to declare.*	Regarder, *to look at.*
Désirer, *to desire.*	Retourner, *to return.*
Devoir, *to be obliged.*	Revenir, *to come back.*
Écouter, *to hear, to listen.*	Savoir, *to know.*
Entendre, *to hear.*	Sembler, *to seem.*
Envoyer, *to send.*	Sentir, *to feel.*
Espérer, *to hope.*	Souhaiter, *to wish.*
Faire, *to make.*	Soutenir, *to maintain.*
Falloir, *to be necessary.*	Valoir mieux, *to be better.*
Imaginer (s'), *to imagine.*	Venir, *to come.*
Laisser, *to let, to suffer.*	Voir, *to see.*
Mener, *to take, to lead.*	Vouloir, *to be willing.*

Je **prétends** vous **traiter** comme mon propre fils. RACINE.	*I intend to treat you as my own son.*

*

Et le Rhin de ses flots **ira grossir** la Loire, Avant que tes faveurs sortent de ma mémoire. BOILEAU.	*And the Rhine will go and swell the Loire with its waves, before the remembrance of thy goodness leaves my memory.*

§ 127.—VERBS REQUIRING THE PREPOSITION **à** BEFORE AN INFINITIVE.

The (*s'*) placed after the verb shows it to be reflective.

Abaisser (s'), *to stoop.*
Aboutir, *to end in.*
Accorder (s'), *to agree.*
Accoutumer, *to accustom.*
Acharner (s'), *to strive.*
Admettre, *to admit, to permit.*
Aguerrir (s'), *to become inured.*
Aider, *to help.*
Aimer, *to like.*
Appliquer (s'), *to endeavour, to apply.*
Apprendre, *to learn.*
Apprêter (s'), *to prepare.*
Aspirer, *to aspire.*
Assigner, *to summon.*
Assujettir (s'), *to subject one's self.*
Attacher (s'), *to apply.*
Attendre (s'), *to expect.*
Autoriser, *to authorise.*
Avilir (s'), *to debase one's self.*
Avoir, *to have.*
Avoir peine, *to have difficulty in.*
Balancer, *to hesitate.*
Borner (se), *to confine one's self.*
Chercher, *to endeavour.*
Complaire (se), *to delight in.*
Concourir, *to co-operate.*
Condamner (se), *to condemn one's self.*
Condescendre, *to condescend.*
Consentir, *to consent.*
Consister, *to consist.*
Conspirer, *to conspire.*
Consumer, *to destroy.*
Contribuer, *to contribute.*
Convier, *to invite.*
Coûter, *to cost.*
Déterminer, *to induce.*
Déterminer (se), *to resolve.*
Disposer (se), *to prepare one's self.*
Divertir (se), *to amuse one's self.*
Employer, *to employ, to devote.*
Encourager, *to encourage.*
Engager, *to induce.*
Enhardir, *to encourage.*
Enseigner, *to teach.*
Entendre (s'), *to be expert in.*
Être, *to be.*
Évertuer (s'), *to strive.*
Exceller, *to excel.*
Exciter, *to excite.*
Exhorter, *to exhort.*
Exposer (s'), *to expose one's self.*
Fatiguer (se), *to weary one's self.*
Habituer (s'), *to become used to.*
Hasarder (se), *to venture.*
Hésiter, *to hesitate.*
Instruire, *to instruct.*
Intéresser, *to interest.*
Inviter, *to invite.*
Mettre, *to set, to put.*
Mettre (se), *to commence.*
Montrer, *to show, to teach.*
Obstiner (s'), *to persist in.*
Offrir (s'), *to offer.*
Pencher, *to incline.*
Penser, *to think, to intend.*
Persévérer, *to persevere.*
Persister, *to persist.*
Plaire (se), *to delight in.*
Pousser, *to urge.*
Prendre plaisir, *to take pleasure.*
Préparer (se), *to prepare.*
Porter, Provoquer, } *to induce, to excite, to urge.*
Réduire, *to constrain.*
Réduire (se), *to tend, to end.*
Renoncer, *to renounce.*
Répugner, *to be repugnant.*
Résigner (se), *to be reconciled.*
Résoudre (se), *to resolve.*
Rester, *to tarry too long.*
Réussir, *to succeed.*
Risquer, *to risk.*
Servir, *to serve.*
Songer, *to think, to intend.*
Suffire (not imp.), *to suffice.*
Tarder, *to tarry.*
Tendre, *to tend.*
Tenir, *to intend, to aim.*
Travailler, *to labour.*
Viser, *to aim.*
Vouer, *to devote.*

L'homme **n'aime** point **à** s'occuper de son néant, et de sa bassesse. MASSILLON.	*Man does not like to contemplate his nothingness and his vileness.*
Avez-vous jamais **pensé à** offrir à Dieu toutes ces souffrances? THE SAME.	*Have you ever thought of offering all these sufferings to God?*

§ 128.—VERBS REQUIRING THE PREPOSITION **de** BEFORE AN INFINITIVE.

Abstenir (s'), *to abstain.*
Accuser (s'), *to accuse one's self.*
Achever, *to finish.*
Affecter, *to affect.*
Affliger (s'), *to grieve.*
Agir (s'), imp., *to be the question.*
Applaudir (s'), *to rejoice.*
Appréhender, *to apprehend.*
Avertir, *to warn.*
Aviser (s'), *to bethink one's self.*
Avoir besoin, *to want.*
Avoir coutume, *to be accustomed.*
Avoir dessein, *to intend.*
Avoir envie, *to wish.*
Avoir garde, *to take care.*
Avoir honte, *to be ashamed.*
Avoir intention, *to intend.*
Avoir le courage, *to have courage.*
Avoir le temps, *to have time.*
Avoir peur, *to be afraid.*
Avoir raison, *to be right.*
Avoir regret, *to regret.*
Avoir soin, *to take care.*
Avoir sujet, *to have reason.*
Avoir tort, *to be wrong.*
Blâmer, *to blame.*
Brûler, *to wish ardently.*
Cesser, *to cease.*
Chagriner (se), *to grieve one's self.*
Charger, *to desire, to intrust.*
Charger (se), *to take on one's self.*
Choisir, *to choose.*
Commander, *to command.*
Conjurer, *to beseech.*
Conseiller, *to advise.*
Contenter (se), *to be satisfied.*
Convaincre, *to convince.*
Convenir, *to become, suit.*
Corriger, *to correct.*
Craindre, *to fear.*
Décourager, *to discourage.*
Dédaigner, *to disdain.*
Défendre, *to forbid.*
Défendre (se), *to defend one's self.*
Défier, *to challenge, to dare.*
Dépêcher (se), *to hasten.*
Désaccoutumer (se), Déshabituer (se), } *to leave off.*
Désespérer, *to despair.*
Désoler (se), *to grieve.*
Détourner, *to dissuade.*
Différer, *to put off.*
Dire, *to say, tell.*
Discontinuer, *to discontinue.*
Disconvenir, *to deny.*
Disculper (se), *to apologise.*
Dispenser, *to dispense.*
Dispenser (se), *to forbear.*
Dissuader, *to dissuade.*
Douter, *to doubt.*
Efforcer (s'), *to endeavour.*
Effrayer (s'), *to be frightened.*
Empêcher, *to prevent.*
Empresser (s'), *to hasten.*
Enrager, *to be vexed.*
Entreprendre, *to undertake.*
Épouvanter (s'), *to be frightened.*
Étonner (s'), *to wonder.*
Éviter, *to avoid.*
Excuser (s'), *to excuse one's self.*
Feindre, *to feign.*
Féliciter, *to congratulate.*

LESSONS IN GERMAN.—LXVI.

§ 79.—VERBS OF THE NEW CONJUGATION.

(*Commonly called Regular Verbs.*)

(1.) In verbs of the New, or simpler form, the imperfect tense and the perfect participle are not produced, as in the Old conjugation, by a change of the radical vowels; but by means of the suffix et or t, which serves as a *tense characteristic:* thus, taking the radical part (lob) of loben, to praise, and affixing thereto et or t, we get lobet or lobt; to which add the *personal* endings, and we have lobete (lob+et+e) or lobte, I praised; lobetest or lobtest, thou didst praise, etc.

(2.) The verbs of the New form differ again from those of the Old, the former having in the perfect participle the termination et or t, instead of en; as, gelobet or gelobt, praised. See the table of terminations § 75.

§ 80.—PARADIGM OF A VERB OF THE NEW FORM.

Loben, to praise, is thus conjugated:—

INDICATIVE MOOD.

PRESENT.	IMPERFECT.
Sing. Ich lobe, I praise.	*Sing.* Ich lobte, I praised.
Du lobst.	Du lobtest.
Er lobt.	Er lobte.
Plur. Wir loben.	*Plur.* Wir lobten.
Ihr lobt.	Ihr lobtet.
Sie loben.	Sie lobten.
PERFECT.	**PLUPERFECT.**
Sing. Ich habe gelobt, I have praised.	*Sing.* Ich hatte gelobt, I had praised.
Du hast gelobt.	Du hattest gelobt.
Er hat gelobt.	Er hatte gelobt.
Plur. Wir haben gelobt.	*Plur.* Wir hatten gelobt.
Ihr habt gelobt.	Ihr hattet gelobt.
Sie haben gelobt.	Sie hatten gelobt.
FIRST FUTURE.	**SECOND FUTURE.**
Sing. Ich werde loben, I shall praise.	*Sing.* Ich werde gelobt haben, I shall have praised.
Du wirst loben.	Du wirst gelobt haben.
Er wird loben.	Er wird gelobt haben.
Plur. Wir werden loben.	*Plur.* Wir werden gelobt habe
Ihr werdet loben.	Ihr werdet gelobt haben.
Sie werden loben.	Sie werden gelobt haben.

SUBJUNCTIVE MOOD.

PRESENT.	IMPERFECT.
Sing. Ich lobe, I may praise.	*Sing.* Ich lobte, I might praise.
Du lobest.	Du lobtest.
Er lobe.	Er lobte.
Plur. Wir loben.	*Plur.* Wir lobten.
Ihr lobet.	Ihr lobtet.
Sie loben.	Sie lobten.
PERFECT.	**PLUPERFECT.**
Sing. Ich habe gelobt, I may have praised.	*Sing.* Ich hätte gelobt, I might have praised.
Du habest gelobt.	Du hättest gelobt.
Er habe gelobt.	Er hätte gelobt.
Plur. Wir haben gelobt.	*Plur.* Wir hätten gelobt.
Ihr habet gelobt.	Ihr hättet gelobt.
Sie haben gelobt.	Sie hätten gelobt

FIRST FUTURE.	SECOND FUTURE.
Sing. Ich werde loben, (if) I shall praise.	*Sing.* Ich werde gelobt haben, (if) I shall have praised.
Du werdest loben	Du werdest gelobt haben.
Er werde loben	Er werde gelobt haben.
Plur. Wir werden loben.	*Plur.* Wir werden gelobt haben.
Ihr werdet loben.	Ihr werdet gelobt haben.
Sie werden loben.	Sie werden gelobt haben.

CONDITIONAL MOOD.

FIRST FUTURE.	SECOND FUTURE.
Sing. Ich würde loben, I should praise.	*Sing.* Ich würde gelobt haben, I should have praised.
Du würdest loben.	Du würdest gelobt haben.
Er würde loben.	Er würde gelobt haben.
Plur. Wir würden loben.	*Plur.* Wir würden gelobt haben.
Ihr würdet loben.	Ihr würdet gelobt haben.
Sie würden loben.	Sie würden gelobt haben.

IMPERATIVE MOOD.

PRESENT.

Sing. Lobe (du), praise thou.
Lobe er, let him praise.
Plur. Loben wir, let us praise.
Lobet (ihr), praise ye.
Loben sie, let them praise.

INFINITIVE MOOD.

PRESENT.	PERFECT.	FIRST FUTURE.
Loben, to praise.	Gelobt haben, to have praised.	Loben werden, to be about to praise.

PARTICIPLE.

PRESENT.	PERFECT.
Lobend, praising.	Gelobt, praised.

§ 81.—THE MIXED CONJUGATION.

(*Embracing the Irregular Verbs properly so called.*)

There are a few verbs (sixteen in all) which have a sort of mixed conjugation, partaking of the Old form, in that they change their radical vowels to form the imperfect tense and the perfect participle, and at the same time partaking of the New form, in that they assume, in the same parts, the *tense-sign* te and the participial ending t. These are they which, strictly speaking, are the *irregular* verbs of the language, and, accordingly, they are here so classed. They will be found, also, in the general list of (so called) "irregular" verbs, which, for the sake of convenience, we have inserted.

§ 82.—VERBS OF THE MIXED CONJUGATION.

INFINITIVE.	INDICATIVE. *Present.*	INDICATIVE. *Imp.*	SUBJUNC. *Imp.*	PAST PARTICIPLE	IMPERATIVE.
Brennen, to burn	regular	ich brannte	ich brennte	gebrannt	regular
Bringen, to bring	"	ich brachte	ich brächte	gebracht	"
Denken, to think	"	ich dachte	ich dächte	gedacht	"
Dürfen, to be permitted	ich darf, du darfst, er darf	ich durfte	ich dürfte	gedurft	"
Haben, to have	ich habe, du hast, er hat	ich hatte	ich hätte	gehabt	"
Kennen, to know	regular	ich kannte	ich kennte	gekannt	"
Können, to be able, can	ich kann, du kannst, er kann	ich konnte	ich könnte	gekonnt	"
Mögen, to be allowed, may	ich mag, du magst, er mag	ich mochte	ich möchte	gemocht	"
Müssen, to be obliged, must	ich muß, du mußt, er muß	ich mußte	ich müßte	gemußt	"
Nennen, to name	regular	ich nannte	ich nennte	genannt	"
Rennen, to run	"	ich rannte	ich rennte	gerannt	"
Senden, to send	"	ich sandte	ich sendete	gesandt	"
Sollen, to be obliged, shall	ich soll, du sollst, er soll	regular	regular	regular	regular
Wenden, to turn	regular	ich wandte	ich wendete	gewandt	"
Wissen, to know	ich weiß, du weißt, er weiß	ich wußte	ich wüßte	gewußt	"
Wollen, to be willing	ich will, du willst, er will	regular	regular	regular	"

KEY TO EXERCISES IN LESSONS IN GERMAN.

EXERCISE 175 (Vol. III., page 327).

1. Warum haben Sie das Fenster geöffnet? 2. Es ist so sehr warm in dem Zimmer, und ich genieße gern die frische Luft. 3. Ich bitte Sie, machen Sie das Fenster zu, und die Thür auf. 4. Schließe die Thür, damit das Fenster auf sein kann. 5. Ich weiß in der That nicht, was ich mit diesem meinem Sohne thun soll; er will nicht auf meinen Rath horchen. 6. Die meisten seiner Zuhörer schliefen während seiner langen Rede ein. 7. Ein gutes Werk kann nur durch Aufmerksamkeit zu Stande gebracht werden. 8. Die Genesung meiner Tochter schreitet nur langsam fort; sie will nichts genießen, trotzdem es der Arzt ihr angerathen hat.

EXERCISE 176 (Vol. III., page 327).

1. The robbers seated themselves around a great fire, which they had kindled in the midst of the forest. 2. He took his seat at the table. 3. He got on his horse and galloped out of the town. 4. The dragoons were all on horseback, and waited only for their commander, in order to begin the attack. 5. He sat on his throne so gloomy and so wan. 6. We found him sitting under a tree. 7. The visitor asked the innkeeper next morning what he owed. 8. He had to pay a Prussian dollar, or one florin and forty-five kreuzers, for what he had eaten. 9. This man owes me one hundred dollars. 10. After he had spent all his money in foreign countries, he returned home poor and destitute. 11. The soldier ate the food placed before him with the greatest appetite. 12. Are there many who defend the fortress? 13. Yes, there are many, but there might be as many more; still we do not fear. 14. There were about a hundred of them, who, under the command of a young soldier, took the battery by storm. 15. An effeminate man is not fit for any work. 16. This evidence is good for nothing. 17. The Hungarian general voluntarily offered his services to the Turkish emperor. 18. The peasant offered some apples to the exhausted traveller. 19. One often reads in the newspapers that a good opportunity of making one's fortune presents itself. 20. He complains of unreasonableness and harshness. 21. You deny me the liberty to be able to complain to you. 22. He felt, he did not know what, and seemed astonished at this event. 23. He seemed surprised as he saw his friend enter, whom he had not seen for nearly ten years.

EXERCISE 177 (Vol. III., page 327).

1. Dieses Messer taugt nichts, geben Sie mir ein anderes. 2. Was Sie gemacht haben, taugt nichts. 3. Wozu taugt ein unehrlicher Mann? 4. Diese armen Leute verzehrten die ihnen vorgesetzte Speise mit dem größten Appetit. 5. Wir lesen in jeder Zeitung, daß Australien eine gute Gelegenheit darbiete, sein Glück zu machen. 6. Wir waren erstaunt, unsern Freund zu sehen, von welchem wir glaubten, daß er in Deutschland sei. 7. Dieser Mann ist mir mehr als zwanzig Pfund schuldig; aber er sagt, er habe mich bezahlt. 8. Ich will Sie bezahlen, aber Sie können nicht beweisen, daß ich Ihnen etwas schuldig bin. 9. Haben Sie heute Ihren Bruder gesehen? 10. Ja, ich sah ihn in unserm Garten unter einem Baume sitzen. 11. Die Soldaten setzten sich zu Pferde, und warteten auf das Signal ihres Anführers, um den Angriff zu beginnen.

EXERCISE 178 (Vol. III., page 378).

1. First he took paper and pens, then he sat down to write. 2. He has only just begun to work. 3. It is only just past seven o'clock. 4. This boy is only fourteen years of age. 5. It now began indeed going on very badly. 6. It is half an hour's walk to the next village. 7. This is the nearest way there. 8. I will write to him by the next post. 9. An inconsiderate word is sometimes the immediate cause of quarrel and dispute. 10. My friend comes here next week. 11. He intends to start next year for America. 12. In future years I shall be more careful. 13. Next week I go into the country for a few days. 14. We should think more of the future life than of the present. 15. My future life shall be devoted to you. 16. I fear it will not succeed in this way. 17. He cares more for earthly than for heavenly riches. 18. The active wife attends to her domestic affairs herself. 19. The neighbour took the letter to the post. 20. The errand was punctually attended to by the little boy. 21. The fortress was sufficiently provided with provisions. 22. My brother provided me early with good books. 23. The poor man has to provide for six children.

METEOROLOGY.—II.

AQUEOUS METEORS—MOISTURE OF THE AIR—HYGROMETERS —MIST—DEW—CLOUDS.

In our present lesson we propose to turn our attention to the aqueous phenomena of the atmosphere. The air, as has been explained, consists mainly of two gases, oxygen and hydrogen; there is, however, always present in it a greater or less amount of watery vapour, and this gives rise to the various phenomena of which we are about to treat.

If we expose a vessel containing water to the air, sheltering it sufficiently to prevent rain falling into it, we shall find that in the course of a few days it will be empty, the water having completely evaporated. By weighing the vessel before, and again after a few hours' exposure, we shall be able to obtain proof of the same fact in a much shorter time, and shall also be able to estimate approximately the rate at which evaporation has been going on. Now try a similar experiment with snow, and it will be found that, even when the temperature is below the freezing point, it slowly evaporates. This explains why it is that snow slowly disappears, even during the continuance of a frost.

Experiments of this kind the student should try for himself, as he will thus acquire more practical information than can well be acquired from books, and, at the same time, will become proficient in interrogating Nature, and making trustworthy observations. The latter point is of the utmost importance, since many observations, which would otherwise be very valuable, are rendered entirely useless by inaccuracies that have crept into them through want of care.

It is a difficult matter to ascertain exactly the amount of evaporation which takes place from the surface of the earth. It varies, of course, with distance from the equator, and various other causes, but is estimated in Great Britain to be equal to an average depth of thirty-two inches of water. Of this amount, less than three inches is raised in the months of November, December, January, and February; while in June, when the maximum is attained, it amounts to nearly four inches. In tropical regions, the quantity is estimated to be from 90 to 100 inches.

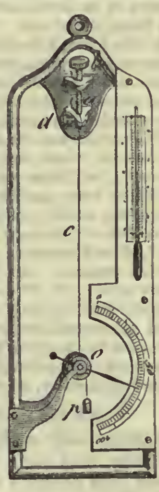


Fig. 2.

The amount of watery vapour that can thus be held by the air is limited. It varies, however, with the temperature, and to this mainly the various phenomena of clouds and rain are to be attributed. It may be well to remember that air at 32° can contain the 160th part of its own weight of water in the state of vapour, and that this amount is doubled by every 27° rise in temperature; so that at 59° air can contain the 80th part, and at 86° the 40th part. It is, however, very rarely that the air is fully saturated, that is, contains as much vapour as it can take up.

Various instruments have been devised for the purpose of ascertaining the humidity of the air; these are known as *hygrometers.* The most common of these is Saussure's Hair Hygrometer, which is represented in Fig. 2.

This instrument consists of a long hair, *c*, carefully cleaned from fat by being treated with ether. One end of it is fixed in a clamp, *d*, capable of being moved by a small screw, *b*, so as to adjust the index. The other end is fastened to a pulley, *o*, which carries the hand. A small weight, *p*, keeps the hair tight. As soon as the hair attracts moisture from the air it elongates; the hand is then moved down by the weight, and shows on the scale the degree of moisture. As the air becomes drier, the hair contracts again, and raises the index.

Another hygrometer, acting upon a different principle, is represented in Fig. 3. This instrument, which is known as Daniell's, consists of a bent glass tube, with a bulb blown at each end. The tube is partly filled with ether, which has been boiled in it so as to expel the air, and inside A is a delicate thermometer, the bulb of which dips into the ether. B is wrapped round with some muslin, and ether is dropped on this when it is required to make an observation. This ether rapidly evaporates, and thus lowers the temperature of B, and some of the ether from A at once begins to condense in it. The temperature of A accordingly falls, and this bulb is watched till the moisture of the air begins to condense on it. As soon as this occurs, the thermometer in it is read, while that in the stand gives the temperature of the air at the same time. When the air is nearly saturated, the difference between the two will be but slight, but the drier the air the greater the difference.

The reading of the thermometer in A gives us, in fact, the *dew-point;* that is, the temperature at which the air becomes saturated, and begins to part with some of its moisture. The humidity can be easily calculated from this.

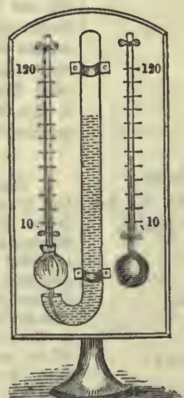


Fig. 4.

Another form of hygrometer consists of two thermometers placed side by side (Fig. 4); the bulb of one is covered with muslin, which is kept wet by capillary attraction, a small vessel of water being placed near it, into which the muslin or some threads of cotton connected with it dip. The difference between the readings of the two will give the moisture of the air.

True watery vapour is quite invisible; but when the air is fully saturated, and it begins to condense, it becomes visible, and takes the form of fogs, mists, or clouds. The usual cause of fogs is the moist soil being at a higher temperature than the air above it. Vapours then continue to arise from the ground, but are speedily condensed by the cooler air, and hang over the soil.

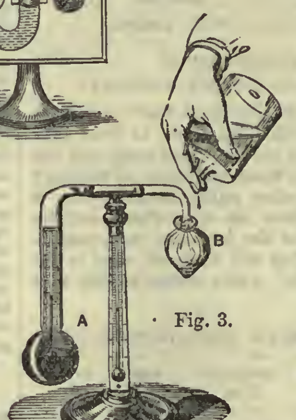


Fig. 3.

Often during a clear night the surface of the ground becomes much cooled by radiation; the air lying on it therefore falls in temperature, and becomes cooler than that above it. If the ground be level, no fog will be caused; but if it be sloping, the cold air will sink by its weight to the lower level, and in doing so will condense the moisture of the warmer air with which it comes in contact. This will accordingly assume the form of mist.

The presence of a lake or river in the valley causes the air to be more saturated, and thus increases the amount of mist, which, in this case, will often seem to lie along the surface of the water.

Rivers which flow from colder into warmer latitudes—as, for example, the Mississippi—are colder than the air above them, and hence condense its moisture into mist. A very similar effect to this may be observed by placing a large lump of ice in a warm room. Vapour will appear to arise from it, the real fact being that the cold given off causes the vapour in the air around to assume a visible form.

If a stream be warmer than the air around, a similar effect will be produced, the quantity of vapour given off by it being greater than can be dissolved in the air above it. The fogs which prevail along the course of the Gulf Stream illustrate this fact clearly.

The densest fogs occur during the winter months in large towns built near rivers. It is believed that the electrical condition of the air influences them to a considerable extent. The main cause, however, is that the abundant moisture of the air is condensed by the cold winds. The amount of this moisture is, of course, much augmented by the breath of the many inhabitants; and in manufacturing places the smoke becomes entangled with the fog, and adds to its opacity.

The tops of mountains are very frequently observed to be covered with clouds, which they are supposed to attract. The real reason of this is that, owing to their elevation, they are much cooler than the air which passes by them, and therefore they condense its vapour and render it visible. The clouds appear to be stationary around their summits; but the fact appears to be that, as the air passes the top of the mountain, its vapour becomes visible; as soon as it has passed on, this is re-dissolved, while another cloud is formed from the fresh particles of air which are now in contact with the peak. In this way the cloud remains permanent, though the particles of which it is composed are continually changing.

Fogs are also very prevalent in places where there is a considerable difference in the temperature of adjoining regions, or where in the open sea a sand-bank causes the colder currents from below to rise to the surface. The dense fogs which are so common on the banks of Newfoundland are illustrations of the latter fact.

The watery vapour of the air is precipitated to the surface of the earth in several different forms. The first we notice is that of *dew*. The common opinion that the dew *falls* is a fallacy; the true theory of it was for a long time unknown, and was first published by Dr. Wells in 1814. The simplest illustration of the phenomenon is seen by bringing a decanter or glass, containing ice-cold water, into a warm room. The surface of the glass will almost immediately be covered with moisture.

Fig. 5.—CIRRUS CLOUD.

Fig. 6.—CUMULUS CLOUD.

Fig. 7.—STRATUS CLOUD.

The reason of this is that the air, by contact with the cold glass, is chilled so much that it can no longer retain all its vapour in solution, and accordingly deposits a portion on the substance that chills it. A similar process goes on in Nature. After the sun has set, many bodies which have been warmed by his rays begin to radiate their heat into space, and in this way become rapidly cooled, so as to be several degrees lower in temperature than the surrounding air, some of the moisture of which accordingly condenses upon them.

Fig. 8.—NIMBUS OR RAIN CLOUD.

This deposition of dew is much more plentiful on a clear and calm night, as then radiation goes on much more rapidly, and consequently the temperature is lowered to a greater extent than when the sky is covered with clouds. A brisk wind, however, considerably interferes with its formation, as it does not allow the air to remain long enough in contact with the earth to part with its moisture.

Those bodies which radiate heat most rapidly receive, of course, the largest amount of dew; and, by comparing various objects in this way, we find that plants receive much more than bare soil, and that again more than the solid rock; so that it is usually most plentifully deposited in those places where it is most needed. It is most abundant in maritime countries, since the humidity of the air is generally greater there. In Great Britain, the annual amount is estimated at an average depth of about five inches all over the surface. The greatest amount falls in the spring and autumn, as in these seasons the difference of temperature between day and night is at its maximum.

When the objects upon which the dew is deposited are at a lower temperature than 32°, the moisture is frozen as it is deposited, and then we have the hoar-frost, which is in reality merely frozen dew.

Clouds are masses of visible vapour, somewhat resembling mists, but suspended in the air at a greater or less height. They are produced by the partial condensation, in the higher regions of the atmosphere, of the vapours that rise from the earth.

During the day evaporation goes on most rapidly, and warm currents of moist air are then constantly ascending from the surface of the earth, heated by the solar rays. As these ascend higher and higher, they lose heat by expansion and by mingling with the colder air around, until their vapour is condensed and assumes the visible form.

There is some little difficulty in understanding clearly why the clouds remain suspended in the air, instead of falling to the surface of the earth. It may, however, be partly accounted for by these ascending currents of heated air which bear them up. Where these cease, the clouds appear to fall slowly towards the earth's surface, the lower portion being slowly dissolved away by the warmer air below, while fresh additions are frequently being made by the condensation of more vapour above. Small clouds may not unfrequently be observed to fall slowly, and gradually vanish, much in the same way as the steam from a railway engine melts away in the air.

The elevation of the clouds varies very greatly. Many of the smaller ones are believed to be at an elevation considerably greater than five miles. A series of observations as to this point was carried on in the neighbourhood of Skiddaw for a long period. From these it appeared that on nearly half the occasions of observation the clouds were above 1,000 yards in height. Only ten times in five years were they seen at a less height than 100 yards.

The varieties of form which the clouds assume are almost endless; the causes which produce these are, however, partly known, and from the earliest times the weather-wise have drawn many of their signs from the appearance they present. As this is frequently done, it is necessary to have some general terms indicative of the forms they more commonly assume. A system of nomenclature was accordingly introduced some time ago, and is almost universally adopted. In this system the clouds are divided into three main classes, *Cirrus*, *Cumulus*, and *Stratus*; there are also several minor and intermediate classes.

Cirrus cloud (Fig. 5) consists of white fleecy filaments, usually arranged in a somewhat irregular manner. Sometimes, too, it assumes the appearance of feathers or flocks, scattered over the surface of the sky. They are usually the most elevated clouds; and while on the summit of a mountain the traveller often looks down on other varieties, these are still far above him. Small groups of these, scattered evenly, often accompany fine weather; but if they be extensively developed, and especially if the ends of the streamers appear to be blown about, wind and storms may most probably be expected. Hence the proverb—

"Mackerel's scales and mare's tails
Make lofty ships carry low sails."

The term *cumulus* is applied to those large rounded heaps of clouds (Fig. 6) which often appear to rest on an horizontal base, and to be piled up one on another. These clouds are frequently formed in the morning, and continue to increase till after noon. Hence this form has been termed the "cloud of the day." It is very easily distinguished from other forms. When these increase rapidly and fall, wet is probably at hand; but when they are of moderate size, and only appear during the heat of the day, they indicate fine weather.

The *stratus* (Fig. 7) consists of almost horizontal layers or bands of clouds, usually near the horizon, and often resting on the surface of the earth. It is usually formed during the evening and night, by the condensation of vapour in the air lying on the ground, and hence it is sometimes called the "cloud of the night."

The *nimbus*, or rain cloud (Fig. 7), is frequently reckoned as a separate form; it is, however, more strictly a combination of the various other forms. It usually has its origin in cumulo-stratus. These increase and spread, at the same time assuming a bluish-black hue. This gradually changes to a lighter grey, the clouds then frequently become fringed at the edges, and the rain descends.

The intermediate varieties of clouds are known as *cirro-cumulus*, *cirro-stratus*, and *cumulo-stratus*. Their names, however, will sufficiently describe their appearance.

LESSONS IN ITALIAN.—XXXVI.

IRREGULAR VERBS OF THE SECOND CONJUGATION (*continued*).

II. IRREGULAR VERBS ENDING IN *ere* SHORT.

3. *Verbs ending in* URRE, *contracted from* CERE.

The irregular verb *addúrre*, to bring, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Addúrre, *to bring.—Pres. Gerund.* Adducéndo, *bringing.—Past Part.* Addótto, *brought.——Compound Tenses.—Past.* Avére addótto, *to have brought.—Past Gerund.* Avéndo addótto, *having brought.*

IND. *Pres.* Addúco, addúci, addúce; adduciámo, adducéte, addúcono. —*Imp.* Adducéva *or* adducéa, adducévi, adducéva *or* adducéa; adducevámo, adduceváte, adducévano *or* adducéano.—*Ind. Pret.* Addússi, adducésti, addússe; adducémmo, adducéste, addússero.—*Fut.* Addurrò, addurrái, addurrà; addurrémo, addurréte, addurránno.—*Cond. Pres.* Addurréi *or* addurría, addurrésti, addurrébbe *or* addurría; addurrémmo, addurréste, addurrébbero *or* addurríano.

IMP. Addúci, addúca; adduciámo, adducéte, addúcano.

SUB. *Pres.* Che addúca, che addúca *or* addúchi, che addúca; che adduciámo, che adduciáte, che addúcano.—*Imp.* Che adducéssi, che adducéssi, che adducésse; che adducéssimo, che adducéste, che adducéssero.

After this example conjugate the following:—

Infinitive.	*Ind. Pret.*	*Future.*	*Past Part.*	*English.*
Condúrre,	condússi,	condurrò,	condótto,	*to conduct.*
Dedúrre,	dedússi,	dedurrò,	dedótto,	*to infer.*
Indúrre,	indússi,	indurrò,	indótto,	*to induce.*
Prodúrre,	prodússi,	produrrò,	prodótto,	*to produce*
Ridúrre,	ridússi,	ridurrò,	ridótto,	*to reduce.*
Sedúrre,	sedússi,	sedurrò,	sedótto,	*to seduce.*
Tradúrre,	tradússi,	tradurrò,	tradótto,	*to translate*

4. *Verbs ending in* GERE.

The irregular verb *vólgere*, to turn, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Vólgere, *to turn.—Pres. Gerund.* Volgéndo, *turning.—Past Part.* Vólto, *turned.——Compound Tenses.—Past.* Avére vólto, *to have turned.—Past Gerund.* Avéndo vólto, *having turned.*

IND. *Pres.* Vólgo, vólgi, vólge; volgiámo, volgéte, vólgono.—*Imp.* Volgéva *or* volgéa, volgévi *or* volgéi, volgéva *or* volgéa; volgevámo, volgeváte, volgévano.—*Ind. Pret.* Vólsi, volgésti, vólse; volgémmo, volgéste, vólsero.—*Fut.* Volgerò, volgerái, volgerà; volgerémo, volgeréte, volgeránno.—*Cond. Pres.* Volgeréi *or* volgería, volgerésti, volgerébbe; volgerémmo, volgeréste, volgerébbero.

IMP. Vólgi, vólga; volgiámo, volgéte, vólgano.

SUB. *Pres.* Che vólga, che vólga, che vólga; che volgiámo, che volgiáte, che vólgano.—*Imp.* Che volgéssi, che volgéssi, che volgésse; che volgéssimo, che volgéste, che volgéssero.

After this example conjugate the following:—

Infinitive.	*Present.*	*Ind. Pret.*	*Past Part.*	*English.*
Aggiúngere,	aggiúngo,	aggiúnsi,	aggiúuto,	*to add.*
Aspérgere,	aspérgo,	aspérsi,	aspérso,	*to sprinkle.*
Cíngere,	cíngo,	cínsi,	cínto,	*to gird.*
Dipíngere,	dipíngo,	dipínsi,	dipínto,	*to describe.*
Emérgere,	emérgo,	emérsi,	emérso,	*to emerge.*
Fíngere,	fíngo,	fínsi,	fínto,	*to feign.*
Giúngere,	giúngo,	giúnsi,	giúnto,	*to come to.*
Indúlgere,	indúlgo,	indúlsi,	indúlto,	*to grant.*
Mérgere,	mérgo,	mérsi,	mérso,	*to plunge.*
Piángere,	piángo,	piánsi,	piánto,	*to weep.*
Púngere,	púngo,	púnsi,	púnto,	*to sting.*
Ravvólgere,	ravvólgo,	ravvólsi,	ravvólto,	*to wrap.*
Scíngere,	scíngo,	scínsi,	scínto,	*to gird.*
Úngere,	úngo,	únsi,	únto,	*to anoint.*

5. *Verbs ending in* GGERE.

The irregular verb *léggere*, to read, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Léggere, *to read.—Pres. Gerund.* Leggéndo, *reading.—Past Part.* Létto, *read.——Compound Tenses.—Past* Avére létto, *to have read.—Past Gerund.* Avéndo létto, *having read.*

IND. *Pres.* Léggo, léggi, légge; leggiámo, leggéte, léggono.—*Imp.* Leggéva *or* leggéa, leggévi, leggéva *or* leggéa; leggevámo, leggeváte, leggévano.—*Ind. Pret.* Léssi, leggésti, lésse; leggémmo, leggéste, léssero.—*Fut.* Leggerò, leggerái, leggerà; leggerémo, leggeréte, leggeránno.—*Cond. Pres.* Leggeréi, leggerésti, leggerébbe *or* leggería; leggerémmo, leggeréste, leggerébbero.

IMP. Léggi, légga; leggiámo, leggéte, léggano.

SUB. *Pres.* Che légga, che légga, che légga; che leggiámo, che leggiáte, che léggano.—*Imp.* Che leggéssi, che leggéssi, che legésse; che leggéssimo, che leggéste, che leggéssero.

After this example conjugate the following:—

Infinitive.	*Present.*	*Ind. Pret.*	*Past Part.*	*English.*
Affíggere,	affíggo,	affíssi,	affísso,	*to affix.*
Confíggere,	confíggo,	confíssi,	confítto,	*to nail.*
Distrúggere,	distrúggo,	distrússi,	distrútto,	*to destroy.*
Eléggere,	eléggo,	eléssi,	elétto,	*to elect.*
Fíggere,	fíggo,	físsi,	fítto *or* -sso,	*to fix.*
Infíggere,	infíggo,	infíssi,	infítto *or* -sso,	*to nail.*
Preeléggere,	preeléggo,	preeléssi,	preelétto,	*to prefer.*
Protéggere,	protéggo,	protéssi,	protétto,	*to protect.*
Riléggere,	riléggo,	riléssi,	rilétto,	*to read again.*
Strúggere,	strúggo,	strússi,	strútto,	*to wear out.*
Trafíggere,	trafíggo,	trafíssi,	trafísso *or* -tto,	*to pierce.*

6. *Verbs ending in* GLIERE.

The irregular verb *cógliere* or *córre*, to gather, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Cógliere *or* córre, *to gather.—Pres. Gerund.* Cogliéndo, *gathering.—Past Part.* Cólto, *gathered.——Compound Tenses. —Past.* Avére cólto, *to have gathered.—Past Gerund.* Avéndo cólto, *having gathered.*

IND. *Pres.* Cóglio *or* cólgo, cógli, cóglie; cogliámo, cogliéte, cógliono *or* cólgono.—*Imp.* Cogliéva *or* cogliéa, cogliévi, cogliéva *or* cogliéa; coglievámo, coglieváte, cogliévano.—*Ind. Pret.* Cólsi, cogliésti, cólse; cogliémmo, cogliéste, cólsero.—*Fut.* Coglierò *or* corrò, coglierái *or* corrái, coglierà *or* corrà; coglierémo *or* corrémo, coglieréte *or* corréte, coglieránno *or* corránno.—*Cond. Pres.* Coglieréi, corréi, *or* corría; coglierésti *or* corrésti; coglierébbe, corrébbe, coglieria, *or* corría. Coglierémmo *or* corrémmo; coglieréste *or* corréste; coglierébbero, corrébbero, coglieríano, *or* corríano.

IMP. Cógli, cólga *or* cóglia; cogliámo, cogliéte, cólgano *or* cógliano.

SUB. *Pres.* Che cóglia *or* cólga, che cóglia *or* cólga, che cóglia *or* cólga; che cogliámo, che cogliáte, che cógliano *or* cólgano.—*Imp.* Che cogliéssi, che cogliéssi, che cogliésse; che cogliéssimo, che cogliéste, che cogliéssero.

After this example conjugate the following:—

Infinitive.	*Present.*	*Ind. Pret.*	*Past Part.*	*English.*
Accógliere *or* accórre,	accólgo,	accólsi,	accólto,	*to welcome.*
Distógliere *or* distórre,	distólgo,	distólsi,	distólto,	*to remove.*
Raccógliere *or* raccórre,	raccólgo,	raccólsi,	raccólto,	*to gather.*
Scégliere *or* scérre,	scélgo,	scélsi,	scélto,	*to choose.*
Tógliere *or* tórre,	tólgo,	tólsi,	tólto,	*to lay hold.*

7. *Verbs ending in* GUERE.

The irregular verb *distínguere*, to note or distinguish, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Distínguere, *to distinguish.—Pres. Gerund.* Distinguéndo, *distinguishing.—Past Part.* Distinto, *distinguished.——Compound Tenses.—Past.* Avére distínto, *to have distinguished.—Past Gerund.* Avéndo distínto, *having distinguished.*

IND. *Pres.* Distínguo, distíngui, distíngue; distinguiámo, distinguéte, distínguono.—*Imp.* Distinguéva, distinguévi, distinguéva; distinguevámo, distinguevàte, distinguévano.—*Ind. Pret.* Distínsi, distinguésti, distínse; distinguémmo, distinguéste, distínsero.—*Fut.* Distinguerò, distinguerái, distinguerà; distinguerémo, distingueréte, distingueránno. *Cond. Pres.* Distingueréi, distingueirésti, distinguerébbe; distinguerémmo, distingueréste, distinguerébbero.

IMP. Distíngui, distíngua; distinguiámo, distinguéte, distínguano.

SUB. *Pres.* Che distíngua, che distíngua, che distíngua; che distinguiámo, che distinguiáte, che distínguano.—*Imp.* Che distinguéssi, che distinguéssi, che distinguésse; che distinguéssimo, che distinguéste, che distinguéssero.

After this example conjugate the following :—

Estínguere, *to put out.* | Stínguere, *to extinguish.*

8. *Verbs ending in* LERE.

The irregular verb *svéllere*, to pluck, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Svéllere, *to pluck.—Pres. Gerund.* Svelléndo, *plucking.—Past Part.* Svélto, *plucked.——Compound Tenses.—Past.* Avére svélto, *to have plucked.—Past Gerund.* Avéndo svélto, *having plucked.*

IND. *Pres.* Svéllo *or* svélgo, svélli, svélle; svelliámo, svelléte, svélgono.—*Imp.* Svelléva *or* svelléa, svellévi, svelléva *or* svelléa; svellevámo, svellevàte, svellevano *or* svelléano.—*Ind. Pret.* Svélsi, svellésti, svélse; svellémmo, svelléste, svelséro. — *Fut.* Svellerò, svellerái, svellerà; svellerémo, svelleréte, svelleránno.—*Cond. Pres.* Svelleréi *or* svelleria; svellerésti; svellerébbe *or* svelleria. Svellerémmo; svelleréste; svellerébbero, svelleriano, *or* svelleríeno.

IMP. Svélli, svélla *or* svélga; svelliámo, svelléte, svelláno *or* svélgano.

SUB. *Pres.* Che svélla *or* svélga; che svélla, svélga, *or* svélli; che svélla *or* svélga. Che svelliámo; che svelliáte; che svéllano *or* svélgano.—*Imp.* Che svelléssi, che svelléssi, che svellésse; che svelléssimo, che svelléste, che svelléssero.

After this example conjugate the following :—

Infinitive.	*Present.*	*Ind. Pret.*	*Past Part.*	*English.*
Avéllere,	avéllo,	avélsi,	avúlso or -lto,	*to root up.*
Cólere,	cólo,	cólsi,	cólto,	*to reverence.*
Disvéllere,	disvéllo,	disvélsi,	divélto,	*to pull up.*
Espéllere,	espéllo,	espúlsi,	espúlso,	*to expel.*

9. *Verbs ending in* MERE.

The irregular verb *opprímere*, to oppress, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Opprímere, *to oppress.—Pres. Gerund.* Oppriméndo, *oppressing.—Past Part.* Opprésso, *oppressed.——Compound Tenses.—Past.* Avére opprésso, *to have oppressed.—Past Gerund.* Avéndo opprésso, *having oppressed.*

IND. *Pres.* Opprímo, opprími, opprime; opprimiámo, oppriméte, opprímono.—*Imp.* Oppriméva, opprimévi, oppriméva; opprimevámo, opprimevàte, opprimévano.—*Ind. Pret.* Oppréssi, opprimésti, opprésse; opprimémmo, oppriméste, oppréssero.—*Fut.* Opprimerò, opprimerái, opprimerà; opprimerémo, opprimeréte, opprimeránno.—*Cond. Pres.* Opprimeréi, opprimerésti, opprimerébbe; opprimerémmo, opprimeréste, opprimerébbero.

IMP. Opprími, opprima; opprimiámo, oppriméte, opprímano.

SUB. *Pres.* Che opprima, che opprima, che opprima; che opprimiámo, che opprimiáte, che opprímano.—*Imp.* Che oppriméssi, che oppriméssi, che opprimésse; che opprimessimo, che oppriméste, che opprimessero.

After this example conjugate the following :—

Infinitive.	*Present.*	*Ind. Pret.*	*Past Part.*	*English.*
Comprímere,	comprímo,	compréssi,	comprésso,	*to keep under.*
Esprímere,	esprímo,	espréssi,	esprésso,	*to express.*
Imprímere,	imprímo,	impréssi,	imprésso,	*to impress.*
Reprímere,	reprímo,	représsi,	reprèsso,	*to restrain.*
Assúmere,	assúmo,	assúnsi, assumésti, assúnse, assumémmo, assuméste, assúnsero,	assúnto,	*to take up.*
Consúmere,	consúmo,	consúnsi,	consúnto,	*to consume.*
Presúmere,	presúmo,	presúnsi,	presúnto,	*to presume.*
Redímere,	redímo,	redénsi, redimésti, redénse, redimémmo, rediméste, redénsero,	redénto,	*to redeem.*

10. *Verbs ending in* PERE.

The irregular verb *rómpere*, to break, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Rómpere, *to break.—Pres. Gerund.* Rompéndo, *breaking.—Past Part.* Rótto, *broken.——Compound Tenses.—Past.* Avére rótto, *to have broken.—Past Gerund.* Avéndo rótto, *having broken.*

IND. *Pres.* Rómpo, rómpi, rómpe; rompiámo, rompéte, rómpono.—*Imp.* Rompéva, rompévi, rompéva; rompevámo, rompeváte, rompévano.—*Ind. Pret.* Rúppi, rompésti, rúppe; rompémmo, rompéste, rúppero.—*Fut.* Romperò, romperái, romperà; romperémo, romperéte, romperánno.—*Cond. Pres.* Romperéi, romperésti, romperébbe; romperémmo, romperéste, romperébbero.

IMP. Rómpi, rómpa; rompiámo, rompéte, rómpano.

SUB. *Pres.* Che rómpa, che rómpa, che rómpa; che rompiámo, che rompiáte, che rómpano.—*Imp.* Che rompéssi, che rompéssi, che rompésse; che rompéssimo, che rompéste, che rompéssero.

After this example conjugate the following :—

Corrómpere, *to spoil.* | Prorómpere, *to rush out.*
Interrómpere, *to disturb.*

KEY TO EXERCISES IN LESSONS IN ITALIAN.

EXERCISE 46.

Whilst certain gentlemen stood admiring the vivacity and readiness of wit of Pico of Mirandola, who had not yet completed the ninth year of his age, an old blockhead began to say in the presence of this young prince: "When children in their tender years have so much talent, they afterwards become in mature age dull and stupid." "Then," said Pico, "if what you say is true, it is certain that you must have had in your youth a most excellent genius."

EXERCISE 47.

A king having to enter a city two hours after mid-day, certain deputies were sent to him from the senate in order to compliment him. He who had this duty to perform said, "Alessándro Magno, il Grand' Alessándro," and suddenly became silent, without being able to utter another word; which the king, who had not yet eaten that day, observing, said to him, "Yes, friend, Alessándro Magno has dined, and I am still fasting;" and this said, he went towards the palace of the senate, where a most sumptuous dinner had been prepared for him.

EXERCISE 48.

A painter showing a bad picture in the presence of many painters of great repute, vaunted himself of having finished it in a very short time. Apelles hearing it, said to him humorously, "It is not needful that thou shouldst tell us of having finished it in a short time: the picture itself tells us enough of that."

LESSONS IN MORAL SCIENCE.—II.

INDUCTION OR UTILITARIAN MORALITY.

ALMOST all writers upon morals are agreed upon the fact that we have in reality the perception or feeling of the difference between right and wrong, however much they may differ as to the source from which it springs. But in addition to this it is also universally admitted that we have, on viewing any action, an emotion or feeling of pleasure or pain arising from the contemplation of the act simply as virtuous or vicious.

It is impossible for us to witness a good or virtuous action without receiving a certain pleasure or pleasurable emotion from so doing: and it is almost equally impossible for us to witness a bad or vicious action without experiencing a feeling of the opposite kind. This feeling of pleasure may be, and of course has been, explained in various ways, according to the different theories which have been propounded as to the nature of virtue and vice. Some consider it to be simple and incomplex in its nature, while others have endeavoured to resolve it into several constituent elements. Be it, however, simple or complex, there is such a feeling manifestly existent in our nature; and it is clearly distinct from our perception of actions as right or wrong, whether it is prior or subsequent to it in the order of time. The pleasure arising from the contemplation of the beauty of virtue in itself has been a subject of remark from the very earliest times, and, indeed, as has been frequently observed, so intimate did this connection appear to the ancient Greeks that they had only one name to denote both "the good" and "the beautiful." And it was in a great measure this feeling which led Plato to hold his famous theory—that vice is ignorance: that the beauty of virtue in itself is such, and the pleasure to be derived from its very contemplation so great, that it would be impossible for any one really to know what it was, and yet not practise it.

It is quite true that there has been from time to time a variation in the standard of what is pleasant and beautiful in actions, just as there has been in the standard of beauty and excellence in painting, sculpture, and the other fine arts; but still the standard has always been the same in kind, even where it has differed greatly in degree. No one has ever tried to set up the standard of virtue as that of vice, or *vice versâ*. Our very nature pronounces against such an attempt. And this fact suffices, when properly developed and reflected on, to answer those who argue against the immutability of moral distinctions, and who try to prove that there is no real difference between right and wrong, on the ground of the difference in the manner in which actions have been judged in different times and countries. For the real fact is that the standard will be found, on examination, never to have varied substantially, although the nearness to the perfection which it requires has been farther from attainment at certain periods than at others.

The perception of the action as right or wrong, and a consequent feeling of pleasure or pain, does not, however, complete the analysis: there is also, in the third place, what has been termed our perception of the merit or demerit of the action. "The virtuous actions performed by other men," says Dugald Stewart, "not only excite in our minds a benevolent affection towards them, or a disposition to promote their happiness, but impress us with a sense of the merit of the agents. We perceive them to be the proper objects of love and esteem, and that it is morally right that they should receive their reward. . . . On the other hand, when we are witnesses of an act of selfishness, of cruelty, or oppression, whether we ourselves are the sufferers or not, we are not only inspired with aversion and hatred towards the delinquent, but find it difficult to restrain our indignation from breaking loose against him." And again, "In our own case, when we are conscious of doing well, we feel that we are entitled to the esteem and attachment of our fellow-creatures. . . . The feelings of remorse which accompany the consciousness of guilt involve, in like manner, a sense of ill desert, and an anticipation of future punishment."

Thus, whenever we see an action and reflect upon it, we have these three feelings, in some order or other: (1) a perception of the act as right or wrong, (2) a perception of it as agreeable or the reverse, and (3) a perception of merit or demerit in the agent who performs it. Different schools of modern philosophers give different accounts of the order in which these arise in the mind, and endeavour to resolve one or two of the three into the remaining one.

Having now in some measure touched upon the different questions with which the Science of Ethics attempts to deal, or, at any rate, having pointed out the nature of the subjects upon which it treats, we shall proceed to consider, somewhat in detail, the two great schools into which moralists have been divided, almost from the very earliest times, according to the views which they have taken upon these various topics, and others of a kindred nature.

One of these systems of Ethics has been termed *inductive*, *utilitarian*, or *selfish;* and the other *intuitive*, *independent*, or *sentimental*. We shall consider them separately, taking the former first.

The great distinctive feature of utilitarianism, as its name implies, is that it recognises utility or interest as the great motive to action, and only regards an action or course of conduct as virtuous or vicious according as it does or does not tend to procure happiness or pleasure, or to secure the interest of the agent directly or indirectly.

This theory, as was naturally to have been expected, has been held in different forms and in different degrees; the lowest form of all, perhaps, being Epicureanism, in which, as already explained, the one natural and praiseworthy motive to action was the gratification of the animal or sensual appetites or instincts of the individual. Every act of virtue, according to Epicurus, is done in order to promote and secure the happiness of the agent. Friendship, for instance, is to be pursued by the wise man only for its usefulness; and his explanation of justice, the greatest of all the virtues in the estimation of the ancients, was similar. "To abstain from what is another's," to quote from Adam Smith's account of the system, "was not desirable on its own account, and it could not, surely, be better for you that I should possess what is my own than that you should possess it. You ought, however, to abstain from whatever belongs to me, because by doing otherwise you will provoke the resentment and indignation of mankind. The security and tranquillity of your mind will be entirely destroyed. . . . That other species of justice, which consists in doing proper good offices to different persons, according to the various relations of neighbours, kinsmen, friends, benefactors, superiors, or equals, which they may stand in to us, is recommended by the same reasons. To act properly in all these different relations procures us the esteem and love of those we live with; as to do otherwise excites their contempt and hatred. By the one we naturally secure, by the other we necessarily endanger, our own ease and tranquillity—the great and ultimate objects of all our desires."

In modern times a theory of morals, more or less identical with this, has been put forward, and supported with all the genius of such men as Paley, Bentham, and J. S. Mill. Paley defined virtue as "the doing good to mankind, in obedience to the will of God, and for the sake of everlasting happiness." According to this definition, no act which is not performed for the sake of the happiness of the agent in a future life, at any rate, can be called virtuous. This doctrine is refuted by the necessary consequence resulting from it—that every act, instigated solely by the promptings of generosity or benevolence, must be a vice. Nor upon this theory is obedience to the will of God anything but a vice, when, even though done from motives of love and gratitude to Him, it is done from any other motive except a desire to secure the reward which He has promised to obedience to His will. These and similar considerations are sufficient to show upon reflection the error of this theory of virtue; in addition to which, it is quite clear that in numberless cases acts of virtue are performed, without any consideration whatsoever of future punishment or reward being present to the mind of the agent. There is, of course, at the root of such a theory the fact discovered by experience—that in the long run virtue and happiness coincide, and that, however it may seem to be the contrary in individual cases, yet a man will ultimately be rewarded in some way for acting rightly. "The usefulness of actions is the mark set on them by the Supreme Legislator, by which reasonable beings discover it to be His will that such actions should be done."

An equally able advocate of the principle of utility was Jeremy Bentham; which he maintained should be the chief motive to human conduct. From the point of view of Bentham and his followers, the motive which is always to influence us in our actions is a regard to the consequences which will ensue either to mankind at large, or, according to the lowest form of this theory, to ourselves individually. That an act will promote "the greatest happiness of the greatest number," or our own self-interest, is not only a reason and a sufficient one for performing it, but also for denominating it a virtuous act; and, in fact, if from any other consideration we had refrained from it, we should have acted viciously

Butler sums up well against this resolution of virtue into benevolence in his Essay on Virtue. "Without inquiring how far, and in what sense, virtue is resolvable into benevolence, and vice into the want of it, it may be proper to observe, that benevolence, and the want of it, singly considered, are in no sort the whole of virtue and vice. For if this were the case . . . . our moral understanding and moral sense would be indifferent to everything but the degrees in which benevolence prevailed, and the degrees in which it was wanting. That is, we should neither approve of benevolence to some persons rather than to others, nor disapprove injustice and falsehood upon any other account, than merely as an overbalance of happiness was foreseen likely to be produced by the first, and of misery by the second." That this, however, is not the case, but that other considerations are taken into account, he proves by several instances. If, for example, two men are competitors for anything of equal advantage to each, a third person will be accounted as exhibiting the virtue of gratitude, if he does his best to obtain it for one of the two, from whom he may have received some kindness. Or, if one man was by fraud or violence to take from another his rightful property, and give it to a third, who would, in his estimation, receive as much pleasure from its possession as would more than balance the loss of pleasure to the first owner from being deprived of it, then such an action, though every one would unhesitatingly pronounce it vicious, would, on Bentham's theory, be virtuous. "The fact," says Butler, "appears to be that we are constituted so as to condemn falsehood, unprovoked violence, injustice, and to approve of benevolence to some preferably to others, abstracted from all consideration which conduct is likeliest to produce an overbalance of happiness or misery."

John Stuart Mill has been the ablest advocate of the utilitarian theory of recent times, and it will be well to consider somewhat in detail the account of it, and the arguments in support of it which he has put forward, chiefly in his "Essay on Utilitarianism." He states the theory thus: "The creed which accepts, as the foundation of morals, utility, or the greatest happiness principle, holds that actions are right in proportion as they tend to promote happiness, wrong as they tend to produce the reverse of happiness. By happiness is intended pleasure, and the absence of pain; by unhappiness pain, and the privation of pleasure." And he gives as the theory of life, on which this theory of morality is founded, this—"that pleasure, and freedom from pain, are the only things desirable as ends; and that all desirable things are desirable either for the pleasure inherent in themselves, or as means to the promotion of pleasure and prevention of pain." And in accordance with this he defines the standard of morality as "the rules and precepts for human conduct, by the observance of which an existence, exempt as far as possible from pain, and as rich as possible in enjoyments, both in point of quantity and quality, might be to the greatest extent possible secured to all mankind; and not to them only, but, so far as the nature of things admit, to the whole sentient creation."

Further on in his Essay, Mill says, "There is in reality nothing desired except happiness. Whatever is desired, otherwise than as a means to some end beyond itself, and ultimately to happiness, is desired as itself a part of happiness, and is not desired for itself until it has become so" (a statement which to some may appear somewhat contradictory). "Those who desire virtue for its own sake, desire it either because the consciousness of it is a pleasure, or because the consciousness of being without it is a pain, or for both reasons united." The evidence which is to be offered in support of this theory, is "self-consciousness and self-observation, assisted by observation of others."

Dr. McCosh, in his "Examination of J. S. Mill's Philosophy," has stated several objections against the theory of utilitarianism as advanced by Mill. (1.) It does not account for the peculiar idea and conviction which we have in regard to moral good and evil. (2.) It does not embrace sufficient sanctions (*i.e.*, means of enforcing its commands) to induce us to approve virtue and condemn vice. (3.) It does not furnish a sufficient test of virtuous acts and of virtuous motives, and (4.) it does not embrace all the virtues. We have not space, however, to examine these separately and in detail.

Before, however, dismissing the theory of utility altogether, it will be well to mention the arguments for and against the adoption of utility as the moral standard, as they are given by Professor Bain, in his able work on "Mental and Moral Science."

The first point urged in favour of utility is—that the greater part of the morality has, and always has had, reference to the welfare of society, *i.e.*, the carrying into effect the aims of morality would be productive of happiness to society at large. This is even the case in the morality of the Bible, where the last six of the ten commandments are, as he says, utilitarian, *i.e.*, aim at preventing misery and securing happiness amongst mankind.

But, more than this, the welfare of society is considered as a justification for laying down many rules, and enforcing or at least expecting obedience to their requirements; and their very utility is often urged as the chief, if not the only motive for yielding obedience to them.

When a new law is to be made, or an old one done away with, utility is frequently the only standard of action appealed to; in which case its supporters are often termed mere advocates of expediency, which may be a most proper motive of action.

And, lastly, Bain observes that there is an increasing tendency every day to withdraw from the moral code, or at all events to withdraw from the sphere of legal restraint, all actions which have no connection directly or indirectly with the welfare of society, *e.g.* the observance of the Sabbath, or of a form of "established" religion.

The principal objection against the utilitarian theory has been already mentioned—that utility is *not* the sole motive to human action, and that men frequently act deliberately and in preference from motives quite different, and with a view to quite different ends. Nay, more than this, men often act, when influenced by passions of one kind or another, in ways which do not tend in any way to the happiness or benefit of themselves or any one else. A regard to virtue itself also has often been a sufficient motive to induce men to forfeit almost the whole happiness of their lives, and even their very lives themselves, when they could not perform the act of virtue without the sacrifice. To say, as the utilitarians say, that virtue in this case is regarded not as the end, but as the means to the attainment of some state of happiness either for others or for the agent himself in another life, seems at variance with the testimony given by experience.

Another strong objection against the theory of utility is this: that the effects and bearings of particular acts on human happiness are very frequently too remote and numerous to be calculated, and that, even when it is possible to estimate them all with anything like accuracy, a man is often called upon to act so promptly that he has not time to make the necessary calculation. To this it is hardly a satisfactory reply to be told that the individual has not himself in each case to make such a calculation; that it has already been made for him by the experience of men who have gone before him, and who have embodied the results of their experience in the form of moral rules and maxims which will guide him in the general run of cases that may arise. For besides the fact that many fresh cases must arise, to suit which rules do not exist, it is, to say the least of it, a very unusual use of terms, to call that the motive of a man's act which is not present to his mind and consciously influencing him at the moment he performs it. If the individual does not act in the particular manner *because* he knows that an overbalance of happiness will be the result, the fact that such a result *will* ensue cannot truly be said to influence him at all.

In the manner in which utilitarianism is generally stated it may also be objected, that it does not furnish any incentive to a man to promote the happiness of others; that the utility which is pointed out to him especially to regard is his own self-interest, and that the theory is at bottom nothing but one of selfishness or self-love. "Utility is a sufficient motive to pursue our own happiness, and the happiness of others as a means to our own; but it does not afford any purely disinterested impulses; it is a selfish theory after all." Bearing in mind the fact that Bishop Butler has shown that self-love is a right and proper motive to action when kept within proper limits as any other, this is the objection which the utilitarian finds it, perhaps, easiest to answer; and, indeed, there are some writers of the utilitarian school whose systems are hardly open to this charge; but our object being to give the leading principles of each school, and the chief objections which have been brought against them, it would be out of place to discuss them in detail.

As might be imagined from their theory of the nature of virtue and vice, the utilitarian or inductive school hold that morality is not intuitive, but is the result of experience. In other words, they assert that there is no faculty in our minds which could inform us *à priori* what was right and what was wrong, before the effect of particular actions had been learnt by experience. Men found, according to this view, that one course of conduct produced happiness to themselves or others, and that the contrary course similarly produced unhappiness: and consequently they handed down from one generation to another the result of their experience, and all who came after, knowing that particular acts would produce happiness, and other particular acts unhappiness, called the former virtuous and the latter vicious. But prior to this inductive process there was nothing in men's nature which would lead them to adopt the one course of conduct rather than the other; there was no faculty of their mind which would approve of the one and disapprove of the other, irrespective of consequences and before any knowledge of them.

We may, then, fitly consider next this question concerning the nature of the moral faculty, and the different arguments which have been brought forward on each side of the controversy.

Those who assert that the moral faculty is intuitive, and pronounces upon actions before and without any consideration of their utility or effects, say, first of all, that our judgments of right and wrong are instantaneous. In most cases, they say, we pronounce our judgment as to the morality of an action at once; and that if there are certain cases in which we are unable to do this, this arises from the difficulty of having all the facts present to our mind, and not from any doubt we have as to the decision when once the facts are clearly ascertained. An act of murder or sacrilege we decide to be criminal and vicious the moment it is mentioned, without waiting to balance any reasons or arguments against one another; simply because we know that *nothing* could lead us to arrive at a different conclusion. We have no more doubt or difficulty in such a case than in judging that it is dark at midnight when once we open our eyes.

On the other side it is urged, that the fact that a judgment is instantaneous or immediate is no proof that it is innate in our minds. Long practice and habit may render the operation so rapid, that we are unable to perceive the process by which it is arrived at. The perception of distance by the eye, for instance, was from its apparent instantaneousness supposed to be perceived directly and immediately by the sight; though it is now clearly ascertained that it involves a comparison by the mind between different objects, and a judgment founded thereon. So also a person accustomed to any particular science will perform operations in a moment, which to a learner will cause considerable delay and difficulty; and, it is urged, the judgments of conscience are not more rapid than some of these. Indeed, it may be also said, it is only in the simpler moral questions which arise every day, that there can be fairly said to be any such rapidity at all.

LESSONS IN LOGARITHMS.—II.

NATURE AND USE.

15. Hitherto we have dealt with numbers and their powers, and have illustrated the use of logarithms by the manipulation of indices, whether whole or fractional numbers. We proceed now to a further definition of logarithms.

16. Given a fixed number, called a *base*. The logarithm of a number with regard to that base is the index of the power to which the base must be raised in order to produce the number.

17. If 2 be assumed as a base, then the powers of 2 will be the *natural numbers*, and the *indices* of those powers will be the *logarithms* of the natural numbers; thus—

TABLE OF LOGARITHMS TO BASE 2.

Natural Numbers.	Logarithms.	Natural Numbers.	Logarithms.
1	0	128	7
2	1	256	8
4	2	512	9
8	3	1024	10
16	4	2048	11
32	5	4096	12
64	6		

18. By means of this table, logarithmic calculations may be exemplified on a small scale, in the following manner:—

19. (*a*) *To Multiply two or more Numbers together.*—If the logarithms of the factors be added together, the sum is the logarithm of the product. Thus, to multiply 128 by 8, add 7 and 3 together, the logarithms of the factors; the sum 10 is the logarithm of the product 1024. Again, to multiply 4, 8, and 16 continuously together, add 2, 3, and 4 together, the logarithms of the factors; the sum 9 is the logarithm of the product 512.

20. (*b*) *To Divide one Number by another.*—If the logarithm of the divisor be subtracted from the logarithm of the dividend, the remainder is the logarithm of the quotient. Thus, to divide 256 by 64, subtract 6, the logarithm of the divisor, from 8, the logarithm of the dividend; the remainder 2 is the logarithm of the quotient 4.

21. (*c*) *To find a fourth Proportional to three given Terms.*—If the logarithms of the second and third terms be added together, and from the sum the logarithm of the first term be subtracted, the remainder is the logarithm of the fourth term. For example, to find a fourth proportional to 8, 32, and 64:—If 8 : 32 : : 64 : the fourth term; then add 5 and 6 together, the logarithms of the second and third terms, and from the sum 11 subtract 3, the logarithm of the first term; the remainder 8 is the logarithm of the fourth term, 256.

22. (*d*) *To find any Power of a Number.*—If the logarithm of the number be multiplied by the index of the required power, the product is the logarithm of that power. Thus, to find the square of 16, multiply 4, the logarithm of the number, by 2, the index of the square; the product 8 is the logarithm of the square 256.

23. (*e*) *To find any Root of a Number.*—If the logarithm of the number be multiplied by the index of the required root, or be divided by its denominator, the quotient is the logarithm of that root. Thus, to find the cube root of 64, divide 6, the logarithm of the number, by 3, the denominator of the index of the cube root; the quotient 2 is the logarithm of the cube root 4.

24. The nature and use of logarithms having been thus illustrated and exemplified in the system of which the base is 2, we shall now give a full explanation of the system in common use.

COMMON SYSTEM OF LOGARITHMS.

25. The number 10 has been assumed as the *base* of the common system of logarithms, because it is the *root* of the decimal scale of notation, and on this account possesses certain advantages which have led to its universal adoption by mathematicians.

26. The powers of the number 10 being respectively unity with as many ciphers annexed as are denoted by the indices of the different powers, the construction of the following table is sufficiently evident to the student:—

TABLE OF POWERS.

$10^0 = 1$	Zero power.	$10^7 = 10000000$	7th power.
$10^1 = 10$	1st power.	$10^8 = 100000000$	8th power.
$10^2 = 100$	2nd power.	$10^9 = 1000000000$	9th power.
$10^3 = 1000$	3rd power.	$10^{10} = 10000000000$	10th power.
$10^4 = 10000$	4th power.	$10^{11} = 100000000000$	11th power.
$10^5 = 100000$	5th power.	$10^{12} = 1000000000000$	12th power.
$10^6 = 1000000$	6th power.	etc.	

27. These powers of 10 being the *natural numbers*, and their *indices* the *logarithms* of those numbers, the construction of the following table is rendered evident by the table in the preceding article:—

FIRST SKELETON TABLE OF LOGARITHMS TO BASE 10.

Natural Numbers.	Logarithms.	Natural Numbers.	Logarithms.
1	0	10000000	7
10	1	100000000	8
100	2	1000000000	9
1000	3	10000000000	10
10000	4	100000000000	11
100000	5	1000000000000	12
1000000	6	etc.	

28. If unity, the first natural number, be divided by the successive natural numbers in the preceding table, the quotients will be a series of decimal fractions—viz., ·1, ·01, ·001, etc. The logarithms of these quotients will be found by subtracting the logarithms of the natural numbers from 0, the logarithm of unity. Now though it be impossible, arithmetically, to subtract the logarithms 1, 2, 3, etc., from the logarithm 0, yet the operation that should be performed is indicated by placing the sign of subtraction before each of these logarithms; thus, -1, -2, -3, etc. Hence, the construction of the following table of decimal fractions, with their logarithms, is evident to the student:—

SECOND SKELETON TABLE OF LOGARITHMS TO BASE 10.

Natural Numbers.	Logarithms.	Natural Numbers.	Logarithms.
·1	-1	·0000001	-7
·01	-2	·00000001	-8
·001	-3	·000000001	-9
·0001	-4	·0000000001	-10
·00001	-5	·00000000001	-11
·000001	-6	·000000000001	-12, etc.

29. These logarithms, being of an opposite character to the former, are called *negative*, while the former are denominated *positive*. From the remarks in the preceding article, it is evident that the logarithm of every proper fraction is essentially negative, and that the logarithms of such fractions numerically increase in proportion as the fractions themselves decrease in value, compared with unity. Hence, when the value of a fraction is indefinitely small, its logarithm, numerically considered, must be indefinitely great; and when the value of a fraction is

infinitely small, so as to be reckoned equal to nothing, its logarithm must be infinitely great; in other words, the logarithm of 0 is negative infinity.

30. If the square root of the number 10 be extracted, and then the square root of this root, and of each successive root, the indices of these roots will be the successive powers of $\frac{1}{2}$, the index of the square root. Thus, by the common rule for extracting the square root, we have, going as far as five places of decimals—

Square root of 10·00000 = 3·16228, index $\frac{1}{2}$.
" " 3·16228 = 1·77828, " $\frac{1}{4}$.
" " 1·77828 = 1·33352, " $\frac{1}{8}$.
" " 1·33352 = 1·15478, " $\frac{1}{16}$.
" " 1·15478 = 1·07461, " $\frac{1}{32}$.
" " 1·07461 = 1·03663, " $\frac{1}{64}$; etc.

On this principle the following table is constructed:—

TABLE OF EVEN ROOTS.

$10^{\frac{1}{2}}$ = 3·16228, Square root.	$10^{\frac{1}{16}}$ = 1·15478, 16th root.
$10^{\frac{1}{4}}$ = 1·77828, 4th root.	$10^{\frac{1}{32}}$ = 1·07461, 32nd root.
$10^{\frac{1}{8}}$ = 1·33352, 8th root.	$10^{\frac{1}{64}}$ = 1·03663, 64th root; etc.

31. If the cube root of the number 10 be extracted, and then the cube root of this root, and of each successive root, the indices of these roots will be the successive powers of $\frac{1}{3}$, the index of the cube root. Thus, by the common rule for extracting the cube root, we have—

Cube root of 10·00000 = 2·15443, index $\frac{1}{3}$.
" " 2·15443 = 1·29155, " $\frac{1}{9}$.
" " 1·29155 = 1·08902, " $\frac{1}{27}$.
" " 1·08902 = 1·02883, " $\frac{1}{81}$.
" " 1·02883 = 1·00952, " $\frac{1}{243}$.
" " 1·00952 = 1·00316, " $\frac{1}{729}$; etc.

On this principle the following table is constructed:—

TABLE OF ODD ROOTS.

$10^{\frac{1}{3}}$ = 2·15443, the cube root.	$10^{\frac{1}{81}}$ = 1·02883, the 81st root.
$10^{\frac{1}{9}}$ = 1·29155, the 9th root.	$10^{\frac{1}{243}}$ = 1·00952, the 243rd root.
$10^{\frac{1}{27}}$ = 1·08902, the 27th root.	$10^{\frac{1}{729}}$ = 1·00316, the 729th root; etc.

32. The *roots* or *fractional powers* of 10, in the two preceding tables, are *natural numbers*, and their *indices* the *logarithms* of those numbers. Hence, the construction of the following skeleton table, composed of two parts, is thus rendered evident; for Part I. is deduced from the *Table of Even Roots*, extended by means of eighteen successive extractions of the square root, as directed in Art. 30; the left-hand column containing the roots or numbers thus obtained, and the right-hand column the decimals approximately equivalent to the fractional indices of those roots or numbers. In like manner, Part II. is deduced from the *Table of Odd Roots*, extended by means of eleven extractions of the cube root, as directed in Art. 31; the left-hand column containing the roots or numbers thus obtained, and the right-hand column the decimals approximately equivalent to the fractional indices of those roots or numbers:—

THIRD SKELETON TABLE OF LOGARITHMS.

Part I.

Natural Numbers.	Logarithms.	Natural Numbers.	Logarithms.
3·16228	·500000	1·00225	·000977
1·77828	·250000	1·00113	·000488
1·33352	·125000	1·00056	·000244
1·15478	·062500	1·00028	·000122
1·07461	·031250	1·00014	·000061
1·03663	·015625	1·00007	·000031
1·01815	·007813	1·00004	·000015
1·00904	·003906	1·00002	·000008
1·00451	·001953	1·00001	·000004
		etc.	etc.

Part II.

Natural Numbers.	Logarithms.	Natural Numbers.	Logarithms.
2·15443	·333333	1·00105	·000457
1·29155	·111111	1·00035	·000152
1·08902	·037037	1·00012	·000051
1·02883	·012346	1·00004	·000017
1·00953	·004115	1·00001	·000006
1·00316	·001372	etc.	etc.

33. By means of these three skeleton tables, and the principles already explained, the logarithms of all natural numbers may be found to any extent required, within certain limits as to the number of decimal figures.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER VIII.—CARTHAGE.

CARTHAGE, the chief offshoot of Tyre, and principal inheritor of the colonial commerce of the mother-city, has had no native historian to recount its glories: its history, indeed, has to be sought in the literature of its conquerors and destroyers. Its foundation is ascribed to Elissa or Dido, who, with many Tyrians, fled from the land of her birth (about 813 B.C.), to escape the domestic distractions which overtook Tyre and Sidon, in consequence of the usurpation of Ishobœa or Ethbaal. Ethbaal was priest of Astarte, and father of Jezebel, the wife of Ahab. He assassinated Pheletus, the last of Hiram's sons, B.C. 898. In opposition to Utica, the Old Town (Hebrew, *atika*, old), founded B.C. 1100, Elissa's settlement was named *Kartchadthe*, or New Town, corrupted by the Romans into *Carthago*, and by the Greeks into *Karchedon*.

Like their ancestors the Phœnicians, the Carthaginians owed nothing at first to conquest. They paid a yearly tribute for the land they settled upon, and sought their wealth in industry and commerce. A skilful, civilised people could not, however, dwell in the midst of nomadic tribes, who were continually at war with each other, without being appealed to by these for aid, and without finally gaining the supreme power. From tributaries they rose to be masters of the neighbouring races, and in the height of their prosperity they ruled a territory extending from Cyrene to Numidia, 1,400 miles in length by 80 in breadth, besides possessing a considerable influence over the interior of the continent. The name Africa, first given to their own colony, grew into use as the common designation of their dominions. Besides the north coast of its own continent, Carthage possessed nearly all Spain, and the islands between Spain and Italy.

The ruling passion with the Carthaginians, as with the Phœnicians, was love of gain. Possessed of little patriotism, they employed mercenaries in all their wars, and imposed upon the African tribes the yoke of military servitude. They showed judgment and good sense in their domestic affairs, for there is no record of turbulence or civil war till the era of their downfall. The soil was cultivated by negro slaves, and a profitable slave-trade existed with the adjacent countries. Their territories yielded corn and fruits of all kinds, various sorts of provisions, wax, honey, oil, skins, wild spartum (a kind of broom, from which they made ropes and numerous articles), a peculiar extract called Punic colour, and other materials for manufactures. The Carthaginians were celebrated for various industrial products, such as woven fabrics and artistic work in leather and wool. Their tanning was very superior: they manufactured pure white and coloured leathers, of the kind now known as marocco. They also practised the arts of pottery and dyeing, and understood the working of metals. Their skill in handicraft caused the term Punic to become descriptive of exquisite workmanship; and in Rome, Punic couches, lanterns, wine-presses, etc., were in the highest estimation. *Punic* is derived from *Pœni* or *Phœni*, the Latin name for these people, the Carthaginians being Phœnicians by descent.

Carthaginian commerce, though very extensive, was in a great measure confined to direct interchange, and managed entirely by merchants. Even after the destruction of Tyre, it did not include the universal carrying or commission trade of the Phœnicians. Its position on what is now called the Bay of Tunis, midway between the Levant and the Pillars of Hercules, enabled it to command the Mediterranean traffic, while various inland caravan routes also brought commodities to its markets.

Colonies, properly so called, Carthage did not possess, for its policy of aggrandisement, which could endure no rival, caused all its settlements to be mere trading stations. The chief of the insular possessions was Sardinia, which was held till a few years after the conclusion of the first Punic war, B.C. 241. Corsica, also a Carthaginian possession, was lost at the same time. After contests which lasted 200 years, Carthage never secured more than a partial footing in Sicily. The last remaining possessions before the destruction of the state were the Balearic Isles, Malta, and Spain.

Phœnician and Greek vessels covered the eastern Mediterranean, compelling the Carthaginians to settle and trade where they could more successfully compete with their rivals. In the west they met the Greeks of Sicily and Italy, the Greek colony of Marseilles, then Massilia, and the Etruscan pirate merchants, for all of whom the Carthaginians were more than a match. They obtained oil and wine from Sicily; honey, wax, and slaves, from Corsica; fruits and beasts of burden, chiefly mules, from the Balearics; and bitumen from the Lipari Islands. Malta furnished costly tissues for clothing. Elba, remarkable to this day for the fine iron it produces, supplied material for their furnaces.

For the commodities thus obtained, the Carthaginians gave the produce of their own industry and commerce, the work of their looms, and especially slaves, precious stones, and gold. As the state increased in wealth, its system of employing mercenaries became further developed, and draughts of labourers from the islands were employed in Spain to work the mines more vigorously than during the Phœnician period.

Their maritime commerce outside the Mediterranean extended both north and south, but the extreme limits were kept profoundly secret. It is recorded that the master of a merchant vessel voyaging north (probably to Britain), rather than permit a Roman ship, which followed him, to learn his destination, ran his vessel ashore, and led his pursuer to do the same. The Carthaginian, then throwing the whole of the cargo overboard, lightened his vessel and got her off. The merchant, upon his return to Carthage, was commended for doing the state a service, and compensated for the loss of his freight.

Cerne, an island on the west coast of Africa, opposite Madeira, was the chief station for business with the natives of that part of the continent. According to Herodotus, who learnt more of this commerce than the Carthaginians would willingly have allowed, a silent bargaining used to take place between the natives and merchants. The latter went ashore with their wares, and kindled a fire of damp wood, the ascending smoke of which was the signal that brought the natives down as soon as the sailors retired to their ships. These natives, a tall and handsome race, of dark complexion, with long but not woolly hair, and of pastoral habits, were fond of showy trinkets, which, with harness, pottery, and Egyptian linen, their visitors deposited on the shore. In exchange, they brought elephants' tusks, skins of wild beasts, and gold, placing them alongside the merchants' wares. The Carthaginians again landed; but, if dissatisfied with the proposed barter, they once more retired, leaving the goods untouched till more gold had been added; when satisfied, however, they made the exchange and departed. Herodotus speaks of the good faith which was always observed, neither side acting unfairly by the other; but when the shrewd, calculating Carthaginians met ignorant African tribes, it is not hard to see who were likely to have the best of the bargain. There are so many references in history to this mode of silent barter, in which the contracting parties scarcely saw each other, that we cannot doubt its existence. It was employed in dealing with the natives of India; and modern travellers describe the practice as continuing in Soudan to the present time. It arose probably from ignorance of each other's language, and from a natural fear of approaching visitors whose power appeared so great. Nevertheless, this mode of conducting traffic could not have been universally practised, for amongst the commodities brought from the interior, black slaves appear prominent, and bulky substances, such as salt from the desert. The whole history of the negro is associated with kidnapping. Negroes were the victims of the slave-dealer, as depicted on the earliest Egyptian monuments; and the Carthaginians in later times bought them in droves for export to Italy and Greece. A trade in which grain produced in Numidia was exchanged for dates, the produce of less fertile parts, as well as a traffic in feathers, and in furs, completes the summary of the maritime commerce of this people. Southwards, across Sahara, the commodities brought by caravans were the same as those obtained on the west coast—slaves, salt, dates, and gold. Communication between Egypt and Ethiopia was constant, and more particularly with the city of Ammonium, now Siwah. The gems and other precious commodities of India, the perfumes and pearls from the coasts of the Red Sea and the Persian Gulf, the costly furniture, wool, and tapestry of Phœnicia, as well as the scarlet and purple dyes, reached Carthage by this route.

Despite the military genius of Hamilcar and Hannibal, and the magnanimity and devotion of the latter, Carthage was worsted in the first and second Punic Wars, forced to agree to a humiliating peace, and deprived of its foreign possessions. The third Punic War, B.C. 149-146, ended in the conquest of the city by the Romans, who were resolved upon its utter destruction. The burning of the temples, palaces, and monuments lasted for seventeen days, and of 700,000 inhabitants before the siege, only 50,000 remained alive at its close. Under Augustus a new or Roman Carthage rose upon the site of the former capital, with which it vied in splendour, and became one of the second cities of the empire; but its Mediterranean trade had departed. Carthage was captured by Genseric, A.D. 439, and made the capital of the Vandal kingdom, re-captured a century later by Belisarius, the general of Justinian, and finally taken by the Arabs under Hassan, by whom it was sacked and utterly destroyed, A.D. 698. One or two Arab villages now stand amid its ruins.

The productive resources of Carthage were extended by tillage, manufactures, and commerce. These branches of industry acted and reacted upon each other, fostering the growth of all, and leading to a vast accumulation of wealth, which the development of maritime power and the establishment of trading stations also continually increased.

A municipal oligarchy, composed of a few wealthy families, whose intelligence in building up their own fortunes by trade ensured some degree of administrative skill, possessed the chief power, and carried their business habits into the offices of government. From them were chosen, to execute the laws, two suffetes, the same title which in the Old Testament is translated "judges." Amongst other regulations by which the suffetes were bound, was one by which they were not permitted to taste wine during their term of office. The revenue was derived from tribute paid by subjugated races; from taxes upon distant dependencies, payable in produce or in gold; from rigorous import duties, and from the Spanish mines. So great was the revenue from this last source, that the whole cost of the second Punic war was defrayed by it. In the army were to be found Gauls, Iberians, Ligurians, and Negroes; the officers were native Carthaginians. The most formidable parts of this heterogeneous army were the Numidian horsemen, and the Balearic slingers. The citadel, Byrza, contained barracks for 20,000 troops, with stables for 4,000 horses and 300 elephants. The inner harbour contained the residence of the admiral, magazines and quays for the shipment of cargo, and docks for the building and repairing of 200 merchant vessels and galleys of war. The fleet was very numerous, numbering, in the great engagement with Regulus (B.C. 256), 350 galleys.

A gloomy and cruel religion was professed. The tutelary deity, Melkarth, has been variously identified with Baal, Bel, Jupiter, and the Sun. The Phœnician Astarte, Ashtaroth, or the Moon, was also worshipped. They sacrificed infants, even of noble families, together with captives taken in war, to Moloch or Saturn, supposed by some to be Melkarth. The cries of the victims were drowned by the sound of fifes and drums. Their religion reflected its character upon their criminal code, which was as severe as that of Draco, crucifixion, for example, being a common punishment.

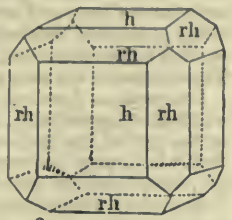
We owe to their commercial acuteness the use of bills of exchange and letters of credit, which have done so much to extend the domain of commerce. They also introduced the practice of bottomry, or lending money on mortgage of ships. The earliest of such documents of which mention is made, were pieces of leather impressed with the government mark, and passing current like our bank-notes. Yet they appear not to have had any money proper, although they must have been acquainted with the coinage of Greece.

The best we know of Carthage is the excellence of her civil constitution, which, according to Aristotle, preserved her for several centuries from anarchy and despotism; her care for the national credit, which led to the payment of every obligation incurred during the struggle with the Romans; and her filial loyalty to Tyre, when besieged by Nebuchadnezzar and by Alexander the Great, on which occasions she opened her gates as an asylum for the Tyrian women, children, and aged people. Literature, that would have at least saved the Carthaginians from oblivion, was probably of less account amongst them than the acquisition and the retention of riches. Cato's stern words, *Delenda est Carthago*, applied to its records, seem to have been as full of meaning as when applied to the city itself.

MINERALOGY.—II.

CRYSTALLOGRAPHY (*continued*).

Cleavage is that property which some crystals eminently possess of splitting in certain directions. If a piece of *calc-spar* be struck with a hammer, the small fragments will all bear indications of having a tendency to become geometrical solids; and by holding a knife-edge along the line of easy fracture, and then hitting the knife, a perfect six-sided figure may be obtained. *Galena*, the ore of lead, will offer another mineral for practice. In this case the crystal is a cube. The crystal does not always exhibit its planes of cleavage parallel to its faces, and the solid obtained by cleavage is called the *fundamental form*, and may appear very different to the one from which it came, yet it has a close connection with it, as will be shown. The plane surfaces which bound the crystal are its *faces;* the line where two faces intersect is an *edge;* and the angle thus formed is a *plane angle;* the angle of a corner—that is, an angle formed by three faces meeting in a point—is a solid angle. In producing *secondary* forms from the *primary* or *fundamental* form the edges are *replaced*—that is, a plane cuts away the edge and occupies its place. Fig. 3 shows a cube whose edges have been replaced by the planes *rh*. The angles are *truncated* when they are cut off by planes. Fig. 4 shows a cube which has been so treated. By these two processes an innumerable variety of forms may be produced, all, however, directly referable to the primary form. There are thirteen primary forms, which are either *prisms*, *octahedrons*, or *dodecahedrons*. A *prism* is a column having from three to any number of sides; its two ends are its bases. An *octahedron* is an eight-sided figure; a *dodecahedron* has twelve sides. Frequent examples of these will be given.



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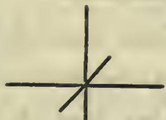
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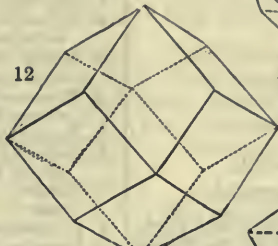
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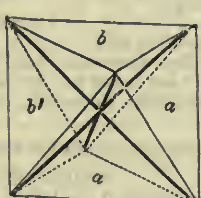

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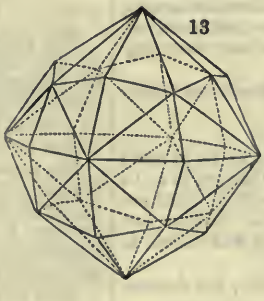
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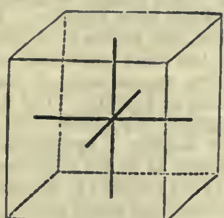
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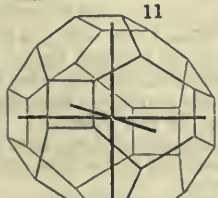
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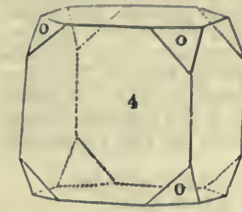
The law of symmetry is one of the principles of creation. It is observable in every organic construction that about a certain plane or planes the body is similarly built up. For instance, a plane which passes through the centre of the human frame would divide the body into two similar halves. So with crystals, they are all arranged symmetrically about certain *imaginary* lines. The position of these lines was first indicated by Weiss; and, by the arrangement of these *axes of symmetry*, crystals are divided into six classes or systems:—

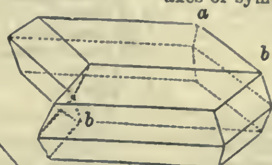
1. The Monometric, Regular Tessular or Cubic System.
2. The Dimetric, Right-square Prismatic or Pyramidal System.
3. The Trimetric, or Prismatic System.
4. The Monoclinic, or the Oblique System.
5. The Diclinic, or the Doubly Oblique System.
6. The Hexagonal or Rhombohedral System.

Yet with crystals, as in the best-regulated families, there are accidents; and we sometimes find departures from the ordinary course. A *pseudomorphous* crystal—one having a false form—that is, a form not belonging to the substance of which it is composed, may be produced by the crystallising material occupying a cavity, perhaps formed by some other crystal which had been dissolved away.

Twin crystals and *compound* crystals exist, as the snow-crystals figured in the last lesson give proof. *Macles* seem to be formed as if the crystals were cut in two, one-half then turned upside down and stuck on again. Fig. 5 shows this peculiarity, *bc* being the continuation of *ab*. These exceptions are uncommon.



1. The *Monometric, Regular Tessular* or *Cubic System* has three axes of symmetry all equal, and all at right angles to each other (Fig. 6). About these lines the crystal is symmetrically arranged, so that when heated it expands equally in all directions, and transmits light without breaking the rays. The primary figures of the system may be found by causing planes to pass perpendicularly through the extremities of the axis. This will produce the *cube* (Fig. 7).



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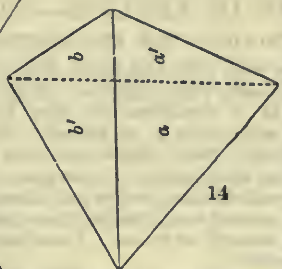
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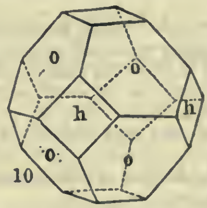
The other prominent figure, the *octahedron*, is formed by causing eight planes to pass through the three extremities of the axes. A glance at Fig. 8 will explain this. By combining these two figures in various proportions, a series of crystals may be produced. The gradations through which these pass are represented in Figs. 7, 4, 10, 8. In Fig. 8, if the axis of the octahedron be produced and made to coincide with the axes of Fig. 7, then imagine the octahedron to contract and to be able to cut away those parts of the cube which it touched first, the angles which would have obtruded themselves through the faces of the octahedron are truncated (Fig. 4). This process proceeds until in Fig. 9 the triangular faces meet, forming the *cubo-octahedron*. Still further, and in Fig. 10, these faces have become hexagons; and finally, in Fig. 8, the whole cube is obliterated, and the octahedron complete. A similar series of changes causes the cube to pass into the *rhombic dodecahedron*, a figure whose faces are twelve rhombs. This is effected not by the truncation of the angles, but by the replacement of the edges. The process is commenced in Fig. 3, carried on in Fig. 11, and completed in Fig. 12. This crystal is of frequent occurrence in Nature, and is the more remarkable from being the form selected by the working bee for its cell. There is another class of modification founded on the *cube, octahedron.*



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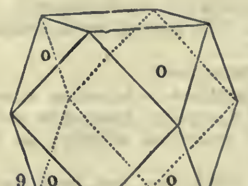

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and *tetrahedron* (a four-sided figure of which we shall presently speak), which are arrived at by placing pyramids of a varying number of sides upon the faces of the primary forms. These are the *six-faced octahedron* or *eight-faced cube*, and the *six-faced tetrahedron*. In Fig. 13 the general contour of the cube will be recognised, having on each face a pyramid with eight sides; or, looking at it as an octahedron, the pyramids on the faces have six sides. The six-faced tetrahedron is similarly constructed by placing six-sided pyramids on the faces of the tetrahedron.

Homohedral or *Holohedral* forms are perfectly symmetrical solids. *Hemihedral* forms are derived from the *homohedral* by producing the alternate faces. Take, for example, the octahedron (Fig. 8); *aa'*, *bb'* are alternate faces; if these all be produced every way until they cut each other, a *tetrahedron* (Fig. 14) would be the result; the sides are correspondingly lettered. This same figure may be made from a cube of chalk or potato by slicing away the alternate corners until two of the diagonals become edges. The minerals which crystallise in the first system, and most commonly met with, are :—

Tetrahedron	Grey Copper Ore.
Cube	Fluor Spar. Galena. Rock Salt. Iron Pyrites.
Octahedron	Alum. Spinelle.
Cubo-octahedron . . .	Galena.
Rhombic Dodecahedron .	Garnet.
Six-faced Tetrahedron . .	Diamond.
Six-faced Octahedron . .	Garnet.

LESSONS IN ENGLISH.—LII.

THE CONJUNCTION—THE INTERJECTION.

CONJUNCTIONS (from cum, *with*, and jungo, *I join*) are words whose office is to connect words together. They are closely allied to adverbs. It is sometimes not easy to determine whether a word is a conjunction or an adverb. *Therefore* and *wherefore*, for instance, have been called conjunctions; they have also been placed among the adverbs. If, however, we adhere to our definitions, we should declare *therefore* and *wherefore* as conjunctions, since they connect words rather than qualify a verb.

Conjunctions also connect sentences. Those sentences may be complete or incomplete.

While conjunctions connect words they may disconnect ideas; for example :—

The man or the woman was drowned.

The *or* connects together *man* and *woman*, but so as to leave it doubtful of which of the two the assertion in the verb is to be made. This view removes the apparent absurdity of what are called *disjunctive conjunctions*, that is, in plain Saxon, *not-joining joiners*. But a word may join in one way and disjoin in another.

Conjunctions may be divided into the *copulative*, the *disjunctive*, and the *corresponsive*.

The *copulative* are those which simply join words, as *and*.

The *disjunctive* are those which while joining words disjoin affirmations; as *or*; for example :—

The man or the woman died.

The *corresponsive* are such conjunctions as introduce corresponding sentences or members of a sentence, forming in each case a pair of corresponding or contrasted objects; as *if then*; *whether*, *or*.

1. *Copulative Conjunctions.*—And, as, both, because, even, for, if, that, then, since, seeing, so, whereas, that.
2. *Disjunctive Conjunctions.*—Or, nor, either, neither, than, though, although, yet, but, except, whether, less, unless.
3. *Corresponsive Conjunctions.*—Both—and; as—as; as—so; if—then; either—or; neither—nor; whether—or; though—yet.

This division proceeds on the ground of the functions which conjunctions discharge. If we contemplate conjunctions in regard to their import also, we may divide them into these classes :—

1. *Copulative.*—And, also, both.
2. *Disjunctive.*—Either, or, neither, nor.
3. *Concessive.*—Though, although, albeit.
4. *Adversative.*—But, yet, notwithstanding, nevertheless.
5. *Causal.*—For, that, because.
6. *Inferential.*—Therefore, wherefore, seeing, since, forasmuch.
7. *Final.*—That, in order that, to the end that.
8. *Conditional.*—But, if.
9. *Exceptive.*—Unless, save, except.
10. *Diminutive.*—At least.
11. *Dubitative.*—Whether or not.
12. *Expletive.*—Now, truly, indeed.
13. *Ordinative.*—Thereafter, finally, moreover, however.
14. *Declarative.*—Namely, to wit.

The *concessive* are such as denote a concession or yielding. The *adversative* are such as denote opposition or contrast. The *causal* are such as denote a cause, occasion, reason, or ground. The *inferential* are such as denote an inference or deduction. The *final* are such as denote an end, aim, or object. The *conditional* are such as denote a condition or requirement. The *expletive* are such as denote words which fill up a sentence not being absolutely necessary to the sense. The *ordinative* are such as denote the order, rank, or succession of things or acts. The *declarative* are such as supply explanations.

Interjections (from inter, *between*, and jacio, *I throw*) are words which give expression to some sudden feeling or strong emotion on the part of the speaker, as *O! oh! alas! pshaw!* Interjections are in part inarticulate, being simply a breathing, as the low, deep-sounding, long-drawn *Oh!* of great pain.

Some degree of order may be given to the interjections common in our language.

There are interjections of :—

1. *Joy.*—Hey! ho!
2. *Approbation.*—Good! bravo! well-done!
3. *Sorrow.*—Oh! ah! alas! well-a-day! alack!
4. *Wonder.*—Oh! ha! indeed! strange! when!
5. *Pain or Fear.*—Oh! ah! oh dear!
6. *Contempt.*—Pooh! pish! tush! pshaw! tut! humph!
7. *Aversion.*—Faugh! off! begone!
8. *Disapprobation.*—Fie! no!
9. *Invocation.*—Ho! what ho! hollo! hallo! hoy! ahoy!
10. *Exultation.*—Ah! aha! huzza! hurrah!
11. *Laughter or Delight.*—Ha, ha!
12. *Salutation.*—Welcome! hail! all hail!
13. *Calling Attention.*—Ho! lo! ho there! behold!
14. *Requiring Silence.*—Hush! hist! whist! 'st! mum!
15. *Surprise or Horror.*—Oh! ha! hah! what!
16. *Weariness or languor.*—Heigh ho! oh dear! oh dear me!
17. *Stopping.*—Hold! soft! avast! woh!
18. *Parting.*—Farewell! adieu!
19. *Detecting.*—Oho! ah-ah! ay-ay!
20. *Interrogating.*—Eh? what?

SYNTAX: SIMPLE SENTENCES.

AGREEMENT.

The preceding lessons have had for their object to make the student thoroughly familiar with the elements which enter into the composition of the English language. Our business now is to take them and put them together. And in doing so we must be guided by fact and by law; we must take lessons of wise master-builders; we must make their master-pieces our models.

The constructive process which I here contemplate bears in grammar the name of SYNTAX. The word is composed of two Greek roots, namely, συν (sune), *with*, and τασσο (tas'-so), *I arrange*, and so denotes a systematic arrangement of words. Consequently syntax is to the grammarian what the science of architecture is to the builder; it teaches the art of construction.

Take this sentence and study it :—

The sick man drinks pure water copiously.

What I now wish you to ascertain is, whether the proposition is in its simplest form. In order to ascertain this, you must distinguish between what is essential and what is not essential in the sentence. Take then word after word, and put the question, Is this essential? If not, strike it out, and strike out every word until you have reduced the proposition to its simplest form, that is, the form a deviation from which would involve no sense.

The. Is this essential? Yes, because some particular man is intended.

Sick. Is this essential? No. Erase the word; you modify, but do not destroy the statement.

Man. Is this essential? Yes, because *man* is the very subject of the proposition.

Drinks. Is this essential? Yes, because *drinks* declares what *the man* does: he drinks, and does not spin.

Pure. Is this essential? No, for though *pure* tells what sort of water the man drinks, yet the proposition is not destroyed by its omission.

Water. Is this essential? Yes, because *water* tells us what the man drinks; he drinks water, not wine.

Copiously. Is this essential? No; *copiously* does indeed refer to the amount of water which the man drinks, but its omission by no means destroys the sentence.

Thus, then, we have the proposition reduced to this form :—*The man drinks water.*

By a second process of a similar kind, the proposition may be still more simplified.

Let it be supposed that you wish to have and contemplate the idea of water being drunk, in its most elementary form, then you do not need the article *the*; accordingly the proposition now assumes this form, *Man drinks water.*

A third process of simplification brings the sentence to these two words, *Man drinks*, which set forth the simplest statement you can make on the subject. Remove the word *man*, you have no sense; remove the word *drinks*, you have no statement. Consequently the original proposition, when reduced to *man drinks*, is in its simplest form.

Such, then, is the form to which all propositions or sentences may be reduced. What does the form involve? Here are two words. Those two words you recognise as a noun and a verb, the one denoting a being and the other an act. Being and doing are the great facts with which all science is concerned, and the relation of being to doing, so far as the utterance of that relation is concerned, is the affair of the grammarian. The simplest proposition consists of a noun and a verb so related that what the verb declares is declared of the noun which is the subject of the proposition.

Agreement.—This, the simplest form of a proposition, may undergo modifications. You may change the subject: for instance, you may make the singular *man* into the plural *men*; but if you make this change, you must also change the verb, substituting *drink* for *drinks*. Here you see an instance of grammatical agreement. *Man drinks, men drink;* these pairs of words severally agree, but in *man drink* and *men drinks* the pairs do not agree. Hence you learn that *a singular noun requires a singular verb, and a plural noun requires a plural verb.*

Agreement, then, is the grammatical correspondence of two or more words one with another; this kind of agreement, however, is in English of less prevalence than another, which may be called logical. Grammatical agreement is an agreement in form; thus, in the above example, the question is whether or not, and in which case the *s* should be added to the verb *drink*. But when I say *the sick man drinks*, and declare that there is an agreement between *sick* and *man*, do I mean an agreement of form? No, for *sick* remains unchanged whatever noun you append to it: thus we say sick *man*, sick *men*, sick *women*, sick *boy*, sick *girls*. The agreement, then, is not in form. Yet the two words "sick man" do agree; in what? In sense; there is a logical agreement.

Observe, also, that the grammatical includes the logical, but the logical does not include the grammatical. The last statement has just been illustrated. The former may be shown to be true, thus: when I say *the man drinks*, I make a statement in which the word *man* agrees in thought with the word *drinks*; that is, the two go together; the two are combined so as to make a proposition; the two agree in sense.

Instances of Agreement.—These are afforded in the following table :—

(*gram. agr.*)	THE SICK MAN	adj. and noun (*log. agr.*)
noun and verb	DRINKS COPIOUSLY.	verb and adv. (*log. agr.*)

Sentences may be either affirmative, negative, interrogative, or interrogative negative: for example :—

Affirmative. I love my father.	*Interrog.* Do I love my father?
Negative. I do not love my father	*Int. Neg.* Do I not love my father?

LESSONS IN ALGEBRA.—XXXVII.

ARITHMETICAL PROPORTION AND PROGRESSION.

IF *four* quantities are in arithmetical proportion, *the sum of the extremes is equal to the sum of the means.*

Thus, if $a \cdot\cdot b : : h \cdot\cdot m$, then $\quad a + m = b + h$.
For by supposition, $\quad a - b = h - m$.
And transposing $-b$ and $-m$, $\quad a + m = b + h$.

So, in the proportion, $12 \cdot\cdot 10 : : 11 \cdot\cdot 9$, we have $12+9=10+11$.

Again, if *three* quantities are in arithmetical proportion, *the sum of the extremes is equal to double the mean.*

If $a \cdot\cdot b : : b \cdot\cdot c$, then, $\quad a - b = b - c$.
And transposing $-b$ and $-c$, $\quad a + c = 2b$.

Quantities which *increase* by a common difference, as 2, 4, 6, 8, 10, etc., or *decrease* by a common difference, as 15, 12, 9, 6, 3, etc., are in *continued arithmetical proportion.*

Such a series is also called an *arithmetical progression*; and sometimes *progression by difference*, or *equidifferent series.*

When the quantities *increase*, they form what is called an *ascending* series, as 3, 5, 7, 9, 11, etc.

When they *decrease*, they form a *descending* series, as 11, 9, 7, 5, 3, etc.

The natural numbers, 1, 2, 3, 4, 5, 6, etc., are in arithmetical progression ascending.

From the definition it is evident that, in an ascending series, each succeeding term is found by *adding the common difference* to the preceding term.

If the first term is 3, and the common difference 2,
The series is 3, 5, 7, 9, 11, 13, etc.
If the first term is a, and the common difference d,
Then $a + d$ is the second term, $a + d + d = a + 2d$ the third, $a + 2d + d = a + 3d$ the fourth, $a + 3d + d = a + 4d$ the fifth, etc.

	1st.	2nd.	3rd.	4th.	5th.	
And the series is	a,	$a + d$,	$a + 2d$,	$a + 3d$,	$a + 4d$,	etc.

If the first term and the common difference are the *same*, the series becomes more simple. Thus, if a is the first term, and also the common difference, and n the number of terms,

Then $a + a = 2a$ is the second term,
$2a + a = 3a$ the third, etc.
And the series is, $a, 2a, 3a, 4a \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad na$.

In a *descending* series, each succeeding term is found by *subtracting the common difference* from the preceding term.

If a is the first term, and d the common difference, the series is

1st.	2nd.	3rd.	4th.	5th.	
a,	$a - d$,	$a - 2d$,	$a - 3d$,	$a - 4d$,	etc.

In this manner we may obtain any term, by continued addition or subtraction. But in a long series this process would become tedious. There is a method much more expeditious. By attending to the series,

1st.	2nd.	3rd.	4th.	5th.	
a,	$a + d$,	$a + 2d$,	$a + 3d$,	$a + 4d$,	etc.,

it will be seen that the number of times d is added to a is *one less* than the number of the term. Thus,

The *second* term is $a + d$, *i.e.*, a added to *once* d;
The *third* „ is $a + 2d$, „ a „ to *twice* d;
The *fourth* „ is $a + 3d$, „ a „ to *thrice* d, etc.

So if the series be continued,

The 50th term will be $\quad a + 49d$.
The 100th term „ $\quad a + 99d$.

If the series be *descending*, the 100th term will be $a - 99d$.

In the *last* term, the number of times d is added to a is *one less* than the number of all the terms.

If, then, d = the common difference, a = the first term, z = the last, n = the number of terms, we shall have in all cases,

$$z = a \pm (n-1) \times d; \text{ that is,}$$

1. To find the *last* term of an *ascending* series.

Add to the first term the product of the common difference into the number of terms minus one, and the sum will be the last term.

2. To find the *last* term of a *descending* series.

From the first term subtract the product of the common difference into the number of terms minus one, and the remainder will be the last term.

N.B. Any other term may be found in the same way. For the series may be made to stop at any term, and that may be considered, for the time, as the last.

Thus, the mth term $= a \pm (m-1) \times d$.

EXAMPLES.

(1.) If the first term of an ascending series is 7, the common difference 3, and the number of terms 9, what is the last term?
Ans. $z = a + (n-1)\,d = 7 + (9-1) \times 3 = 31$.

(2.) If the first term of a descending series is 60, the common difference 5, and the number of terms 12, what is the last term? *Ans.* $z = a - (n-1)\,d = 60 - (12-1) \times 5 = 5$.

(3.) If the first term of an ascending series be 9, and the common difference 4, what will the 5th term be? *Ans.* $z = a + (m-1) \times d = 9 + (5-1) \times 4 = 25$.

There is one other inquiry to be made concerning a series in arithmetical progression. It is often necessary to find the *sum of all the terms*. This is called the *summation* of the series. The most obvious mode of obtaining the amount of the terms is to add them together. But the nature of progression will furnish us with a more expeditious method.

Let us take, for instance, the series	3,	5,	7,	9,	11.
and also the same inverted,	11,	9,	7,	5,	3.
The sums of the terms will be,	14,	14,	14,	14,	14.

Take also the series	a	$a+d$,	$a+2d$,	$a+3d$,	$a+4d$,
and the same inverted,	$a+4d$,	$a+3d$,	$a+2d$,	$a+d$,	a
The sums will be,	$2a+4d$,	$2a+4d$,	$2a+4d$,	$2a+4d$,	$2a+4d$.

Hence it will be perceived that the sum of *all* the terms in the double series is equal to the sum of the extremes repeated as many times as there are terms. Thus,

The sum of 14, 14, 14, 14, and $14 = 14 \times 5$.

And the sum of the terms in the other double series is $(2a + 4d) \times 5$.

But this is *twice* the sum of the terms in the *single* series. If, then, we put

a = the first term, n = the number of terms,
z = the last, s = the sum of the terms,

we shall have this equation, $s = \frac{a+z}{2} \times n$. Hence—

3. To find the *sum* of all the terms in an arithmetical progression.

Multiply half the sum of the extremes into the number of terms, and the product will be the sum of the given series.

EXAMPLE.—What is the sum of the natural series of numbers 1, 2, 3, 4, 5, etc., up to 1000?

$$Ans.\ s = \frac{a+z}{2} \times n = \frac{1+1000}{2} \times 1000 = 500500.$$

The two formulæ, $z = a \pm (n-1)d$, and $s = \frac{a+z}{2} \times n$, contain five different quantities; viz., a, *the first term;* d, *the common difference;* n, *the number of terms;* z, *the last term; and* s, *the sum of all the terms.*

From these two formulæ others may be deduced, by which, if any *three* of the *five* quantities are given, the remaining two may easily be found. The most useful of these formulæ are the following:—

By the first formula,

1. *The last term,* $z = a \pm (n-1)\,d$; in which a, n, and d are given.

Transposing $(n-1)d$,

2. *The first term,* $a = z \mp (n-1)d$; z, n, and d being given.

Transposing a in the first, and dividing by $n-1$,

3. *The common difference,* $d = \frac{z-a}{n-1}$; a, z, and n being given.

Transposing and dividing,

4. *The number of terms,* $n = \frac{z-a}{d} + 1$; a, z, and d being given.

By the second formula,

5. *The sum of the terms,* $s = \frac{a+z}{2} \times n$; a, z, and n being given.

Or, by substituting for z its value,

$s = \frac{2a + (n-1)\,d}{2} \times n$; in which a, n, and d are given.

Reducing the preceding equation,

6. *The first term,* $a = \frac{2s - dn^2 + dn}{2n}$; s, d, and n being given.

7. *The common difference,* $d = \frac{2s - 2an}{n^2 - n}$; s, a, and n being given.

8. *The number of terms,* $n = \frac{\sqrt{(2a-d)^2 + 8ds} - 2a + d}{2d}$; a, d, and s being given.

A variety of other formulæ may be deduced from the equations already given, the investigation of which will afford the student a pleasing and profitable exercise.

By the third formula, for example, may be found any number of arithmetical means between two given numbers. For the whole number of terms consists of the *two extremes* and all the *intermediate* terms. If, then, m = number of means, $m + 2 = n$, the whole number of terms. Substituting $m + 2$ for n in the third equation, we have—

The common difference, $d = \frac{z-a}{m+1}$, in which a, z, and m are given.

EXAMPLE.—Find 6 arithmetical means between 1 and 43. Here $n = 8$; $a = 1$; $z = 43$; $d = \frac{z-a}{n-1} = \frac{43-1}{8-1} = 6$, common difference; ∴ the series is 1, 7, 13, 19, 25, 31, 37, and 43.

It is obvious, from the mode in which we obtained an expression for the sum of an arithmetical series, that *the sum of the extremes is equal to the sum of any other two terms equally distant from the extremes.* Thus, in the series 3, 5, 7, 9, 11, the sum of the first and last terms, of the first but one and last but one, etc., is the same in each case, viz., 14. The same is true of every series.

EXERCISE 68.

1. If the first term of an increasing arithmetical series is 3, the common difference 2, and the number of terms 20, what is the sum of the series?
2. If 100 stones are placed in a straight line, at the distance of a yard from each other, how far must a person travel to bring them one by one to a box placed at the distance of a yard from the first stone?
3. What is the sum of 150 terms of the series

$$\frac{1}{3},\ \frac{2}{3},\ 1,\ \frac{4}{3},\ \frac{5}{3},\ 2,\ \frac{7}{3},\ \text{etc.?}$$

4. If the sum of an arithmetical series is 1455, the least term 5, and the number of terms 30, what is the common difference?
5. If the sum of an arithmetical series is 567, the first term 7, and the common difference 2, what is the number of terms?
6. What is the sum of 32 terms of the series

$$1,\ 1\tfrac{1}{2},\ 2,\ 2\tfrac{1}{2},\ 3,\ \text{etc.?}$$

7. A gentleman bought 47 books, and gave 10 shillings for the first, 30 shillings for the second, 50 shillings for the third, etc. What did he give for the whole?
8. A person put into a charity-box a shilling the first day of the year, two shillings the second day, three shillings the third day, etc., to the end of the year. What was the whole sum for 365 days?
9. How many strokes does a common clock strike in 24 hours?
10. The clocks of Venice go on to 24 o'clock; how many strokes do they strike in a day?
11. Required the sum of the odd numbers 1, 3, 5, 7, 9, etc., continued to 100 terms; and also to n terms.
12. Required the 365th term of the series of even numbers 2, 4, 6, 8, 10, 12, etc.; and also the nth term.
13. The first term of a series is 4, the common difference 3, and the number of terms 100. What is the last term, and also the nth term?
14. A man puts £1 out to interest at 6 per cent.; what will be the amount in 40 years at simple interest?
15. The extremes of an arithmetical series are 2 and 29, and the number of terms is 10. What is the common difference?
16. The extremes of an arithmetical series are 3 and 59, and the common difference 2. What is the number of terms?
17. Find 5 means between 6 and 48.
18. Find 6 means between 8 and 36.

Problems of various kinds, in arithmetical progression, may be solved by stating the conditions algebraically, and then reducing the equations. Thus:—

EXAMPLE.—Find four numbers in arithmetical progression, whose sum shall be 56, and the sum of their squares 864.

Let x = the second of the four numbers,
And y = their common difference.
The series will be $x-y$, x, $x+y$ and $x+2y$.
By the conditions, $(x-y) + x + (x+y) + (x+2y) = 56$.
And $(x-y)^2 + x^2 + (x+y)^2 + (x+2y)^2 = 864$.
That is, $4x + 2y = 56$.
And $4x^2 + 4xy + 6y^2 = 864$.

Reducing these equations, we have $x = 12$, and $y = 4$.
The numbers required, therefore, are 8, 12, 16 and 20.

EXAMPLE.—A certain number consists of three digits, which are in arithmetical progression, and the number divided by the sum of its digits is equal to 26; but if 198 be added to it, the digits will be inverted. What is the number?

Let the digits be equal to $x - y$, x, and $x + y$, respectively. Then the number $= 100\,(x - y) + 10x + (x + y) = 111x - 99y$, etc. This example will give the result $= 234$.

Exercise 69.

1. The sum of three numbers in arithmetical progression is 9, and the sum of their cubes is 153. What are the numbers?
2. The sum of three numbers in arithmetical progression is 15, and the sum of the squares of the two extremes is 58. What are the numbers?
3. The sum of the squares of the extremes of four numbers in arithmetical progression is 200, and the sum of the squares of the means is 136. What are the numbers?
4. There are four numbers in arithmetical progression; the sum of the squares of the first two is 34, and the sum of the squares of the last two 130. What are the numbers?
5. There are four numbers in arithmetical progression whose sum is 28, and their coutinued product is 585. What are the numbers?

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XXXVI.

Exercise 67.

1. The ratio of $44 : 35$ is the greater; for $\frac{44}{35} = \frac{396}{315}$, and $11 : 9 = \frac{11}{9}$ or $\frac{385}{315}$.
2. $2a + 7 : \frac{1}{3}a$.
3. 5.
4. 126.
5. $42ax + 6a : 105by - 70b$.
6. $x^2 - y^2 : bh$.
7. $10x^2 + 34x + 28 : 2x^2 + 9x - 18$ is a ratio of greater inequality.
8. Ratio of equality, or 1.
9. $3024 : 3240$ or $14 : 15$.
10. $21x^3 : 21y^3$ or $x^3 : y^3$

LESSONS IN FRENCH.—LXXXIV.

§ 128.—Verbs requiring the Preposition de before an Infinitive (*continued*).

Flatter (se), *to flatter one's self.*
Frémir, *to shudder.*
Garder (se), *to take care.*
Gémir, *to lament.*
Glorifier (se), *to pride one's self.*
Hasarder (se), *to venture.*
Hâter (se), *to hasten.*
Imputer, *to impute.*
Indigner (s'), *to be indignant.*
Ingérer (s'), *to take into one's head.*
Inspirer, *to inspire.*
Jurer, *to swear.*
Manquer, *to fail.*
Méditer, *to think, to intend*
Mêler (se), *to meddle.*
Menacer, *to threaten.*
Mériter, *to deserve.*
Moquer (se), *to laugh at.*
Mourir (figu.), *to long.*
Négliger, *to neglect.*
Nier, *to deny.*
Pardonner, *to excuse.*
Parler, *to speak.*
Passer (se), *to do without.*
Permettre, *to permit.*
Persuader, *to persuade.*
Piquer (se), *to take pride in.*
Plaindre, *to pity.*
Plaindre (se), *to complain.*
Prendre garde, *to take care, heed.*
Prendre soin, *to take care.*
Prescrire, *to prescribe.*
Presser, *to urge.*
Presser (se), *to hasten.*
Présumer, *to presume.*
Prier, *to desire.*
Promettre, *to promise.*
Proposer, *to propose.*
Proposer (se), *to intend.*
Protester, *to protest.*
Punir, *to punish.*
Rebuter (se), *to be weary.*
Recommander, *to recommend.*
Refuser, *to refuse.*
Regretter, *to regret.*
Réjouir (se), *to rejoice.*
Remercier, *to thank.*
Repentir (se), *to repent.*
Reprendre, *to censure.*
Reprocher (se), *to reproach one's self.*
Résoudre, *to resolve.*
Ressouvenir (se), *to remember.*
Rire, *to laugh.*
Rougir, *to blush.*
Scandaliser (se), *to take offence.*
Seoir (imp.), *to become, suit.*
Sommer, *to summon.*
Soupçonner, *to suspect.*
Souvenir (se), *to remember.*
Suffire (imp.), *to suffice.*
Suggérer, *to suggest.*
Supplier, *to beseech.*
Témoigner, *to show.*
Tenter, *to attempt.*
Trembler, *to tremble.*
Vanter (se), *to boast.*

Il vaut mieux **hasarder de** sauver un coupable que **de** condamner un innocent. Voltaire.	*It is better to run the risk of sparing a guilty person, than to condemn an innocent one.*
Le monde se **vante de** faire des heureux. Massillon.	*The world boasts that it can render men happy.*

§ 129.—Rule on the Construction of Verbs requiring different Prepositions.

(1.) Two or more verbs may govern the same object, provided they are all transitive, or require all the same preposition:—

Nous **aimons**, nous **instruisons**, et nous **louons** nos enfants.	*We love, we instruct, and we praise our children.*
Je **pense** et j'**écris** souvent **à** mes **amis**.	*I often think of, and write to my friends.*

These sentences are correct, because **aimer**, **instruire**, and **louer**, being all transitive verbs, admit of a direct object; and **penser** and **écrire** require both the same preposition, viz., **à**.

(2.) But when the verbs require different kinds of objects, or different prepositions, they cannot govern one and the same noun; and therefore another form must be given to the sentence. We could not say in French,—**Un grand nombre de vaisseaux entrent et sortent de ce port tous les mois,** *A great number of vessels enter and go out of this port every month*, or **J'aime et j'écris à mes enfants,** *I love and write to my children*, because **entrer** requires the preposition **dans**; **sortir**, the preposition **de**; **aimer**, no preposition; and **écrire**, the preposition **à**. We should say:—

Un grand nombre de vaisseaux entrent **dans** ce port et **en** sortent tous les mois.	*A large number of vessels enter this port and leave it every month.*
J'aime mes **enfants**, et je **leur** écris.	*I love my children and write to them.*

See § 89, (1.), (2.), also note, and § 136.

§ 130.—The Participle Past.

(1.) We have seen [§ 67, (3.)] that the participle past, not accompanied by an auxiliary, assumes the gender and number of the noun which it qualifies:—

Les inimitiés sourdes et **cachées** sont plus à craindre que les haines **ouvertes** et **déclarées**. Noël.	*Quiet and concealed enmity is more to be feared than open and declared hatred.*

(2.) The participle past, accompanied by the auxiliary **être**, agrees in gender and number with the subject of the verb, whether the subject be placed before or after it, and whether the verb is passive or intransitive. (*See* § 131, (1.)]:—

Le fer est **émoussé**; les bûchers sont **éteints**. Voltaire.	*The sword is blunted; the piles are extinguished.*
La vertu obscure est souvent **méprisée**. Massillon.	*Humble virtue is often despised.*
Ma mère est **sortie**.	*My mother is gone out.*
Mes tantes sont **arrivées**.	*My aunts have arrived.*
Leurs fils sont **devenus** grands.	*Their sons have become tall.*
Son grand-père est **mort** hier.	*His grandfather died yesterday.*
Quant il vit l'urne où étaient **renfermées** les cendres d'Hippias, il versa un torrent de larmes. Fénelon.	*When he perceived the urn in which were enclosed the ashes of Hippias, he shed a torrent of tears.*

(3.) The participle past, having **avoir** as its auxiliary, never agrees with the subject:—

Vous riez? Écrivez qu'elle **a ri**. Racine.	*You laugh? Put down that she laughed.*
Mes amis **ont parlé**; leurs cœurs sont attendris. Voltaire.	*My friends have spoken; their hearts are moved.*
Mes cousines **ont lu**. Bescherelle.	*My cousins have read.*

(4.) The participle past, having **avoir** for an auxiliary, agrees with its direct object, when the latter precedes the auxiliary:—

La lettre **que** vous avez **écrite**.	*The letter which you have written.*
Pédro, qu'as-tu fait de nos montures?—Seigneur, je **les** ai **attachées** à la grille. Le Sage.	*Pedro, what hast thou done with our horses?—My lord, I have fastened them to the grate.*
Les meilleures harangues sont celles **que** le cœur a **dictées**. Marmontel.	*The best addresses are those which the heart has dictated.*
Je **les** ai **cherchés** dans tous les coins, et je ne **les** ai pas **trouvés**. Mme. de Genlis.	*I have sought them in every corner, but have not found them.*

(5.) But, if the direct object is placed after the participle, this participle remains invariable:—

J'ai **reçu** votre **lettre**.	*I have received your letter.*
C'est la vérité elle-même qui lui a **dicté** ces belles **paroles**. Bossuet.	*It is truth itself which has dictated to him those fine words.*
Les dieux ont **attaché** presque autant de **malheurs** à la liberté, qu'à la servitude. Montesquieu.	*The gods have attached almost as many misfortunes to liberty as to servitude.*

§ 131.—Remarks on the Foregoing Rules.

(1.) Although the compound tenses of the reflective and reciprocal verbs [§ 44, (6.), § 47, (2.), § 57] take **être** as an anxiliary, the past participle of those verbs comes under the same rnles as those conjugated with **avoir**, and agrees in gender and nnmber with their direct object when it precedes the auxiliary, remaining invariable when it follows the past participle:—

Votre sœur **s'est acheté** de belles robes.	*Your sister has bought (herself) handsome dresses,* i.e., *for herself.*
Cette femme **s'est rendue** malheureuse.	*That woman has rendered herself unhappy.*
Ils **se** sont **injuriés**.	*They abused each other.*

Acheté in the first example does not vary, becanse **se**, placed before the auxiliary, is indirect object, while the direct object, **robes**, is placed after the participle. **Rendue** in the second example varies, because the word **se**, representing **femme**, is a direct object, and precedes the anxiliary. **Injuriés** in the third example agrees with **se**, the reciprocal pronoun, becanse it is direct object and precedes **sont**, the auxiliary.

(2.) The past participle of natnrally pronominal verbs *agrees with the subject:—*

La **maison** s'est **écroulée**.	*The house fell down.*

(3.) However, the naturally pronominal verb **s'arroger** is an exception; its reflective pronoun being indirect object, and this verb admitting of a direct object, its past participle agrees with the latter according to thè rules given above (1.):—

Les privilèges **que** la reine s'était **arrogés** excitaient un mécontentement général.	*The privileges that the queen had arrogated to herself caused general dissatisfaction.*
Il y avait un an que le Prince s'était **arrogé** ces **droits**.	*It was a year since the prince had arrogated those rights to himself.*

(4.) When pronominal reflective verbs, of which the second pronoun is indirect object, are accompanied by another pronoun, or by a noun used as direct object, the participle agrees with this pronoun or noun when it precedes the auxiliary, and remains invariable when the direct object follows it. See Rules (4.), (5.) of the preceding paragraph:—

Variable.	*Invariable.*
L'indiscrétion **que** nous nous sommes **reprochée**.	Nous nous sommes **reproché l'indiscretion**.
The indiscretion with which we have reproached ourselves.	*We have reproached ourselves with the indiscretion.*

(5.) The verb **avoir**, followed by a past participle placed before an infinitive, may be preceded by the object of the past participle or by that of the infinitive: in the former case, the past participle agrees with the object; in the latter, it does not:—

Voici la dame **que** vous avez **entendue** chanter.	*Here is the lady whom you heard sing.*
Voici la chanson **que** vous avez **entendu** chanter.	*Here is the song which you heard sung.*

In the first sentence, **que**, standing for **dame**, is object of **entendue**, which it governs. In the second, **que**, standing for **chanson**, is object of **chanter**, and does not govern **entendu**, which has an object nnderstood, viz.: **quelqu'un**: **Voici la chanson que vous avez entendu (quelqu'un) chanter**, *i.e., Here is the song which you heard (somebody) sing*, or *which you heard sung (by somebody)*.

To ascertain to which verb the object belongs there is only to change the order of the sentence:—

Vous avez **entendu** une **dame** chanter, la voici.	*You have heard a lady sing, here she is.*
Vous avez entendu **chanter** une **chanson**, la voici.	*You have heard (somebody) sing a song, here it is.*

or else the French sentence should be translated into English, and if then the French infinitive may be expressed in English by a past participle, the French past participle cannot agree:—

Variable.	*Invariable.*
Je **les** ai **vus** repousser les ennemis.	Je **les** ai **vu** repousser par les ennemis.
I saw them repel (repelling) the enemies.	*I saw them repelled by the enemies.*
Je **les** ai **vus** prendre la fuite.	Je **les** ai **vu** prendre sur le fait.
I saw them taking flight.	*I saw them taken in the deed.*
Je **les** ai **vus** frapper.	Je **les** ai **vu** frapper.
I saw them striking.	*I saw them struck.*
Les personnes **que** j'ai **entendues** chanter.	Les chansons **que** j'ai **entendu** chanter.
The persons whom I heard singing.	*The songs which I heard sung.*

Exception to Rule 5 above: When the verb **avoir**, followed by a past participle placed before an infinitive, is preceded by a direct object referring to a thing, and a personal pronoun referring to a person, the latter is indirect object, and the past participle does not agree:—

Chantez la chanson **que** nous **lui** avons **entendu** chanter.	*Sing the song that we have heard sung by her* (i.e., *that we have heard her sing*).

(6.) The past participle **fait**, when followed by an infinitive, the past participles **dû**, **voulu**, **pu**, when an infinitive is understood after them, do not agree:—

La maison qu'il a **fait** bâtir est belle.	*The house he has had built is beautiful.*
Il a obtenu toutes les grâces qu'il a **voulu** (obtenir).	*He has obtained all the favours he wished (to obtain).*
Il n'a pas fait tous les efforts qu'il a **pu** (faire).	*He has not used all the endeavours he could (use).*
Elle n'a pas rempli tous les devoirs qu'elle aurait **dû** (remplir).	*She has not fulfilled all the duties which she ought (to have fulfilled.)*

(7.) When, however, no infinitive is understood after **dû** and **voulu**, they agree with their object:—

On lui a accordé toutes les faveurs **qu'il** a **voulues**.	*They have granted to him all the favours he wanted.*
Il m'a payé les sommes **qu'il** m'a **dues** si longtemps.	*He has paid to me the sums he owed me so long.*

(8.) The past participles **coûté**, **valu** do not agree when used in their literal sense, bnt they do agree when used figuratively:—

La somme **que** ce cheval m'a **coûté**, il ne l'a jamais **valu**.	*The sum that this horse has cost me, he was never worth it (i.e., that horse was never worth the sum it cost me).*
Quels **avantages** cette charge vous a-t-elle **valus**?	*What advantages has this office procured to you?*
Que de **peines** elle vous a **coûtées**!	*What troubles it cost you!*

(9.) A past participle preceded and followed by **que**, or between **que** and **qui**, does not agree:—

La chimie **que** vous avez **voulu que** j'étudie.	*Chemistry which you wished me to study.*
Avez-vous reçu les estampes **que** je vous ai **informé qui** vous avaient été expédiées?	*Have you received the engravings which, as I informed you, had been forwarded to you?*

(10.) The participles past of nenter verbs, conjngated with **avoir**, and those of impersonal verbs, are always invariable:—

Que de bien n'a-t-elle pas fait, pendant le peu de jours qu'elle a **régné**! FLÉCHER.	*How much good has she not done, during the few days that she reigned!*
Les chaleurs excessives qu'il a **fait**, ont causé beaucoup de maladies. CONDILLAC.	*The excessive heat which we have had, has caused much sickness.*

(11.) A past participle having the pronoun **en** as object does not agree:—

Avez-vous mangé des fruits? **J'en** ai **mangé**.	*Have you eaten some fruits? I have eaten some.*
Tout le monde m'a offert des services, et personne ne m'**en** a **rendu**. MME. DE MAINTENON.	*Everybody tendered me services, and no person rendered me any.*

It does not agree either when, **en** being nsed with an adverb of quantity, the latter follows the anxiliary or the past participle:—

Je n'avais plus d'hameçons, mais j'**en** ai beaucoup **acheté**.	*I had no more fish-hooks, but I have bought many.*
Il n'avait plus de chevaux, mais il **en** a **acheté** plusieurs.	*He had no more horses, but he has bought several.*

(12.) The presence of **en** does not, however, prevent the past participle from agreeing—1st, When it has a direct object preceding its auxiliary :—

Cassius, naturellement fier et impérieux, ne cherchait dans la perte de César que la vengeance de quelques injures **qu'il en** avait **reçues**. VERTOT.	*Cassius, naturally proud and imperious, sought in the death of Cæsar only revenge for some injuries which he had received from him.*
Rendez grâces au ciel qui **nous en a vengés**. CORNEILLE.	*Render thanks to Heaven, which has revenged us for it.*

2ndly, When, being joined to an adverb of quantity, the latter precedes the auxiliary :—

Plus il a eu de livres, plus il **en a lus**.	*The more books he has had, the more he has read.*
Plus il a eu d'amis, moins il **en a conservés**.	*The more friends he has had, the fewer he has preserved.*

(13.) **Le peu** has in French two meanings : it signifies *a small quantity*, or *lack, absence*.

When it signifies *a small quantity*, the participle agrees with the noun which follows **le peu** :—

Le peu d'**affection** que vous lui avez **témoignée**, lui a rendu le courage.	*The little affection which you have shown him, has restored his courage.*

When **le peu** is used in the sense of *lack, absence*, the participle remains unaltered :—

Le peu d'affection que vous lui avez **témoigné**, l'a découragé.	*The lack of affection which you have shown him, has discouraged him.*

(14.) The past participles **supposé**, *supposed ;* **excepté**, *except ;* **passé**, *past ;* **compris**, *including ;* **joint, inclus**, *annexed, inclosed ;* when their auxiliary is understood, agree with the noun when it precedes them, and remain invariable when it follows them :—

Vous trouverez **ci-joint** la copie de la lettre que M. . . m'a écrite. J. J. ROUSSEAU.	*You will find annexed the copy of the letter which M. . . has written to me.*
Le dessin de cet oiseau m'a été envoyé d'Angleterre, avec la description **ci-jointe**. BUFFON.	*The drawing of that bird came to me from England with the description here annexed.*
Vous trouverez **ci-inclus**, une copie de ma lettre. DOMERGUES.	*You will find inclosed, a copy of my letter.*
Je vous recommande les cinq lettres **ci-incluses**. BERNARDIN DE ST. PIERRE.	*I recommend to you the five letters inclosed.*

§ 132.—THE ADVERB.—RULES.—PLACE OF THE ADVERB.

(1.) In French the adverb used to modify a verb in a simple tense is generally placed after the verb :—

Que de gens prennent **hardiment** le masque de la vertu ! SCUDÉRI.	*How many people assume boldly the mask of virtue !*

(2.) Adverbs of place, and those used in interrogations, have the same place in French as in English :—

Où est votre frère ? Il est **ici**.	*Where is your brother ? He is here.*

(3.) In compound tenses the adverb is placed between the auxiliary and the participle :—

Vous avez **mal** fait.	*You have done wrong.*
Il nous a **bien** reçus.	*He received us well.*

(4.) Adverbs of manner ending in *ment*, may, in compound tenses, be placed before the participle, or after it when they are very long, or followed by other modifying words. When, however, they are followed by such words, it is better to introduce the clause or sentence by the adverb :—

Cela est **heureusement** exprimé. Cela est exprimé **heureusement**.	*That is happily expressed.*
Heureusement il est venu à temps.	*He came fortunately in time.*

(5.) The adverbs **aujourd'hui**, *to-day ;* **demain**, *to-morrow ;* **hier**, *yesterday*, may be placed before or after the verb, but never between the auxiliary and the participle. The adverb **davantage**, *more*, follows the participle :

Nous sommes arrivés **aujourd'hui**.	*We arrived to-day.*
Votre frère s'est blessé **hier**.	*Your brother hurt himself yesterday.*
Aujourd'hui il fait beau temps ; **demain** il pleuvra. GIRAULT DUVIVIER.	*To-day it is fine weather ; to-morrow it will rain.*

LESSONS IN GEOLOGY.—XXIV.

THE CRETACEOUS SYSTEM.

THE white cliffs of old England, bounding the coasts of the south-east corner of our island, give an indication as to the locality occupied by the cretaceous system. The chalk deposit being the chief characteristic of the system, gives its name (*creta*, chalk) to the whole, although, as may be supposed, there are many strata which have not the well-known appearance of that material.

The members of the cretaceous system are thus classified:—

UPPER CRETACEOUS.

1. Maestricht beds and Faxoe limestones.
2. White chalk with flints.
3. Grey chalk.
4. Upper Greensand.
5. Gault.

LOWER CRETACEOUS OR NEOCOMIAN.

1. Lower Greensand.
2. Wealden beds { 1. Weald clay. 2. Hastings sand.

THE WEALD.

Although the lowest member of the cretaceous group cannot boast of occupying a large area, yet it balances the insignificance of its size by the interest of its associations. The name by which those portions of Kent, Surrey, and Sussex, where its beds are deposited, are known—the *Wolds* or *Wealds*—has been adopted by geologists to designate the formation. Probably its beds pass under the Channel, for we find the opposite shore of the Straits of Dover exhibiting, in the neighbourhood of Boulogne, the same geological conformation. They also appear in the southern half of the Isle of Wight. The coast line occupied by the Weald extends from Dover to Beachy Head. The wealden deposit owes its interest to the fact that it is of *fresh*-water origin. We find no ammonites, no echinites, no corals, not a shell which tells us of the presence of the sea. But the Paludinæ, the Melaniæ, the bones of terrestrial animals, and the fossils of land plants, all declare that the weald owes its existence to some great river which brought down mud from the continent it drained, depositing a delta. A change took place in the level of the land ; the region of the weald, and all the south-east corner of England with a portion of France, became covered with the waters of the cretaceous sea. Ages then passed away, the elevation of the area returned, the sea became dry land, the waters gathering themselves together in other hollows. At this period the chalk beds completely covered the wealden deposits, and we never should have suspected their existence had not the chalk been removed and these underlying beds exposed. That our knowledge of the existence of the weald depends upon the denudation of the chalk is clearly proved by an examination of the localities where the weald clay meets the chalk, and there the clay is seen invariably to pass beneath the chalk, and the chalk does not "thin out," but terminates abruptly, forming what evidently was once a steep escarpment, but which, in the lapse of ages, has had its angles worn round, and now appears as a steep hill.

The *denudation of the Weald* has been explained in various ways. Scrope, Martin, and Hopkins ascribe it to volcanic agency variously exhibited—the débris being washed away by currents. Professor Jukes and Professor Ramsay expressed opinions that in the wearing away of the chalk, atmospheric agency—that is, the action of rain and rivers—played at least some part ; whilst Sir Charles Lyell depends on "the marine theory" for its explanation, believing that the sea broke in, owing to the depression of the land, and carried away the overlying chalk, exposing the wealden beds beneath. This explanation was the one generally received until Messrs. Foster and Topley produced facts so at variance with it that it must be abandoned :—(1.) If the sea had worn away the chalk, and

formed the escarpments which bound the weald, it is evident that the foot of the chalk escarpment, as well as that of the lower greensand, ought to be of the same level; this, however, is not the case. (2.) The escarpments follow the *strike* of the beds, always changing their directions as the strike changes. Now if the sea had beaten against the cliffs, it would not have worn them away in one direction only, but would have cut through the formation regardless of the strike. (3.) At the foot of all sea-formed escarpments there must necessarily be a beach, an accumulation of rounded pebbles caused by the action of the waves rolling the detached pieces of the rock against each other, but nothing of the kind has ever been discovered at the edge of the weald; and (4) if the country were at present submerged so as to allow the sea again to cover the weald, there would be such an arrangement of channels and islands as would preclude the possibility of the formation of escarpments. There is no doubt that the weald has been denuded by the simple action of rain and rivers; for in the valley of the Medway river gravel is found at all levels. Without hesitation any one would say that the Aylesford gravel was the former bed of the river now forty feet below; but similar gravel, containing similar fossils, and placed by water flowing in the same direction, is found here and there on the hill-sides, until we are constrained to admit that the Medway once flowed 300 feet above its present level, and the river must have excavated a valley some seven miles wide and 300 feet deep. If this can be distinctly proved in the case of the basin of the Medway, we may fairly conclude that the rest of the wealden area has been denuded by the same means.

The *Hastings Sand* is the lower division of the weald. Notwithstanding its name, the division contains more argillaceous strata than arenaceous: the whole attain a thickness of some 750 feet. The "High rocks," and the steep cliffs which give such picturesqueness to the scenery in the neighbourhood of Tunbridge, belong to the Hastings sand. The remains of reptiles, chiefly saurians, are not uncommon in this deposit. The pterodactyl is here found, so also are many remains of chelonians.

The shells are of fresh-water origin, belonging to the genera *Melanopsis, Melania, Paludina, Cyrena, Cyclas, Unio.*

The *Weald clay*, upon which the Lower Greensand rests, has the same mineral composition. This may be accounted for upon the supposition that when the sea covered the delta of the river which deposited the Wealden beds, the river was still flowing and still carrying down the mud which formed the clay. Now the same material from salt water gives rise to the Lower Greensand. Occasionally bands of a limestone which is called "Sussex marble" occur in the clay. This stone is almost wholly composed of a species of *Paludina*. Shells of the crustacean, the *Cypris*, are plentiful in the clay.

The *Lower Greensand* takes its name from the fact that sometimes it contains green grains of the silicate of iron; occasionally they are so numerous as to impart a greenish tint to the rock; but the term "green" as a description is inapplicable. The general colour is dark brown, the sand being often bound together by an abundance of oxide of iron, so much so, indeed, that formerly the formation was known as "iron-sand." The fossils it contains are marine, the most prominent being *Perna Mulleti* (Fig. 123), *a* being part of the upper hinge; *Ancyloceras gigas* (Fig. 124); *Nautilus plicatus* (Fig. 125); *Trigonia caudata* (Fig. 126); *Diceras Lonsdallii* (Fig. 127, *a*, *b*).

The ancyloceras seems to be an ammonite more or less uncurled. The Lower Cretaceous is sometimes called Neocomian, because the formation is well developed near Neufchatel, the *Neocomum* of the Romans.

THE UPPER CRETACEOUS.

The Gault.—Although the Lower Greensand is sometimes only separated from the upper by a thin bed of clay, yet a plain line of demarcation runs between them, as may be gathered from the fact that only eighteen per cent. of the fossils of the one are to be found in the other, a fact which indicates a vast lapse of time between their respective depositions. The Gault is a dark-grey, blue, or brown clay, so stiff that it is used for brickmaking, as is the case at Cambridge and Folkestone. The fossils of the Gault are admirably preserved, and so definite as to enable the deposit to be traced in many parts of Europe.

The *Upper Greensand* bears a strong lithological likeness to the Lower Greensand. Beds and concretionary masses occur in it, and are called in Surrey *firestones*. The greensand is usually looked upon as the littoral deposit of the cretaceous sea. In the greensand at Cambridge, a bird about the size of a woodcock has been found, which is introduced into our sketch of a scene of the period.

Chalk.—We now enter the distinctive deposit of the epoch. In England the chalk deposit reaches a thickness of 1,000 feet. The upper beds contain flints, then follows a great mass of white chalk without flints, and under this is chalk marl, which is chalk with an admixture of argillaceous matter.

IDEAL FLORA AND FAUNA OF UPPER CRETACEOUS PERIOD.

1. Equisetum. 2. Ichthyosaurus. 3. Plesiosaurus. 4. Bird from Greendsand. 5. Pterodactyle. 6. Pinus. 7. Cycadeæ. 8. Turtles.

Chalk is pure carbonate of lime, usually white, though it may be found grey and even red. The area in which it appears stretches from Ireland to the Crimea, a distance of 1,140 miles, and extends in breadth from Sweden to Bordeaux, 840 miles; and throughout this vast deposit, it retains its homogeneous composition—carbonate of lime and nothing else. Even this fact alone would make us look at the chalk suspiciously as a sedimentary deposit; and when we consider the circumstances under which carbonate of lime is held in solution in water, and how it may be precipitated, our suspicions are confirmed. We must seek for other causes to account for the existence of chalk than the ordinary deposition from water which held it mechanically suspended.

Water has no solvent power on carbonate of lime, unless it be charged with carbonic acid gas. The water of the sea, as all water exposed to the atmosphere, contains this gas, and hence it is capable of holding a little chalk in solution. This chalk could only be deposited if the gas were driven out of the water, which might be done either by raising the water to a temperature approaching its boiling point, or by evaporating the water away: to neither of these conditions could the water of the sea ever have been submitted. It may be asked, could not the carbonate of lime have been mechanically suspended in the sea, as we see it is at the foot of the chalk cliffs? The answer to this is, that the sea never has sufficient chalk in it to use up all the carbonic acid gas in its water. There is always present in the sea-water such a quantity of gas that all the chalk brought down by a river, or eroded by the waves washing a chalk-bound coast, might easily be rendered soluble; and unless we have some very convincing evidence that things in the cretaceous epoch were not as they are now, we have no right to imagine that the constitution of the atmosphere and of the sea was at all different in those distant times. Moreover, there are at present agencies at work which are quite capable, time being granted—and Nature never is restricted to time to complete her works—to construct masses of chalk of any size. We find all the shell-fish, and many other of the inhabitants of the ocean world, endowed with a power of secreting the lime held in solution in the sea-water, in order to build for themselves protective coverings. In the Southern seas the coral polype has built up enormous reefs of limestone, some of which edge the Australian continent for more than 1,000 miles! Islands innumerable stud the Pacific Ocean which almost all owe their existence to the indefatigable little workers, who for ages untold have taken from the very waves which seemed to threaten them with a furious destruction the limy material wherewith to build their habitations. Each generation added to the work of their fathers, thus raising from the watery depths a wall of rock. The aggregate efforts of the nation of the coral polypes has produced a mass of limestone well deserving of a place in the geological system were it but embedded in the crust of the earth. But although from the coral fossils found in the chalk we may conclude that those deposits partly owe their existence to the coral polype, yet other workers shared in the construction. By carefully pulverising a piece of chalk, and allowing the grains to settle after throwing them into water, upon examining them under the microscope it will be discovered that most of the grains are either perfect shells or parts of shells. They belong to the family of the Rhizopods or radiate animals, for they have long filaments issuing from their shells which have the appearance of *roots;* hence their name, *radix* (a root). They are also known as *Foraminifera*, because the shells, to allow the passage of the roots, are perforated with holes (*foramen*, a hole). The shells of these minute creatures form the great bulk of our chalk rocks. To confirm this fact, and make the organic origin of chalk beyond dispute, by deep-sea dredging vast areas have been discovered in the Atlantic Ocean where the ocean floor is covered with calcareous mud. The microscope reveals that this mud is composed of living foraminifera, who are hourly engaged in secreting the lime from the water and forming their shells. Here then we have the chalk beds in course of construction; and in after ages, if the world should still exist in its present form, and the bottom of the Atlantic become dry land, there will be a bed of chalk, unmixed with sand or pebbles or any other débris, and without fossils of terrestrial plants or animals; but probably the discovery of ashes thrown overboard by our steamers, and now and then some article of ship-craft, will be a sore puzzle to the geologists of that distant day, unless they have the benefit of our experience.

Flints are generally found arranged in layers, at a distance of two or three feet from each other. In all probability they owe their existence to a similar cause as the chalk in which they are embedded. All the creatures working at the bottom of the ocean do not secrete lime; many of them are clad in siliceous shells. We can well suppose that for some reason or other the quantity of lime held in solution in the water decreased, and in its place there was a superabundance of silica. This would cause the lime-secreting foraminifera to die out, and the animals requiring a siliceous shell would occupy the area under circumstances advantageous to their existence.

The fact that very frequently at the centre of a flint nodule is found a fossil, is accounted for by Mr. Dana, by supposing that when the microscopic organisms decomposed, the alkaline water of the sea would be able to take up a little of their silica, and the rest would then have an opportunity of aggregating round any foreign body, thus forming a concretionary nodule. There are, however, some facts connected with chalk flints which yet wait for explanation.

Among the fossils found in the chalk, every one who has hunted in a lime-pit knows that the *Echinoderms* are the most numerous. The spines are cleared off, and the plated shell remains. The *Ananchytes* is a genus peculiar to the cretacean period (Fig. 128, *a*, *b*). Other prominent fossils are *Scaphites æqualis* (Fig. 129), *Turrilites costatus* (Fig. 130), *Rhynconella octoplicata* (Fig. 131), *Terebratula biplicata* (Fig. 132), *Lima spinosa* (Fig. 133), *Ostrea carinata* (Fig. 134).

FOSSILS OF THE WEALD.

Plants.—Chara Valdensis; Endogenites erosa; Equisetites Lyellii; Sphenopteris gracilis.
Conchifera.—Corbula alata; Cyrenaangulata, major; Mytilus Lyellii; Unio aduncus, compressus.
Gasteropoda.—Actæon Popii; Bulla Mantelliana; Cerithium carbonarium; Melanopsis attenuata; Paludina elongata, fluviorum.
Crustacea.—Cypridea tuberculata, spinigera; Estheria elliptica.
Fish.—Acrodus Hirudo; Æchmodus mastodonteus; Asteracanthus granulosus; Hybodus dubius, subcarinatus; Pycnodus Mantelli.
Reptiles.—Chelone Mantelli; Iguanodon Mantelli; Pterodactylus Cliftii.

FOSSILS CHARACTERISTIC OF THE LOWER GREENSAND.

Plants.—Abietites Benstedi; Zamiostrobus Sussexiensis.
Sponges.—Conis coutortoplicata.
Corals.—Holocystis elegans, Siphodictyum gracile.
Brachiopoda.—Discina lævigata; Lingula truncata; Rhynconella depressa, elegaus; Terebratula celtica, oblonga.
Conchifera.—Avicula depressa; Gervillia anceps; Lima lingua; Ostræa retusa; Astarte obovata; Cardium imbricatorium; Cyprina angulata; Corbula striatula; Cucullæa costellata; Cypricardia undulata; Cyprina angulata; Lithodomus oblongus; Modiola æqualis; Mytilus cuneatus; Nucula obtusa; Pholadomya gigantea; Trigouia caudata, ornata.
Gasteropoda.—Actæon marginatus; Cerithium attenuatum; Littorina conica; Natica lævigata; Pleurotomaria gigantea; Turbo munitus.
Cephalopoda.—Ammonites furcatus, Martini; Ancyloceras gigas, grande; Nautilus plicatus.
Echinodermata.—Cardiaster Beustedi.
Fish.—Strophodus sulcatus.

FOSSILS CHARACTERISTIC OF THE GAULT.

Foraminifera.—Cristellaria obsoleta; Dentalina legumen.
Corals.—Bathycyathus Sowerbyi.
Brachiopoda.—Rhynconella sulcata; Terebratula obtusa.
Conchifera.—Inoceramus sulcatus; Mytilus Galliennei; Nucula ornatissima; Pholas constricta.
Gasteropoda.—Actæon affinis; Cerithium trimouilc; Natica gaultina; Pleurotomaria Gibbsii; Rostellaria elongata, cariuata.
Cephalopoda.—Ammonites biplicatus, circularis, crenatus, etc.; Ancyloceras spiuigerum; Belemnites attenuatus; Hamites compressus; Turrilites catenatus, etc.
Echinodermata.—Cardiaster bisulcatus; Hemiaster asterias.

CHARACTERISTIC FOSSILS OF THE UPPER GREENSAND.

Plants.—Chondrites fastigatus.
Brachiopoda.—Lingula subovalis; Rhynconella Grasiana; Terebratula ovata.
Conchifera.—Avicula gryphæoides; Gryphæa vesiculosa; Lima ornata; Pecten elongatus, asper; Cyprina globosa; Trigonia Archiaci.
Gasteropoda.—Natica gentii; Pleurotomaria Rhodani.
Echinodermata.—Auanchytes lævis; Cardiaster fossarius; Cidaris insignis; Echinus inflatus, granulosus.

CHARACTERISTIC FOSSILS OF THE LOWER CHALK.

Foraminifera.—Dentalina Lorneiaua; Globigerina cretacea; Texularia trochus.
Brachiopoda.—Rhynconella Cuvieri; Terebratella incerta; Terebratula albensis, rugulosa, etc.
Conchifera.—Inoceramus latus, striatus; Lima aspera; Ostrea virgata; Arca subacuta; Pholadomya decussata.
Gasteropoda.—Actæon elongatus; Avellana cassis; Natica Dupinii; Turbo gemmatus.
Cephalopoda.—Ammonites cinctus, falcatus, navicularis; Hamites simplex; Nautilus elegans; Scaphites æqualis; Turrilites costatus.
Echinodermata.—Ananchytus planus; Cidaris dissimilis; Discoidea cylindrica; Goniaster latus.
Reptiles.—Chelone Benstedi; Ichthyosaurus campylodon; Plesiosaurus constrictus; Pterodactylus giganteus.

CHARACTERISTIC FOSSILS OF THE UPPER CHALK.

Plants.—Confervites fasciculata.
Amorphozoa.—Spongia ramosa; Ventriculites alternans, flexuosus.
Polyzoa.—Actinopora Brongniarti; Alecto ramea; Eschara cancellata; Flustra tessallata; Tubulipora; Vincularia.
Brachiopoda.—Crania costata; Rhynconella octoplicata; Terebratula carnea.
Conchifera.—Inoceramus annulatus; Ostrea curvirostris, triangularis; Pecten virgatus; Pinna decussata; Modiola quadrata; Teredo rotundus.
Echinodermata—Cardiaster excentricus; Cidaris vesiculosa; Goniaster angustatus; Marsupites lævigatus; Ophiura serrata: Oriaster bulbiferus.

LESSONS IN SPANISH.—XVII.

THE ARTICLE.

THE definite article is to be used before all common nouns taken in a general sense, and in the whole extent of their signification; as—

El ódio levauta rencillas,	*Hatred excites strife.*
La caridad es paciente,	*Charity is patient.*
Los hombres son mortales,	*Men are mortal.*

If the noun be not taken in a general sense, the article is not used; as—

Hace buen tiempo,	*It is good weather.*
Tiene envídia,	*He has envy.*

The definite article is used before proper names of countries, states, and days of the week; as—

La Fráncia es un hermoso pais,	*France is a beautiful country.*
Juan volverá el Mártes,	*John will return on Tuesday.*

The definite article is to be used before numerals indicating the day of the month or the hour of the day; as—

El seis de Enero,	*The sixth (six) of January.*
Á las tres de la tarde,	*At three o'clock in(of) the afternoon.*

The definite article is used before nouns indicating the rank, office, profession, or titles of persons when they are spoken of (but not when they are addressed); as—

El General Brown es valiente,	*General Brown is brave.*
La Señora Tranor no es prudente,	*Mrs. Tranor is not prudent.*

The definite article (and not the indefinite, as in English) is used before nouns signifying a certain weight, measure, size, quantity, or number, when preceded by the price, and to specify time; as—

Á tres duros la libra, — *At three dollars a (the) pound.*
Á dos pesos la vara, — *At two dollars a (the) yard.*
A razon de diez duros el mes, — *At (the) rate of ten dollars a (the) month.*

Instead of the definite article, the preposition *por* may be used after the price; thus we can say, á tres duros la libra, *at three dollars the pound;* or, á tres duros por libra, *at three dollars per pound.*

The definite article is not used before a noun which denotes relationship or kindred of another noun, when a verb comes between them; as—

María es hermana de Juana, — *Mary is the sister of Jane.*
Pablo es hijo del juez, — *Paul is the son of the judge.*

The definite article is not used before proper names nor before nouns in apposition, when not employed in a definite or determinative sense; as—

Pablo, apóstol de los Gentiles, — *Paul, the apostle of the Gentiles.*
Ellos pecaron al Señor, esperanza de sus padres, — *They sinned against the Lord, the hope of their fathers.*

The definite article is not used before numerical adjectives when they denote order or succession; as—

Tomo segundo, página sexto, — *Volume the second, page the sixth.*
Enrique octavo, — *Henry the Eighth.*

The cardinal numbers (and not the ordinal) are generally used when the number expressing the order or succession exceeds nine; thus, Cárlos doce, *Charles the Twelfth* (literally, *Charles Twelve*), and not Cárlos duodécimo; tomo trece, *volume thirteen*, and not tomo décimotercio, *volume thirteenth.*

The titles of books, essays, chapters, or extracts, and the names of periodicals, do not generally take the definite article before them (except when spoken of); as—

História de España, — *The History of Spain.*
Gaceta de Lóndres, — *The London Gazette.*

The indefinite article is not generally used when some portion of a thing only is meant, and when the adverb *no* is used in the sense of *not a* (that is, *not any*), or *no*; as—

Tiene calentura, — *He has a fever.*
Ella tiene idéa de comer, — *She has an idea of eating (to eat).*
Juan hace ruido, — *John makes a noise.*

The indefinite article is not used before two nouns, one of which, being connected by a verb to the other, shows the nation, relationship, rank, office, profession, or vocation of the latter; as—

Juan es Frances, — *John is a Frenchman.*
Cárlos es impresor, — *Charles is a printer.*
Halló en él padre y madre, — *He found in him a father and a mother.*

The indefinite article is not used before a noun in apposition with another; as—

Estéban, hombre lleno de fé, — *Stephen, a man full of faith.*

The indefinite article is not used in the title of a book, chapter, or essay; as—

Coleccion de los mejores Autores Españoles, — *A selection of the best Spanish authors.*

The indefinite article is not used before a noun in an ejaculatory phrase; as—

¡Que idea! ¡Que desgrácia! — *What an idea! what a misfortune!*

The indefinite article is not used between an adjective and its noun; as—

Médio peso, *half a dollar.*
En tal tiempo, *in such a time.*
Tan hermosa hija, *so beautiful a daughter.*

The indefinite article is not used before the words médio, *a half;* cien or ciento, *a hundred;* and mil, *a thousand;* as—

Cien hombres, *a hundred men.*
Dia y médio, *a day and a half.*

The indefinite article is not used after algo, *something*, or nada, *nothing*, followed by the preposition *de;* as—

Pedro tiene algo de poeta, — *Peter is something of a poet.*

The indefinite article can be used before (but not after) tal, *such;* as—

Tenemos un tal Pontífice, — *We have such a High Priest.*

The infinitive mood, being used in Spanish as a noun with a preposition before it, in the same manner that the present participle is in English, can take the masculine definite article before it; as—

El murmurar de las fuentes, — *The murmuring of the fountains.*
Al ver el árbol, — *On seeing the tree.*

The definite article is used before the adverbs mas, *more*, and ménos, *less*, to express the superlative degree of comparison; as—

María es la mas hermosa de las mugeres, — *Mary is the most beautiful of the women.*

The article is generally to be repeated before nouns which immediately follow each other, especially if they do not agree in gender; as—

La prudencia y el valor del rey, — *The prudence and the valour of the king.*

The learner will find many exceptions to the above rule in the best Spanish writers. The article must always be repeated in such cases when each noun is designed to be emphatic. When the word todo, *all*, sums up the several nouns, the article is not generally used before any of the nouns; as—

Españoles, Franceses, Ingleses, y Americanos, todos son mortales, — *Spaniards, Frenchmen, Englishmen, and Americans, all are mortal.*

The article is omitted in Spanish, as in English, before nouns taken in a partitive sense; as—

El carpintero tiene dinero, — *The carpenter has money.*

THE NOUN.

AUGMENTATIVES, DIMINUTIVES, AND COMMON TITLES OF RESPECT.

Augmentative nouns are such as are increased, in the extent of their signification, by the terminations *on, ona, azo, aza, ote;* thus the words daga, *dagger;* cuchara, *spoon;* fraile, *friar;* gato, *cat;* manga, *sleeve;* muger, *woman;* frente, *forehead*, can be rendered augmentative; as dagon, *large dagger;* cucharon, *large spoon*, i.e., *a ladle;* frailon, *fat friar;* gatazo, *large cat;* mangote, *large sleeve;* mujerona, *stout woman;* frentaza, *broad forehead.*

Diminutive nouns are such as are decreased, in the signification of their primitives, by the terminations *ico, ica, ejo, eja, ito, ita, eto, eta, illo, illa, uelo, uela;* thus, fraile, *friar;* capilla, *chapel;* cuchara, *spoon;* batel, *boat*, can be rendered diminutive; as, frailecico, frailecito, frailezuelo, *a little friar;* capilleja, capillita, capilleta, *small chapel;* cucharica, cucharita, cuchareta, cucharillo, *small spoon;* batelico, batelejo, batelito, batelillo, *little boat.* The terminations *uelo* generally, and *illo* also sometimes, express contempt; as hombre, *man;* hombrezuelo or hombrecillo, *an insignificant or contemptible little fellow.*

Adjectives are also frequently found used in a diminutive sense; as, poco, *little;* poquillo, poquitico, poquito, *very little.*

There is also a kind of nouns composed of the name of some instrument or object and one of the terminations *azo, aza, ada*, the compound word including in its meaning both the instrument and some effect produced by it; as, dardo, *a dart;* dardada, *a blow given with a dart;* cuchara, *a spoon;* cucharazo, *a blow with a spoon;* pluma, *a pen;* plumada, *a dash or stroke with a pen;* mano, *the hand;* manotazo or manotado, *a blow with the hand;* aldaba, *a knocker;* aldabada, *a rap with the knocker;* and aldabazo, *a violent rap with the knocker.*

When a noun with a singular termination denotes several persons or things, it is called a *collective* noun, or noun of multitude; as turba, *a crowd;* vacada, *a drove of cows.*

The ordinary titles of respect, corresponding to Mr. or Esq. in English, are in Spanish *Señor* and *Don;* and those corresponding to Madam and Mrs. are *Señora* and *Doña;* and Miss, *Señorita. Don* and *Doña* never take the article before them, and can be used before Christian names only. *Señor* and *Don* are often used together before the Christian name. A few examples will show the manner in which these words are used:—

El Señor Blake es Americano, *Mr. Blake is an American.*
Don Diego Ticknor, me alegro mucho de verle, *Mr. James Ticknor, I am very glad to see you.*
El Señor Ray; La Señora Ray, *Mr. Ray; Mrs. Ray.*
La Señorita Mason, *Miss Mason.*
Al Señor Don Diego Harper, *to James Harper, Esq.*
Los Señores Don Juan Millon y Don Pablo Surret, *Messrs. John Millon and Paul Surret.*
Da una silla á Doña Sarah Ray, *give a chair to Mrs. Sarah Ray.*

The article is never used before these titles, except when the persons are spoken of; of course, when persons are addressed, the proper title only is used; as—

Buenas tardes tenga vmd., Señorita Wilson, — *I wish you a good evening, Mrs. Wilson.*

Señor, señora, señorita, señores, señoras, señoritas, also are used for *sir*, *madam*, *miss*, *gentlemen*, *ladies*, *young ladies*, respectively: as—

Buenos dias, señor, *good morning, sir.*	Buenas noches, señores, *good night, gentlemen.*

Señor and *Señora* are used as an additional mark of respect before the name of a relative in such cases as the following:—

¿ Cómo está su señor hermano ? *how is your brother?*	¿ Cómo está su señora madre ? *how is your mother?*

HUMAN PHYSIOLOGY.—VIII.

CIRCULATION (*continued*).

THE arteries are distributed to all parts of the body; the only portions which are destitute of them are the hair, the nails, the outer covering of the skin, and the cartilages. They divide and subdivide, the branches freely communicating with each other, till they become diminished to a very small size, and at length they terminate in a very delicate network of vessels, which, from their great minuteness, are termed capillaries (or hairs). The great artery of the body, called the aorta, starts from the left ventricle of the heart, and first ascends, and makes a kind of arch; it then descends, passing downwards through the thorax and abdomen, at the lower part of which it divides into two. From the arch of the aorta are given off large branches —the innominate artery, which divides into the right common carotid, and the right subclavian. The common carotid ascends the side of the neck, and divides into the external and internal carotids. From the first of these numerous branches arise, which are distributed to the external parts of the neck, the head, and the face; the internal carotid passes up into the skull, and is the principal channel for the blood going to the brain. The subclavian gives off a large branch, the vertebral, which enters the skull through the occipital foramen, and completes the blood-supply for the cerebral organs; it then gives off branches to the shoulder and external parts of the chest, and terminates in a large trunk called the axillary, which afterwards, taking the name of brachial, passes down the arm to the bend of the elbow, where it divides into the radial and ulnar arteries, which supply the fore-arm and hand. The left common carotid and subclavian arise directly from the aorta, without the intervention of an innominate artery. From the descending trunk of the aorta branches spring which supply all the viscera and the muscular walls of the thorax and abdomen, and eventually the aorta splits into two halves, called the right and left common iliacs; these each again divide into external and internal iliacs, the latter of which is distributed to the pelvic organs, whilst the former, taking the name of the femoral, at its exit from the abdomen, passes down the front of the thigh, giving off branches to the muscles in that neighbourhood; two-thirds down it pierces the muscles, and appears at the back just above the bend of the knee, there called the popliteal. Soon after it enters the leg, it divides into two, an anterior and posterior tibial, which supply the leg and foot. This is the general arterial circulation of the body; but in addition to this must be mentioned the pulmonary artery, which springs from the right ventricle, and immediately divides into a right and left pulmonary artery; these convey the blood to the corresponding lungs, in the substance of which they break up into a dense network of capillaries, which will be more particularly described when we come to speak of the structure of the lungs.

The capillaries, or intermediate vessels in which the finest branches of the arteries terminate, are extremely minute, their average diameter being about $\frac{1}{3000}$ of an inch: they vary somewhat in size; those of the brain and the intestines are the smallest. These vessels form a dense network all through the body, their number and the closeness of the network being proportionate to the activity of the tissue they have to supply with blood; the walls of the capillaries are composed of a fine transparent membrane, containing cells interspersed at intervals, and offering little obstruction to the process of absorption. There is no definite line to mark where vessels cease to be arteries and become capillaries, or where the veins commence; but the intermediate vessels have this peculiarity, that when once they have attained a certain degree of minuteness, they retain it, and do not continue to diminish, and the meshes of the capillary network are more even and uniform than those formed by the smaller branches of the arteries or the commencing radicles of the veins. The veins take their rise from the capillary network, first as very small vessels, and gradually join together, forming larger and larger trunks, till they are all eventually merged in two, which have been already mentioned, the superior and inferior cavæ. The veins are larger and more numerous than the arteries, and convey back to the heart the blood which has exhausted its nutritive properties. In structure their walls resemble those of the arteries, but have very little elastic tissue in them; in shape they are not so completely cylindrical as the arteries, and when empty their walls collapse: they also have another important point of difference from the artery, in that there are valves placed in all the larger veins that are subject to much pressure. These valves, which are semi-lunar in shape, and generally occur in pairs, are so arranged as to allow the blood to pass onwards towards the heart, but prevent any backward movement of the current. Veins may be divided into superficial, deep, and sinuses. The superficial lie immediately beneath the skin, and communicate with the deep ones. The deep veins accompany the arteries, and are usually inclosed in the same fibrous sheath; to the larger arteries, such as the femoral or the subclavian, there is but one vein to each artery; but in the smaller ones, as the radial or ulnar, there are a pair, one lying on each side of the artery. In the brain, and some other parts of the body, the arteries and veins take different courses, and do not accompany each other. The venous sinuses only exist in the interior of the skull; they are large channels, formed between the layers of the dura mater, which collect the venous blood from the substance of the brain and discharge it into the internal jugular veins.

Having now examined the blood, and the apparatus by which it is circulated, we pass on to consider the act of circulation itself, and we may take as a starting-point the left ventricle of the heart. When this chamber is filled with blood, it contracts and forces the blood into the aorta; this conveys it, by means of its many branches, to all parts of the body. When the blood has reached the extreme divisions of the arterial system, it leaves them and enters the capillary network; from thence it makes its way to the ultimate radicles of the veins, which carry it forward and empty it into the superior or inferior cava; these at their termination empty it into the right auricle of the heart; the auricle, when it is filled, contracts and drives the blood into the right ventricle, which in its turn pumps it into the pulmonary artery; this vessel, dividing into two, conveys it to the lungs; here, whilst passing through the capillary network, it is exposed to the action of the air; leaving the lung, it is conveyed by the pulmonary veins and discharged into the left auricle, which contracting, drives it once more into the left ventricle, to commence again the same unceasing round.

In addition to the general circulation of the body, there is a minor one of the liver, called the portal circulation. This has been before alluded to in the article on Digestion. The veins which collect the blood from the viscera of digestion join together to form a large trunk, called the portal vein; this vessel enters the substance of the liver at its under surface, and divides like an artery into a capillary network, thus bringing the blood it conveys into intimate relation with the secreting cells of the liver. This network terminates in a number of moderate-sized veins called the hepatic veins, which unite into three large branches, and finally empty themselves into the inferior vena cava.

We must now consider the part which each constituent of the circulatory apparatus plays in the performance of this function; and first in importance is, of course, the heart. In order to understand the way in which the heart fulfils its duties, we must constantly bear in mind that the heart is a muscular organ, split up into four distinct chambers, and richly supplied with nerve power. The action of the heart is made up of two sets of motions, the dilatation and contraction alternately of the auricles and ventricles: the auricles contract together in alternation with the contraction of the ventricles, which is also simultaneous; the dilatations follow the same rule, and the contraction of the auricles takes place at the same moment that the ventricles are dilating, and *vice versâ*. The interval between the two sets of movements is, of course, very short, but is easily made out when the heart is acting quietly. During the contraction of the ventricles the apex of the heart is drawn upwards and tilted forwards, striking the parieties of the chest, thus giving that sensation which is described as the beat of the heart, and which in a healthy state is usually felt between the fifth and sixth ribs. When the action of the heart is examined by the ear, two sounds are heard. The first is dull and prolonged; its commencement coincides with the impulse of the heart, and just precedes the pulse at the wrist; the second is a shorter, sharper sound, which follows the pulse. The cause of the first of these sounds is still very uncertain; it coincides in point of time with the contraction of the ventricles, and is probably partly caused by the noise or bruit produced by the contraction of muscular fibre. The second sound is held to be occasioned by the sudden tightening of the valves when they are pressed across the orifices of the aorta and pulmonary artery. The contraction of the auricles is a much more rapid and less complete process than that of the ventricles; the auricles are probably never completely emptied; but the ventricles contract so firmly, that in some cases, where the heart has been examined after death, their cavities have been found completely obliterated, only a slight fissure marking their existence. The heart, then, by its contraction propels the blood, and the amount of force thus generated is sufficient to carry the blood through the complete circle. This force has been estimated to be equal to a pressure of six pounds to the square inch; and taking the area of the heart at ten inches, this would give a propelling force of sixty pounds. The left ventricle, as would be supposed, from the much greater thickness of its walls, contracts with a force nearly double that of the right.

The time required for the blood to traverse the circulatory system is very brief, the average probably being about a minute, though in some experiments made by injecting substances into the vein of an animal, the circuit was completed in a much shorter time. By the contraction of the several cavities of the heart the blood is forced along its proper course; but as these contractions are intermittent, and alternate with each other, there would be a constant reflux of the blood into the cavity it had left, but for the interposition of those valves which have been before described. Those which shut off the communication between the auricles and ventricles are the most important, and may be taken as types of the rest. In speaking of them, it was said that their under-surfaces are connected by strings, the chordæ tendinæ, with the summits of the projecting masses of muscular fibre, the columnæ carneæ. When the ventricles contract upon their contents, the blood presses up the flaps of the valves, and so mechanically closes the auricular opening; but this is not all, for just in proportion to the amount of pressure made by the blood upon the under-surface of the valves is the action excited in these little muscular columns, which at once contract and draw the valves tighter and tighter, and close more perfectly the opening, and so prevent the reflux of the blood; this is, therefore, a most perfect floodgate—not simply a mechanical contrivance, but a vital organ, developed just sufficiently to perform the necessary work.

LESSONS IN ENGLISH LITERATURE.—XVIII.

MILTON.

NOTHING can be more complete than the change which the Restoration wrought in the position and prospects of Milton. Up to that time, whatever his personal calamities, and they were heavy, Milton had lived in keen enjoyment of the triumph of that cause for which he had fought so long and so strenuously. He had himself been honoured and powerful in his own country, and his fame and influence were known throughout Europe. But the revulsion of feeling which accompanied, and which, indeed, effected the Restoration, was something stronger than it is at all easy for us to realise in the present day. With the exception of a faithful few, the whole nation, Cavaliers and Roundheads, Royalists and Republicans, all alike bowed the knee to Baal. All vied with one another in servile adulation of the new-found sovereign. All alike hastened to lay their political principles, their personal honour, their faith, their liberties, at the foot of the throne. A blind enthusiasm of royalty, real in some, assumed in others, was the spirit of the hour. No ill-will and contempt was too strong for those who had been identified with the establishment or the conduct of the old government. Milton's position was a singularly trying one. He was growing old; he was totally blind; he had to see the work of his life undone; the republic for which he had struggled overthrown; the hated monarchy, and the still more hated prelacy, re-established; the lofty, though austere morality of the Puritan supremacy giving place to the unbridled licentiousness of the new *régime*. Milton himself narrowly escaped being included in the list of those sacrificed to the royal vengeance; a proclamation for his discovery was even issued; and more than one of his works was burned by order of the House of Commons. But Milton's was not the spirit to sink in despondency. The same lofty purpose and proud self-reliance which he had shown in the earlier days of conflict did not forsake him in this hour of defeat. The few remaining years of his life were passed in close retirement, for the most part in London; and during these years his greatest works were written.

We know, from Milton's own pen, that from a very early age he had entertained the thought of writing a great epic or heroic poem. We know, too, that, probably under the influence of his favourite master, Spenser, he had at one time chosen the story of King Arthur for his theme, though there is no reason to suppose that he ever actually commenced any poem on this subject. "Long choosing, and beginning late," as he himself tells us, it is probable that many other themes may have passed through his mind before he finally determined upon the sublime history which he has embodied in "Paradise Lost." Even when his subject was chosen, the form and character was not at once determined upon. We know that Milton at one time intended to represent the fall of man in the form of a sacred drama; and it is related upon authority which we can scarcely question, that some of the noblest passages in "Paradise Lost," and notably Satan's celebrated "Address to the Sun," at the commencement of the fourth book, were written as part of the intended play. But in all probability the substance and form of the great work must have been selected, and probably portions of it written, before the Restoration, though it was mainly composed after that event. It was certainly completed, and, there is no reason to doubt, completed much as we now have it, in 1665; and it was published in 1667.

No English poet, no poet, indeed, of any nation has ever ventured to treat so vast, so awful a theme as that which Milton has handled in his great epic. He has painted the calm serenity of heaven before sin or discord had found entrance; the war in heaven; the rebellion and fall of the disobedient angels; the horrors of the hell to which they fell; the creation; the temptation and the fall of man; the punishment of the guilty pair, and their penitence lightened by the hope and promise of a future redemption. He has touched the most awful mysteries—the loftiest counsels of heaven, and the lowest depths of hell—no less than the history of the human race. He has essayed to

"Assert eternal providence,
And justify the ways of God to men."

Nor has he sought in vain to rise "to the height of this great argument." For, whatever his faults, Milton has done what no other poet could ever have done; he has, throughout the whole of his long poem, maintained a sublime elevation of thought, of moral tone, and of style worthy of his subject. Some of the means by which this effect is attained we can easily perceive. Milton's genius was essentially not dramatic; that is to say, he had little power of conceiving, portraying, and giving life to individual characters. And this, which for most purposes would have been a defect, was for this poem an immense advantage. Had the awful personages by whom his heaven is peopled—the Eternal Father, the Divine Son, the great archangels, and all the hierarchy of heaven—been presented to us too vividly, with too much dramatic life, they would have been too like ourselves; the infinite would have been lost in the finite, the Divine in the human; heaven would have become earth. But one power which Milton did possess, and that in a very rare degree—as he showed in his early poems, "L' Allegro," in particular—was the power of minute, delicate, and accurate painting of scenes and incidents. This power he carefully abstains from using in "Paradise Lost." In that poem all is vast, shadowy, indefinite; and by this vagueness of outline, Milton adds grandeur to his figures, as mountains are grandest when half veiled in cloud.

Nothing can surpass the masterly art which Milton shows in the conduct of his story, especially the skill with which he preserves a complete unity of interest throughout the whole, and, in spite of the inherent difficulties of his subject, maintains that movement and action which are above all things essential in an epic poem; and this is achieved mainly by making Satan and his subordinate spirits the central figures of the poem. After a few lines of introduction, the first book opens with the scene in hell, immediately after the expulsion of the rebel angels from their heavenly home, and we see how Satan,

> "With his horrid crew
> Lay vanquished, rolling in the fiery gulf,
> Confounded, though immortal;"

where—

> "A dungeon horrible on all sides round
> As one great furnace flamed, yet from those flames
> No light, but rather darkness visible,
> Served only to discover sights of woe,
> Regions of sorrow, doleful shades, where peace
> And rest can never dwell, hope never comes
> That comes to all."

Satan, raising himself from the lake of fire, awakes his prostrate companions, who, at his words, start up with renewed energy and hope. The several leaders of the host, all the evil spirits and false gods whose names are known in history or legend, sacred or profane, are brought before us in passages of wonderful power. They set themselves to make the best of their new and dismal abode. The great city and palace of Pandemonium under their hands "rises like an exhalation;" and an assembly is summoned to decide upon their future course. In the second book the infernal council is described, and its proceedings related. At last it is decided, in accordance with the advice of Satan, that the new-created world, with its inhabitant man, of which rumours had been rife in heaven before the fall, should be the point at which they should seek revenge upon their Almighty Victor, by counteracting his beneficent designs, and marring his creation. In pursuance of this purpose, Satan himself undertakes the task of searching out this new world, and he starts upon this errand. Reaching the gates of hell, he finds them guarded by two awful shapes, Sin and Death. And here we meet, in the allegorical conception of these two beings, one of the most sublime passages in all Milton's works. Satan having passed hell-gates, and made his way through the vast expanse of chaos, comes at last within view of "the opal towers and battlements" of heaven:—

> "And hard by, hanging in a golden chain,
> This pendant world, in bigness as a star
> Of smallest magnitude, close by the moon."

And so the second book closes. It must be observed that by the world, in this and other passages, Milton means, not the earth, but the globe which he supposed to embrace the whole solar and stellar systems, for his astronomy was that of Ptolemy, not of Copernicus. In the third book the scene changes to heaven. God the Father and the Son, in a marvellous dialogue, discourse of the state of man and the enterprise of Satan; the approaching fall of man, and the Divine purposes of mercy to be fulfilled in his ultimate redemption, are disclosed to us. The poet then again returns to Satan, and traces his wanderings till he lands at last on this earth upon the top of Mount Niphates. In the fourth book Satan, wandering over our globe, comes upon the Garden of Eden, and sees our first parents in their state of innocence and bliss. And their angelic guardians, warned of the presence of the evil spirit, discover him in the bower where Adam and Eve lie asleep, and he is for the time driven from Paradise. Of the following four books the scene is, strictly speaking, on this our earth. Raphael, "the affable archangel," sent by God to warn man of his approaching danger, relates to Adam the great events which had preceded the point of time at which the action of the poem commenced in the first book; the revolt of Satan and his fellows; the war in the heaven, with its varying fortunes; the intervention and triumph of the Messiah himself, with the rout of his foes, and their fall from the battlements of heaven to the hell prepared to receive them; the creation of the world, and of man as its inhabitant and ruler; and Adam in his turn relates the result of his short experience of life. And the eighth book ends with a solemn warning of the archangel. In the ninth book is told the temptation and fall, first of Eve, and then of Adam. In the tenth book the doom of man is pronounced, but not without an obscure promise of future redemption. Again we meet with those two awful shapes, Sin and Death, no longer guardians of the closed gates of hell, but hurrying to this earth, there to find the prey won for them by Satan, and leaving in their track a firm and easy road between earth and hell. Satan in the meantime returns to relate triumphantly in hell his success on earth; and he and his associates begin to feel the first-fruits of the curse by finding themselves transformed into serpents. In the eleventh book the repentance of Adam and Eve is accepted in heaven; but the archangel Michael is sent to expel the guilty pair from Paradise. In this and the twelfth book the archangel, leading Adam to the summit of a hill, shows him in vision the history of his posterity, ending in the final redemption of mankind through Christ. The book and the poem end with the actual departure of Adam and Eve from Eden.

In a work of such magnitude it is hardly necessary to say that even Milton has been by no means uniformly successful in all parts of it. The scenes in heaven are the least satisfactory. In pursuing his purpose "to justify the ways of God to man," Milton has sometimes placed in the mouth of the Almighty arguments and explanations which scarcely tend to exalt our idea of the Divine character. And the scenes which present to us our first parents in their state of innocence, though always full of purity and beauty, have certainly something of monotony, if not of dulness, about them. Action there could, of course, from the nature of the case, be none in such scenes, and the unchanging round of life seems tedious to fallen humanity. It is in the other world that Milton's success has been supreme. The true action of this epic is with the fallen spirits; the real interest of the poem centres in the character and achievements of Satan. It is a trite remark that poets whose genius is not of a dramatic character are apt in portraying their heroes to show us themselves under various disguises; and in the majestic portrait of the rebel Satan it is not difficult to trace some of the features of the rebel Milton. For Satan is no devil of the vulgar, no mere spirit of evil, compounded of baseness and malignity. He is an "archangel ruined;" a form and countenance of celestial beauty, though marred by sin and deformed by wounds and flame; a character of which the basis is a lofty courage which no adversity can shake, a "courage never to submit or yield;" a stern determination and fixity of purpose, though these noble qualities are perverted by "pride and worse ambition." He is still capable of a magnanimous devotion, and a tender pity for those whom his example has brought to ruin. Even for his victims, Adam and Eve, when he first sees them, he is not without compunctious visitings. He can still "feel how awful goodness is," and stand silent and abashed in its presence. Upon this stupendous figure, one of the greatest that any poet has ever painted, and upon his exploits, Milton has exercised all the highest quality of his genius, and with a result entirely successful.

The metre of "Paradise Lost" deserves careful attention. Blank verse, as we have already seen, had been known in England from the time of Lord Surrey, and had been habitually used by the great dramatists. But when Milton wrote, this metre had been long disused for any poetry other than dramatic. Milton deliberately adopted it, as being more suited to the dignity of his subject, and because he held that rhyme fettered the freedom of the poet, and was "of itself, to all judicious ears, trivial, and of no true musical delight; which consists only in apt numbers, fit quantity of syllables, and the sense variously drawn out from one verse into another, not in the jingling sound of like endings." But Milton's blank verse is distinguished from all other by its infinite variety in rhythm, and in the mode of drawing out of the sense from verse to verse.

When Milton wrote "Paradise Lost" he does not seem to have at all contemplated a companion poem. The idea of "Paradise Regained" was suggested to him by a friend, to whom he had shown the finished manuscript of the earlier poem; but Milton at once adopted the suggestion, and in four years after the publication of "Paradise Lost," "Paradise Regained" appeared. It is a much shorter poem, consisting of only four books, as against the twelve of "Paradise Lost." It has always enjoyed much less popularity than the earlier poem, not from any poetical inferiority, but from the nature of its subject, which is didactic rather than epic. It is essentially a companion piece. As the climax of the action of "Paradise Lost" was the temptation and the fall of Adam, the subject of "Paradise Regained" is the temptation and victory of Christ:—

> "Recovered Paradise to all mankind,
> By one man's firm obedience fully tried
> Through all temptation, and the tempter foiled

In all his arts, defeated and repulsed,
And Eden raised in the waste wilderness."

Another great work of the same period is the drama of "Samson Agonistes." This play is founded upon the classical model of the Greek tragedies. It is not only very noble and elevated in spirit and character, but contains scenes and passages of very pathetic beauty. In one respect this work has an especial and peculiar interest and attraction for every reader. In the character of the great Hebrew champion in the hour of his fall, his servitude, and his blindness, and in the touching lamentations which he utters, it is impossible to doubt that we are reading to some extent the expression of Milton's own sorrow and bitterness of heart, under trials not wholly dissimilar to those of his hero.

There still remains a class of Milton's poems, the consideration of which we have postponed until now, for they belong to no one period of the poet's life, but are scattered over very many years. The sonnet is a form of composition which had already been cultivated with much success in England, as well as in Italy, and notably by Shakespeare and Spenser. But the sonnets of Milton differ from those of all his predecessors in the peculiar concentration of thought and elevation of feeling which they express, as well as in the solemn and organ-like music of their language and versification. We can find space for but one example, Milton's nineteenth sonnet, on his blindness:—

"When I consider how my light is spent,
Ere half my days, in this dark world and wide
And that one talent, which 'tis death to hide,
Lodged with me useless, though my soul more bent
To serve therewith my Maker, and present
My true account, lest he returning chide.
Doth God exact day-labour, light denied?
I fondly ask; but patience, to prevent
That murmur, soon replies, God doth not need
Either man's work, or his own gifts; who best
Bear his mild yoke, they serve him best. His state
Is kingly; thousands at his bidding speed
And post o'er land and ocean without rest;
They also serve who only stand and wait."

Milton died at his home in London in the year 1674.

RECREATIVE SCIENCE.—XVII.

"THE SHOOTING STAR" AN ILLUSTRATION OF PERSISTENCE OF VISION—IMITATION OF THIS NATURAL EFFECT BY PILKINGTON'S TOY AND THE ASTROMETROSCOPE.

In the last chapter it was shown that the eye might be affected in peculiar ways either in disease or health, and whilst showing the value of surgical aid in the former case, it is quite as well to remember that if an unusual effect on the vision is produced by a known cause, such as too great a straining of the eye and mind by over-study or special art work, such as engraving steel plates or gems, the remedy is obvious—viz., repose and rest for the eye, and change of thought for the mind.

The famous Benedetto Pistrucchi, who was one of the most celebrated engravers of gems and jewels, says, in a most interesting autobiography translated by Dr. Billing:—"At the age of twenty-four, my great application to such minute objects as the finer parts of the cameos, and having just worked upon a stone which had a stratum of a fiery-red colour, produced a weakness of the eyes so great, that whenever I worked for half an hour my sight failed, and whichever way I looked there appeared two clouds of smoke, which disappeared when I fixed my eyes on an object steadily, but returned the moment I moved the pupils. Being tormented in this manner, I applied to the principal surgeons and physicians of Rome, who dosed me with *viper broth*, applied blisters, bled me, and in fine *martyrised* me, all to no purpose. I became so melancholy that my relatives, fearing I might commit suicide, never permitted me to be alone, and did all in their power to entertain me. It happened that a certain apothecary, of the name of Ricci, supplied me with some medicines, who, coming to the house, and seeing me so depressed by my malady, invited me to accompany him on a visit to his native place, where, he said, the air was so pure as to '*seem to have almost the power to restore life.*'"

Pistrucchi starts on this journey, and having encountered many adventures both pleasing and dangerous, seems to forget all about his complaint, and we hear no more of the affliction of the eyes that caused him so much torment; indeed, he subsequently came to England, where he produced works at the Royal Mint which have placed his name in the front rank of engravers of jewels, and designers and executants of dies for medals and coins.

To return to the healthy affection of the optic nerve, called "persistence of vision," no one can fail to remember that at some time or other they have seen darting suddenly through the sky that which appears to be a splendid star with a train of fire behind, and then it wholly fades from the vision.

A meteor, or "shooting star," may be defined to be some kind of light, combustible matter, which moves with great velocity in the upper regions of the air, and is changed to the vaporous or rather dust-like condition before it can reach the Earth, and whilst thus changing its physical condition emits an intense light.

Such meteors sometimes fall towards the Earth in showers, emitting a remarkable amount of light; and when the Earth passes through the orbit of these little bodies in the precise part of it where they are collected, then the beautiful "star shower" becomes apparent.

The November meteors require a period of about 33¼ years to perform their orbit or path around the Sun, and it is found that the Earth breaks through the group once in thirty-three years, and always in the month of November. A shower of this kind was seen in November, 1799, again in November, 1831, and also in November, 1832, when it is related that multitudes of "shooting stars" fell in the western part of Asia and southern part of Europe. But, Bouvier says, the most magnificent shower of meteors which has ever been known was that which fell during the night of November 12, 1833. This shower commenced at nine o'clock in the evening, and continued till the morning sun concealed them from view. It extended from Canada to the northern boundary of South America, and over a tract of nearly three thousand miles in width, its western limit extending to longitude 100° west from Greenwich.

The area covered by these groups must be very great, considering that the Earth moves at the rate of 1,000 miles per hour, and met this body of meteors moving at the same rate, which velocity increased to 1,200 miles per minute by the Earth's attraction; and yet it took many hours—from nine in the evening until the brilliancy of the Sun's light overpowered that of the meteors—before the Earth had travelled through this immense assemblage of meteoric particles, like the sand of the sea-shore in number.

Stars have shone with "trains of fire" in an immense shower within the memory of the youngest of the present generation, viz., on the 13th and 14th of November, 1866, and have again completed the cycle of 33 years from the last recorded, November 12, 1833. It is supposed that these meteoric particles do not exceed two grains in weight; they commence burning at a height of seventy-four miles above our Earth, and are all dissipated into vapour by the time they have travelled twenty miles through the upper and more rarefied parts of the air, and passed within a distance of fifty-four miles of the Earth.

All *motion* when arrested generates *heat*. It is the resistance of our atmosphere—the friction of these particles (moving at the rate of upwards of 1,000 miles per minute) against the material substance of the air surrounding the globe—that generates the heat which ultimately converts them to a vaporous condition.

An observer at Cowes, Isle of Wight, thus tersely describes the appearance of the great shower of swift, silent, luminous "shooting stars," with their trails of light, that fell in November, 1866, and surpassed anything that the present generation has witnessed:—

"The predicted display of shooting stars was observed here (Cowes) on a magnificent scale during the early hours of this morning, and, as the sky may have possibly been in few places so clear as here, the notes I made may perhaps be interesting to some of your numerous readers.

"During the half-hour preceding midnight about 66 were observed.

"From midnight to 12.30 about 200 were observed.

"From	12.30	„	12.50	„	201	„		
"From	12.50	„	12.58	„	190	„		
"From	12.58	„	1.2	„	201	„	in 4 mins.	
"From	1.2	„	1.5	„	206	„	in 3	„

"From	1.5	„	1.10	„	214	„	in 5 mins.
"From	1.10	„	1.11	„	100	„	in 1 „
"From	1.11	„	1.13	„	206	„	in 2 „

"The falls now became so incessant that *it was impossible to count numbers fast enough*, ten to a dozen falling stars being at intervals all visible at once.

"This rapid fall continued visible for 16 minutes, when the sky, which had been clear from midnight, became obscured with heavy rains, and rain fell sharply for some ten minutes.

"At 1.50 it cleared up a little; stars were still falling, but not so rapidly.

"From 1.50 to 1.54 over 83 were observed, when the sky again became overcast, and a little rain again fell, clearing up at 2.20, when stars were still falling.

"From 2.20 to 2.35, 73 fell in 15 minutes; the sky again became cloudy, clearing up at 3.15, when very few, some two or three per minute, were falling; and after 5 o'clock none were observed.

"About 25 per cent. of the shooting stars were exceedingly brilliant, burning with an intense *orange-yellow colour*, the larger ones marking their *track* with an *intense blue* or *greenish-blue streak*, which, in some instances, exceeded a length of 60° in space. These streaks were apparently always widest at the middle point of their observable course.

"With the exception of a very small number (not 2 per cent.) which appeared erratic, the radiant point was near the star ϵ, in the constellation Leo, at about 25° north declination, and at about 9 hours 50 minutes right ascension.

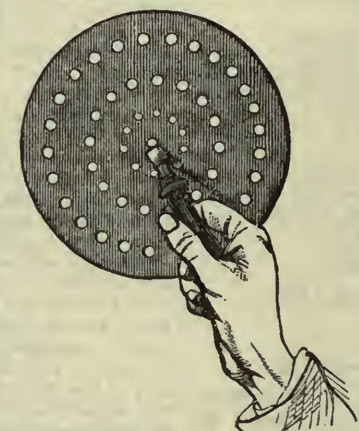
"A few of the meteors appeared to burst, leaving *a cloudy haze*, and from one especially, that fell at 1.14, passing westward, nearly through our zenith, and disappearing at about 45° above the horizon, the *smoke* or *vapour* was visible for fully three minutes after it exploded.

"A child, who had been aroused to look at the display from a window looking westward, remarked that it was like the feathers in a display of rocket fireworks, 'only,' he said, 'they went the wrong way.'"

The change of something of a solid nature into the vaporous condition, or rather perhaps into the finest dust, is thus distinctly alluded to, and the production of what appeared to be smoke or vapour (like that from an ordinary firework) is recorded by this observer.

Subsequently, Mr. Alexander Herschel delivered a lecture on the same shower before the members of the Royal Institution, and stated that the height of some of those meteors had been ascertained to be about fifty miles, and he mentioned the appearance of others which were as near the Earth as four and five miles. The periodical meteoric showers, he said, are conceived to be composed of streams of meteoric bodies moving in separate orbits, the width of such a stratum of meteors being equal to two or three times the diameter of the Earth. The meteors observed on the 14th of November last were visible at the Cape of Good Hope a quarter of an hour before they were seen in this country; the cause of which he explained to be owing to the inclination of the globe to the zodiac, and the consequent arrival of the meteors at the southern portion before they could be visible in the north. He stated that it has been observed that each periodical stream of meteors is accompanied by a comet, the orbit of which has been calculated and the times of its return estimated. With reference to the probable course of luminous meteors in the material substance of the zodiacal light, the speculations offered were of the vaguest kind. Mr. Herschel said that attempts to explain the nature of the zodiacal light have hitherto failed to present a theory that would bear investigation, and the one that he advanced was—that the light is emitted from an immense number of small solid particles surrounding the Sun in the form of an elongated spheroid, or double cone, and that the meteors are constructed from these particles. He said this theory had the advantage over others of not having been hitherto proved to be fallacious.

The November meteors were noiseless, but others have been seen, called "detonating meteors," which have exploded with a loud noise, as well as producing a magnificent emission of light. Such meteors have been called "fire-balls." Occasionally a small stony mass remains as the result of the rushing flame and explosion, which is like the loudest thunder; and it is satisfactory to know that out of ten millions of shooting stars seen from the Earth, barely one case of a fallen substance is recorded. It has been stated by Mr. Herschel that he observed the sodium line in the train of a "fire-ball meteor," which he submitted to spectrum analysis. And it will be noticed in the account given by the observer at Cowes, that the colour of the light of at least one quarter of the meteors was "an intense orange-yellow colour," the larger ones marking their track with an intense blue or greenish-blue streak. This change of colour of the track from intense orange-yellow colour to an intense blue or greenish-blue is probably due to the same cause that produces the beautiful changes of colour when burning magnesium wire is moved in a circular form around the face, as described in our last paper. The meteor, like the magnesium, could not be in every part of the track at the same time, and the train of light produced a like change of colour whilst it faded away from the vision. As this subject is proceeded with, it will be found that after staring at any brilliant train of coloured light, the original colour does not remain upon the visual nerve, but changes, as in the experiment of the magnesium wire; therefore, the meteor itself might consist of matter yielding a yellow or orange-yellow light only, and the track of blue light was probably an optical and illusory effect.



TOY FOR EXHIBITING THE EFFECT OF METEORS.

Thus, then, it is shown that a meteor is a "shooting star" or fire-ball, so long as it moves in the highest regions of the air and does not fall to the Earth as a solid mass, but in the state of fine dust. If, however, the wandering matter from space, like the famous Kaaba stone at Mecca, is of larger bulk and weight, and does fall in a solid mass to the Earth, then it is called a meteorite or aërolite, of which a fine collection has been brought together by Mr. Maskelyne, at the British Museum. They are 237 in number. Of these "meteorites" 80 consist of masses of meteoric iron, called "*aërosiderites;*" 10 have a composition partly of stone and partly of iron, and are termed "*siderolites;*" 147 are stones, and to these the term "*aërolites*" is now exclusively applied.

All these meteorites vary in weight from ounces to tons, whilst meteors, such as those that formed the shower in November, 1866, are estimated in grains. The difference between a meteor and a meteorite is, therefore, only one of bulk and weight, and in all possibility, as suggested by Mr. Sorby (who has so carefully examined some of the meteorites with the microscope), may have been produced from metals in a nebulous or gaseous state, like the vaporous condition of metallic matter in the photosphere of the Sun.

A very good imitation of the effect of a meteor may be shown by the simple toy devised by the Rev. Mr. Pilkington, in which a circular disc of cardboard, perforated with a series of holes concentric with each other, is moved by a wire attached to a handle: the wire is not fixed tightly in the centre, but so arranged as to enable the operator to give various motions. The holes are from about a quarter to an eighth of an inch in diameter: the centre hole is left colourless; the first ring of holes, green; the second, violet; and the third, crimson; and the colours are obtained by pasting coloured gelatine, such as that used in crackers and bon-bons, behind the apertures.

By giving the handle various movements in a circular, perpendicular, horizontal, or diagonal direction, a variety of tracks of coloured light can be obtained. This simple contrivance is an excellent illustration of persistence of vision, and will enable our readers to understand a more complicated contrivance called the astrometroscope, an instrument for producing complicated forms on the disc with the oxy-hydrogen light, by the various movements of star-like figures, and which will be described in our next paper.

LESSONS IN ETHNOLOGY.—III.

EUROPEAN SECTION OF THE ARYAN RACE.

THE dominant races of Europe are nearly all Aryan. Those of them which are so, when arranged according to their languages, fall naturally under six subdivisions:—(1.) The Teutonic; (2.) the Celtic; (3.) the Slavonic, or Windic; (4.) the Italic; (5.) the Illyric; and (6.) the Hellenic races.

The *Teutonic race* is one of a very remarkable character. It has never been properly subdued. While several other European races were so thoroughly brought under the sway of Rome that they lost their native languages, and now speak tongues in which Latin words predominate, the Teutons maintained their political independence, and kept their speech virtually unmodified by their proximity to the all-conquering empire. Next, ceasing to act simply on the defensive, they began to assail the colossal Roman dominion itself; and finally, under the names of Ostrogoths (East Goths), Visigoths (West Goths), Vandals, etc., they burst in upon the effete empire and trampled it under foot. All decay and death in this world of God's are designed to be the prelude to new life, and the overthrow of the old civilisation—though its immediate result might be ages of confusion and intellectual darkness—yet was followed at last by the birth of a new and better culture than that which had perished. How closely the destroyers of the Roman empire were akin to the modern Teutonic nations—our own, for example—will be apparent from a glance at one or two of the half-English names applied to their tribes or armies: thus, the Romans spoke of the Marcomanni, that is, "the men of mark;" and the Alemanni, or "all men," showing the miscellaneous nature of the assemblage which desire of plunder had drawn together. Germany was the great seat of the Teutonic tribes: their boundaries, when the Romans first came in contact with them, being the Rhine on the west, the Danube on the south, the Vistula on the east, and on the north a line running in some unknown latitude across Scandinavia.

The classical authors of antiquity describe the Germanic tribes as tall in stature and strong in body, with a fair complexion, yellow, or, more frequently, red hair, and blue eyes. But, remarkably enough, these characteristics are not now common in Germany; to find them extensively diffused one must repair to Scandinavia. In Germany the hair and eyes in a vast number of instances are dark. Unless the Romans made some strange mistake—which it is hard to think that they can have done—the physical characteristics of the Germans must have altered considerably within the last two thousand years. A conjecture has been hazarded as to how this may have taken place. In all the hotter parts of the world, the hair of the several indigenous races of mankind is black, and it is accompanied by dark eyes; it is only when one goes some distance towards the north that fair hair and blue eyes become common. Hence it has been thought that the clearing away of the forests which once overspread Germany has made the climate of that country so much more genial, that the southern peculiarities of black hair and blue eyes are much more frequently met with now than of old. Latham thus describes the physical conformation of the entire Teutonic, or, as he calls it, "Gothic" family:—(*a*) "Blue eyes, flaxen hair, ruddy complexion, smooth skin, fleshy limbs; (*b*) Eyes, grey, dark, or hazel; hair, brown or black; complexion, sallow or swarthy; bulk, varied."

If the classification of the several Teutonic tribes and subtribes be founded on language, then this great race will be resolved into three smaller ones—the High German, the Low German, and the Scandinavian sub-races. The locality inhabited by the first of these is the south of Germany, and the language spoken is the one which is in general simply designated "German." To the second, or Low German sub-race, belong the English, the Dutch, and the Frieslanders. The inhabitants of Norway, Sweden, Denmark, and Iceland—the Northmen or Normans of old piratical times—constitute the Scandinavians. Besides these three assemblages of Teutons speaking yet living tongues, should be ranked a fourth, the Goths, whose language is now extinct.

Fig. 3.—TYPE OF TEUTONIC VARIETY.

The vast majority of the Teutons are Protestant in faith, and the same assertion cannot be made about any other race in the world. Of the many aspects in which the Reformation in the sixteenth century may be viewed, one is that it was a religious revolt of the Teutonic race against Italian dominancy. The only notable section of the Teutons who have remained Roman Catholic are the Germans of the Austrian empire.

In war the Teutons are remarkable not so much for romantic courage in assault, as for stubborn endurance. The amazing tenacity of life which the Austrian empire has all along shown, and its great fortitude under crushing defeats, have in large measure resulted from the prominent place held by the Teutonic element in its political system. The tenacity of endurance now spoken of is called by the French "solidity;" hence either the Emperor Napoleon or the *Moniteur*, referring on one occasion, during the Crimean war, to the British soldiers, used the expression, "that solidity which is peculiar to them;" and in the French narrative of the battle of Inkermann, admiration was expressed for "the energetic solidity with which our allies faced the storm so long."

The *Celtic* is the second of the great races now inhabiting Europe. Even before the conquests of Julius Cæsar, the Romans had become well acquainted with one great section of it, namely, the Gallic tribes, who had oftener than once burst through the Alps, and rolled an invading torrent like an avalanche down upon the plains of Italy. These aggressive Celts, too, had so well held their own in that peninsula, that there was a Cis-Alpine as well as a Trans-Alpine Gaul; that is, a

Gaul on the south as well as one on the north of the Alps. Hence the Latin authors have left behind them in their writings sundry interesting notices with respect to the physical and mental qualities of the Celtic tribes. One of these, dashed off with a free pen, is by Ammianus Marcellinus, who flourished in the latter part of the fourth century, and whose observations with respect to Celtic peculiarities possess a special value from the fact that he was a Roman military officer, who, it is believed, spent a considerable period in Gaul.

"The Gauls," says Ammianus, "are almost all tall of stature, very fair, and red-haired, and horrible from the fierceness of their eyes; fond of strife, and haughtily insolent. A whole band of strangers would not endure one of them, aided in his brawl by his powerful and blue-eyed wife, especially when with swollen neck and gnashing teeth, poising her huge white arms, she begins, joining kicks to blows, to put forth her fists, like stones from the twisted strings of a catapult. Most of their voices are terrific and threatening, as well when they are quiet as when they are angry. All ages are thought fit for war, and an old man is led out to be armed with the same vigour of heart as the man in his prime, with limbs hardened by cold and continual labour, and a contempt of many even real dangers. None of them are known, like those who in Italy are called in joke Marci, to cut off their thumbs, through fear of serving in war. They are as a nation very fond of wine, and invent many drinks resembling it, and some of the poorer sort wander about with their senses quite blunted with continual intoxication."

Other ancient authors concur with Ammianus in representing the Gallic Celts as having blue eyes and fair or red hair. The people of Britain, again, were said to be of a feebler physical type, and one tribe—the Silures—was reported to be swarthy in colour, and to have dark, curly hair. Here, then, we are met by a difficulty. The Celtic tribes are not to any large extent characterised at present by blue eyes and fair or red hair. A good many of them are dark; and if the observations made by Ammianus and others were trustworthy—as they appear to have been—then some change must have taken place among the Celts, as among the Germans, within the last two thousand years. Dr. Latham, following Retzius, considers the Celtic skull as one of remarkable length. He further describes the race as having prominent cheek-bones; while as to the colour of the hair and eyes, he institutes two divisions:—(1.) The Silurian type: "Eyes and hair, black; complexion, dark with a ruddy tinge: chiefly found in South Wales. (2.) The Hibernian type: eyes, grey; hair, yellow, red, or sandy; complexion, light." The race, as proved by a study of the languages peculiar to it, should be divided into two sub-races: the one speaking dialects akin to the Welsh, and the other those allied to the Gaelic. There were at no remote date three dialects, falling under the former of these divisions: the Welsh proper, the Cornish, and the Armoric. Within the memory of the present generation, an old woman was reported to be living in Cornwall who could speak Cornish; then it was said that she had died, and the Cornish language had died with her. The Armoric is spoken in Brittany, in the north-west of France. The Gaelic is divided into three dialects: the Gaelic proper, current in the Highlands of Scotland; the Erse, in the wilder parts of Ireland; and the Manx, in the Isle of Man. The Celtic languages are becoming rooted in parts of Canada. In England, in France, and in other places there is much Celtic blood in regions where Armoric has become extinct. With the exception of the Scottish Highlanders, nearly all the Celts are Roman Catholics. In war they are more dashing in assault than the cooler Teutons, but do not bear up so well against long-continued difficulties and disasters. Ancient authors charged them with fickleness, and it is remarkable that the same complaint is made by the Apostle Paul against the church at Galatia, which, as the name of the town imports, was a Gallic one, though situated beyond the limits of Europe, in Asia Minor.

We come next to the *Slavonic race.* As residents in this country have less opportunity of becoming acquainted with the Slavonic race than with Teutons and Celts, we take from Milne-Edwards of Paris, as quoted in Nott and Gliddon, the following careful summary of its physical characteristics:—"The contour of the head viewed in front approaches nearly to a square; the height surpasses a little the breadth, the summit is sensibly flattened, and the direction of the jaw is horizontal. The length of the nose is less than the distance from the base to the chin; it is almost straight from the depression at its root, that is to say, without decided curvature, but, if appreciable, it is slightly concave, so that the end has a tendency to turn up; the inferior part is rather large, and the extremity rounded. The eyes, rather deep set, are perfectly on the same line; and when they have any particular character, they are smaller than the proportion of the head would seem to indicate. The eyebrows are thin, and very near the eyes, particularly at the internal angle, and from this point are often directed obliquely outwards. The mouth, which is not salient (projecting), has thin lips, and is much nearer to the nose than to the tip of the chin. Another singular characteristic may be added, and which is very general, viz., their small beard, except on the upper lip." This is said to be the common type among all the subdivisions of the great Slavonian family.

To this third division of the Aryan race belong not merely the Russians and the Poles, but also the Bulgarians—or, at least, a portion of them—the Servians, the Bosnians, the Montenegrins, the Dalmatians, the Croats, the Vends or Slovaks, the Czechs or Bohemians, the Moravians, the Lettic tribe, the Lithuanians, and others. So large a portion of the Slavonic race is under the Russian czar, and so slender is the cohesion of at least one of the two empires—Turkey, in which many other Slavonic tribes reside—that there has grown up the doctrine of Panslavism. In πᾶν (pan) may be recognised the neuter of the Greek adjective, or rather collective pronoun, signifying "all." Panslavism, then, at the least, contemplates the gathering together of all the Slavonic tribes under one head—the Russian czar; and it may, in the wishes of some of its votaries, go beyond this, and aim at using the hoped-for union for purposes of domination over other races. The first Napoleon is reported to have said that in a certain number of years (100 we think it was), all Europe would be either republican or Cossack. By Cossack he meant Russian; and Panslavism, in its most extensive signification, accepts the second side of the alternative, and says with eagerness, "Then Cossack let it be." The so-called Eastern question received no more than a temporary solution in the arrangements which followed on the Crimean war, and it remains to be seen whether the changes resulting from the war between Russia and Turkey, and the Berlin Congress of 1878, will afford any basis for a permanent settlement of the matter in time to come. It is a weak point also in the Austrian political system that the Bohemians, the Moravians, and many other Austrian subjects, are Slavonians; at the same time, not a few of these are Roman Catholics like their emperor, and therefore they are less disposed than they otherwise would be to embrace Panslavism, and regard St. Petersburg as their pole-star. Even in the great Muscovite empire itself, difference of religious belief between the Russians proper and the Poles—of whom the former mainly belong to the Greek Church, while the latter are for the most part Roman Catholics—has been one of the most patent causes of alienation between these two great sections of the Slavonians.

The other Aryan races in Europe live along the shores of the Mediterranean. According to Dr. Latham, they have long heads, high facial angles, dark eyes and complexion, and a bodily frame more slender than bulky. As stated before, if classified according to the languages which they speak, they must be divided, as is done by Professor Max Müller of Oxford, into the Italic, the Illyrian, and the Hellenic races.

In the case of the first, the test of language is somewhat fallacious, since Latin spread among tribes not closely akin to those who spoke it originally. Six more modern forms of speech sprung from it, and are sometimes called the Romance languages. They are the Portuguese, the Spanish, the French, the Provençal, the Italian, and the Wallachian. Only two of these require explanation. The Provençal language was that of the old troubadours, but it has now degenerated into a mere *patois* spoken in the Grisons of Switzerland, and on the borders of the Tyrol. The Wallachian tongue is current in Roumania, in parts of Hungary, Transylvania, and Bessarabia, and to a certain extent in districts of old Thrace, Macedonia, and even Thessaly. The principality first mentioned constituted the major portion of the province of Dacia, colonised by the Romans as an outpost to defend the empire on that side from the barbarians; and the Latin introduced by those colonists has modified the speech of the people there to this day.

It has already been mentioned that many of the nations who now speak Latinised languages have no close affinity to the old Romans. They are very mixed in blood. Most of the inhabitants of Roumania are probably of Slavonic, and some even of Gothic descent. The Etruscans, though resident in Italy, are not at all akin to the other inhabitants of that peninsula, and are very difficult to classify. The north and middle of France were originally Celtic; its southern portion was inhabited by the Basques or Iberians, who were not Aryans. Spain was partly Iberian and partly Celtic; Portugal was much the same.

The *Illyrian race* is now represented by the Albanians, who speak a language not closely akin to others, but which has at length been declared Indo-European.

The *Hellenic race* comprehends the Greeks, once so renowned throughout the world, but now so greatly fallen.

Of the three Aryan races of Northern and Central Europe, the Celts seem to have been the first to come from the primitive settlement in Persia. The Teutons, perhaps, followed next, and then the Slavonians. The Lithuanian language, one belonging to the Slavonian family, approaches most nearly of all the European tongues to Sanscrit.

There are other than Aryan peoples in the great continent to which this paper has been devoted, but of these we shall speak subsequently, when treating of the Turanian race.

LESSONS IN ITALIAN.—XXXVII.

IRREGULAR VERBS OF THE SECOND CONJUGATION (*continued*).

II. IRREGULAR VERBS ENDING IN *ere* SHORT.

11. *Verbs ending in* ORRE.

The irregular verb *pórre*, to put, is thus conjugated :—

INF. *Pres.* Pórre, *to put.*—*Pres. Gerund.* Ponéndo, *putting.*—*Past Part.* Pósto, *put.*——*Compound Tenses.*—*Past.* Avére pósto, *to have put.*—*Past Gerund.* Avéndo pósto, *having put.*

IND. *Pres.* Póngo, póni, póne; poniámo, ponéte, póngono.—*Imp.* Ponéva *or* ponéa; ponévi; ponéva, ponéa, *or* ponía. Ponevámo; ponevàte; ponévano *or* ponéano.—*Ind. Pret.* Pósi, ponésti, póse; ponémmo, ponéste, pósero.—*Fut.* Porrò, porrái, porrà; porrémo, porréte, porránno.—*Cond. Pres.* Porréi *or* porría, porrésti, porrébbe *or* porría; porrémmo, porréste, porrébbero.

IMP. Póni, pónga; poniámo, ponéte, pongano.

SUB. *Pres.* Che pónga *or* pógna, che pónga *or* pógni, che pónga *or* pógna; che poniámo, che poniáte, che póngano.—*Imp.* Che ponéssi, che ponéssi, che ponésse; che ponéssimo, che ponéste, che ponéssero.

After this example conjugate the following :—

Compórre, *to compose.*	Frappórre, *to interpose.*
Dispórre, *to dispose.*	Oppórre, *to oppose.*
Ripórre, *to replace.*	Pospórre, *to delay.*

12. *Verbs ending in* RERE.

The irregular verb *córrere*, to run, is thus conjugated :—

INF. *Simple Tenses.*—*Pres.* Córrere, *to run.*—*Pres. Gerund.* Corréndo, *running.*—*Past Part.* Córso, *run.*—— *Compound Tenses.*—*Past.* Avére córso, *to have run.*—*Past Gerund.* Avéndo córso, *having run.*

IND. *Pres.* Córro, córri, córre; corriámo, corréte, córrono.—*Imp.* Corréva, corrévi, corréva; correvámo, correváte, corrévano.—*Ind. Pret.* Córsi, corrésti, córse; corrémmo, corréste, córsero.—*Fut.* Correrò, correrái, correrà; correrémo, correréte, correránno.—*Cond. Pres.* Correréi, correrésti, correrébbe; corréremmo, correréste, correrébbero.

IMP. Córri, córra; corriámo, corréte, córrano.

SUB. *Pres.* Che córra, che córra, che córra; che corriámo, che corriáte, che córrano.—*Imp.* Che corréssi, che corréssi, che corrésse; che corréssimo, che corréste, che corréssero.

After this example conjugate the following :—

Accórrere, *to run to.*	Discórrere, *to discourse.*
Concórrere, *to run together.*	

13. *Verbs ending in* TERE.

The irregular verb *méttere*, to put, is thus conjugated :—

INF. *Simple Tenses.*—*Pres.* Méttere, *to put.*—*Pres. Gerund.* Metténdo, *putting.*—*Past Part.* Mésso, *put.*——*Compound Tenses.*—*Past.* Avére mésso, *to have put.*—*Past Gerund.* Avéndo mésso, *having put.*

IND. *Pres.* Métto, métti, métte; mettiámo, mettéte, méttono.—*Imp.* Mettéva *or* mettéa; mettévi; mettéva *or* mettéa. Mettevámo; mettevàte; mettiévano, mettéano, *or* mettíeno.—*Ind. Pret.* Mísi, mettésti, míse; mettémmo, mettéste, mísero.—*Fut.* Metterò, metterái, metterà; metterémo, metteréte, metteránno.—*Cond. Pres.* Metteréi *or* metteria; metterésti; metterébbe *or* metteria. Metterémmo; metteréste; metterébbero, metteríano, *or* metteríeno.

IMP. Métti, métta; mettiámo, mettéte, méttano.

SUB. *Pres.* Che métta, che métta, che métta; che mettiámo, che mettiáte, che méttano.—*Imp.* Che mettéssi, che mettéssi, che mettésse; che mettéssimo, che mettéste, che mettéssero.

After this example conjugate the following :—

Infinitive.	*Present.*	*Ind. Pret.*	*Past Part.*	*English.*
Consístere,	consísto,	consistéi,	consistíto,	*to consist.*
Assístere,	assísto,	assistéi,	assistíto,	*to assist.*
Resístere,	resísto,	resistéi,	resistíto,	*to resist.*
Avértere,	avérto,	avérsi,	avérso,	*to turn off.*

14. *Verbs ending in* ARRE.

The irregular verb *trárre*, to draw, is thus conjugated :—

INF. *Simple Tenses.*—*Pres.* Trárre, *to draw.*—*Pres. Gerund.* Traéndo, *drawing.*—*Past Part.* Trátto, *drawn.*——*Compound Tenses.*—*Past.* Avére trátto, *to have drawn.*—*Past Gerund.* Avéndo trátto, *having drawn.*

IND. *Pres.* Trággo, trái *or* trággi, tráe *or* trágge; trajámo *or* traggiámo, traéte, trággono *or* tránno.—*Imp.* Traéva *or* traéa; traévi; traéva *or* traéa. Traevámo; traeváte; traévano, traéno, *or* traéano.—*Ind. Pret.* Trássi, traésti, trásse; traémmo, traéste, trássero *or* trásseno.—*Fut.* Trarrò, trarrái, trarrà; trarrémo, trarréte, trarránno.—*Cond. Pres.* Trarréi *or* trarría, trarrésti, trarrébbe *or* trarría; trarrémmo, trarréste, trarrébbero.

IMP. Trái, trágga; traiámo *or* traggiámo, traéte, trággano.

SUB. *Pres.* Che trágga, che trágga, che trágga; che traiámo *or* traggiámo, che traiáte *or* traggiáte, che trággano.—*Imp.* Che traéssi, che traéssi, che traésse; che traéssimo, che traéste, che traéssero.

After this example conjugate the following :—

Attrárre, *to attract.*	Ritrárre, *to draw out.*
Contrárre, *to contract.*	Sottrárre, *to subtract.*
Distrárre, *to take off.*	

15. *Verbs ending in* VERE.

(1.) The irregular verb *móvere* or *muóvere*, to move, is thus conjugated :—

INF. *Simple Tenses.*—*Pres.* Móvere or muóvere, *to move.*—*Pres. Gerund.* Movéndo *or* muovéndo, *moving.*—*Past Part.* Mósso, *moved.*——*Compound Tenses.*—*Past.* Avére mósso, *to have moved.*—*Past Gerund.* Avéndo mósso, *having moved.*

IND. *Pres.* Muóvo *or* móvo, muóvi, muóve; moviámo, movéte, muóvono.—*Imp.* Movéva, movévi, movéva; movevámo, moveváte, movévano.—*Ind. Pret.* Móssi, movésti, mósse; movémmo, movéste, móssero.—*Fut.* Muoverò, muoverài, muoverà; muoverémo, muoveréte, muoveránno.—*Cond. Pres.* Muoveréi, muoverésti, muoverébbe; muoverémmo, muoveréste, muoverébbero.

IMP. Muóvi, muóva; moviámo, moviáte, muóvano.

SUB. *Pres.* Che muóva, che muóva, che muóva; che moviámo, che moviáte, che muóvano.—*Imp.* Che movéssi, che movéssi, che movésse; che movéssimo, che movéste, che movéssero.

(2.) The irregular verb *scrivere*, to write, is thus conjugated :—

INF. *Simple Tenses.*—*Pres.* Scrívere, *to write.*—*Pres. Gerund.* Scrivéndo, *writing.*—*Past Part.* Scrítto, *written.*——*Compound Tenses.*—*Past.* Avére scrítto, *to have written.*—*Past Gerund.* Avéndo scrítto, *having written.*

IND. *Pres.* Scrívo, scrívi, scríve; scriviámo, scrivéte, scrívono.—*Imp.* Scrivéva or scrivéa, scrivévi, scrivéva or scrivéa; scrivevámo, scriveváte, scrivévano.—*Ind. Pret.* Scríssi, scrivésti, scrísse; scrivémmo, scrivéste scríssero.—*Fut.* Scriverò, scriverài, scriverà; scriverémo, scriveréte, scriveránno.—*Cond. Pres.* Scriveréi, scriverésti, scriverébbe; scriverémmo, scriveréste, scriverébbero.

IMP. Scrívi, scríva; scriviámo, scrivéte, scrívano.

SUB. *Pres.* Che scríva, che scríva, che scríva; che scriviámo, che scriviáte, che scrívano.—*Imp.* Che scrivéssi, che scrivéssi, che scrivésse; che scrivéssimo, che scrivéste, che scrivéssero.

After this example conjugate the following :—

Circonscrívere, *to circumscribe.*	Riscrívere, *to write again.*
Contrascrívere, *to write against.*	Soscrívere, } *to subscribe.*
Descrívere, *to describe.*	Sottoscrívere, } *to subscribe.*
Inscrívere, *to inscribe.*	Soprascrívere, *to put the direction.*
Prescrívere, *to prescribe.*	Trascrívere, *to transcribe.*
Proscrívere, *to proscribe.*	

(3.) The irregular verb *sólvere*, to untie, is thus conjugated :—

INF. *Simple Tenses.*—*Pres.* Sólvere, *to untie.*—*Pres. Gerund.* Solvéndo, *untying.*—*Past Part.* Solúto, *untied.*——*Compound Tenses.*—*Past.* Avére solúto, *to have untied.*—*Past Gerund.* Avéndo solúto, *having untied.*

IND. *Pres.* Sólvo, sólvi, sólve; solviámo, solvéte, sólvono.—*Imp.* Solvéva *or* solvéa, solvévi, solvéva *or* solvéa; solvevámo, solveváte, solvévano *or* solvéano.—*Ind. Pret.* Solvéi *or* sólsi, solvésti, solvè *or* sólse; solvémmo, solvéste, solvérono *or* sólsero.—*Fut.* Solverò, solverái, solverà; solverémo, solveréte, solveránno.—*Cond. Pres.* Solveréi, solverésti, solverébbe; solverémmo, solveréste, solverébbero.

IMP. Sólvi, sólva; solviámo, solvéte, sólvano.

SUB. *Pres.* Che sólva, che sólva, che sólva; che solviámo, che solviáte, che sólvano.—*Imp.* Che solvéssi, che solvéssi, che solvésse; che solvéssimo, che solvéste, che solvéssero.

After this example conjugate the following :—

Infinitive.	*Present.*	*Ind. Pret.*	*Past Part.*	*English.*
Asciólvere,	asciólvo,	asciólsi,	asciólto,	*to take lunch.*
Assólvere,	assólvo,	assólsi,	assólto *or* -úto,	*to absolve.*
Dissólvere,	dissólvo,	dissólsi,	dissólto *or* -úto,	*to dissolve.*
Risólvere,	risólvo,	risólvi,	risólto *or* -úto,	*to resolve.*

(4.) The irregular verb *vivere*, to live, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Vivere, *to live.—Pres. Gerund.* Vivéndo, *living.—Past Part.* Vivúto *or* vissúto, *lived.——Compound Tenses.—Past.* Avére vivúto, *to have lived.—Past Gerund.* Avéndo vivúto, *having lived.*

IND. *Pres.* Vívo, víví, víve; viviámo, vivéte, vívono.—*Imp.* Vivéva *or* vivéa, vivévi, vivéva *or* vivéa; vivevámo, viveváte, vivévano *or* vivéano. —*Ind. Pret.* Víssi, vivésti, vísse; vivémmo, vivéste, víssero.—*Fut.* Viverò *or* vivrò, viverái, viverà; viverémo, viveréte, viveránno.—*Cond. Pres.* Viveréi, vivréi, *or* vivería; viverésti; viverébbe *or* vivería. Vivrémmo, viveréste, viverébbero.

IMP. Vívi, víva; viviámo, vivéte, vívano.

SUB. *Pres.* Che víva, che víva *or* víví, che víva; che viviámo, che viviáte, che vívano.—*Imp.* Che vivéssi, che vivéssi, che vivésse; che vivéssimo, che vivéste, che vivéssero.

After this example conjugate the following :—

Convívere, *to live together.*	Sorvívere, *to survive.*
Benevívere, *to live well.*	Sopravívere, *to survive.*
Rivívere, *to revive.*	

IRREGULAR VERBS OF THE THIRD CONJUGATION.

TABLE OF THE TERMINATIONS OF THE VERBS IN *isco.*

INFINITIVE MOOD.

Present. -íre. *Present Gerund.* -éndo. *Past Participle.* -íto.

INDICATIVE MOOD.

Present.	-ísco,	-ísci,	-ísce;	-iámo,	-íte,	-íscono.
Imperfect.	-íva,	-ívi,	-íva;	-ivámo,	-iváte,	-ívano.
Ind. Pret.	-íi,	-ísti,	-í;	-ímmo,	-íste,	-írono.
Future.	-irò,	-irái,	-irà;	-irémo,	-iréte,	-iránno.
Cond. Pres.	-iréi,	-irésti,	-irébbe;	-írémmo,	-iréste,	-irébbero.

IMPERATIVE MOOD.

	-ísci,	-ísca;	-iámo,	-íte,	-íscano.

SUBJUNCTIVE MOOD.

Present.	-ísca,	-ísca,	-ísca;	-iámo,	-iáte,	-íscano.
Imperfect.	-íssi,	-íssi,	-ísse;	-íssimo,	-íste,	-íssero.

1. The irregular verb *finíre*, to finish, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Finíre, *to finish.—Pres. Gerund.* Finéndo, *finishing.—Past Participle.* Finíto, *finished.——Compound Tenses.—Past.* Avére finíto, *to have finished.—Past Gerund.* Avéndo finíto, *having finished.*

IND. *Pres.* Finísco, finísci, finísce; finiámo, finíte, finíscono.—*Imp.* Finíva, finívi, finíva; finivámo, finiváte, finívano.—*Ind. Pret.* Finíi, finísti, finì; finímmo, finíste, finírono.—*Fut.* Finirò, finirái, finirà; finirémo, finiréte, finiránno.—*Cond. Pres.* Finiréi, finirésti, finirébbe; finirémmo, finiréste, finirébbero.

IMP. Finísci, finísca; finiámo, finíte, finíscano.

SUB. *Pres.* Che finísca, che finísca, che finísca; che finiámo, che finiáte, che finíscano.—*Imp.* Che finíssi, che finíssi, che finísse; che finíssimo, che finíste, che finíssero.

After this example conjugate the following :—

Abbellire, *to embellish.*	Garantire, *to warrant.*	Proibire, *to prohibit.*
Abbonire, *to perfect.*	Gestire, *to gesticulate.*	Rabbellire, *to adorn.*
Bandire, *to banish.*	Illaidire, *to grow ugly.*	Riunire, *to re-unite.*
Blandire, *to flatter.*	Illiquidire, *to liquefy.*	Sbaldanzire, *to despond.*
Brunire, *to burnish.*	Istituire, *to institute.*	Sbalordire, *to astonish.*
Candire, *to candy.*	Istruire, *to instruct.*	Schernire, *to mock.*
Chiarire, *to explain.*	Largire, *to give.*	Sminuire, *to diminish.*
Custodire, *to guard.*	Lenire, *to soften.*	Supplire, *to supply.*
Deferire, *to defer.*	Obbedire, *to obey.*	Tradire, *to betray.*
Difinire, *to define.*	Olire, *to smell sweet.*	Vagire, *to cry.*
Demolire, *to demolish.*	Ostruire, *to obstruct.*	Ubbidire, *to obey.*
Erudire, *to teach.*	Partorire, *to produce.*	Usucapire, *to claim by possession.*
Esanrire, *to exhaust.*	Patire, *to suffer.*	

2. The irregular verb *cucíre*, to sew, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Cucíre, *to sew.—Pres. Gerund.* Cucéndo, *sewing.—Past Part.* Cucíto, *sewed.——Compound Tenses.—Past.* Avére cucíto, *to have sewed.—Past Gerund.* Avéndo cucíto, *having sewed.*

IND. *Pres.* Cúcio, cúci, cúce; cuciámo, cucíte, cúciono.—*Imp.* Cucíva *or* cucía, cncívi, cucíva *or* cucía; cucivámo, cuciváte, cucívano *or* cucíano.—*Ind. Pret.* Cucíi, cucísti, cucì; cucímmo, cucíste, cucírono. *Fut.* Cucirò, cucirái, cncirà; cucirémo, cuciréte, cuciránno.—*Cond. Pres.* Cuciréi *or* cucirìa, cucirésti, cucirébbe *or* cuciria; cucirémmo, cuciréste, cucirébbero *or* cuciríano.

IMP. Cúci, cúcia; cuciámo, cucíte, cúciano.

SUB. *Pres.* Che cúcia, che cúcia, che cúcia; che cuciámo, che cuciáte, che cúciano.—*Imp.* Che cucíssi, che cucíssi, che cucísse; che cucíssimo, che cucíste, che cucíssero.

3. The irregular verb *apríre*, to open, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Apríre, *to open.—Pres. Gerund.* Apréndo, *opening.—Past Part.* Apérto, *opened.——Compound Tenses.—Past.* Avére apérto, *to have opened.—Past Gerund.* Avéndo apérto, *having opened.*

IND. *Pres.* Ápro, ápri, ápre; apriámo, apríte, áprono.—*Imp.* Apríva *or* aprìa, aprívi, apríva *or* apría; aprivámo, apriváte, aprívano *or* apríano. *Ind. Pret.* Aprii *or* apérsi; aprísti; aprì, apérse, *or* aprío. Aprímmo; apríste; aprírono *or* apérsero.—*Fut.* Aprirò, aprirái, aprirà; aprirémo, apriréte, apriránno.—*Cond. Pres.* Apriréi *or* apriría, aprirésti, aprirébbe *or* apriría; aprirémmo, apriréste, aprirébbero *or* apriríano.

IMP. Ápri, ápra; apriámo, aprite, áprano.

SUB. *Pres.* Ché ápra, che ápra, che ápra; che apriámo, che apriáte, che áprano.—*Imp.* Che apríssi, che apríssi, che aprísse; che apríssimo, che apríste, che apríssero.

4. The irregular verb *díre*, to say, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Díre, *to say.—Pres. Gerund.* Dicéndo, *saying.* —*Past Part.* Détto, *said.——Compound Tenses.—Past.* Avére détto, *to have said.—Past Gerund.* Avéndo détto, *having said.*

IND. *Pres.* Díco, díci *or* di', díce; diciámo, díte, dícono.—*Imp.* Dicéva *or* dicéa; dicévi; dicéva *or* dicéa. Dicevámo; diceváte; dicévano, dicéano, or dicíen.—*Ind. Pret.* Díssi, dicésti, dísse; dicémmo, dicéste, díssero.—*Fut.* Dirò, dirái, dirà; dirémo, diréte, diránno.—*Cond. Pres.* Diréi, dirésti, dirébbe; dirémmo, diréste, dirébbero.

IMP. Dì, díca; diciámo, díte, dícano.

SUB. *Pres.* Che díca, che díca, che díca; che diciámo, che diciáte, che dícano.—*Imp.* Che dicéssi, che dicéssi, che dicésse: che dicéssimo, che dicéste, che dicéssero.

After this example conjugate the following :—

Benedire, *to bless.*	Predire, *to foretell.*
Contradire, *to contradict.*	Ridire, *to speak again.*
Interdire, *to forbid.*	Soprabbenedire, *to bless again.*
Maladire, *to curse.*	Sopraddire, *to add something.*

5. The defective verb *íre*, to go, is thus conjugated :—

INF. *Pres.* Íre, *to go.—Past Part.* Íto, *gone.*

IND. *Pres.* Íte, *you go.—Imp.* Íva, *I was going;* ívano, *they were going.* —*Fut.* (plur.) Irémo, iréte, iránno.

IMP. Ite, *go ye.*

6. The irregular verb *moríre*, to die, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Moríre, *to die.—Pres. Gerund.* Moréndo, *dying.—Past Part.* Mórto, *dead.——Compound Tenses.—Past.* Éssere mórto, *to be dead.—Past Gerund.* Esséndo mórto, *being dead.*

IND. *Pres.* Muójo *or* muóro, muóri, muóre *or* muór; muojámo *or* moriámo, muoríte, muójono *or* muórono.—*Imp.* Moríva *or* moría; morívi; moríva or moría. Morivámo; moriváte; morívano, moríano, *or* moríeno.—*Ind. Pret.* Moríi; morísti; morì *or* morío. Morímmo; moríste; morírono, moríro, *or* morír.—*Fut.* Morrò *or* morirò, morrái *or* morirái, morrà *or* morrirà; morrémo *or* morirémo, morréte *or* moriréte, morránno *or* moriránno.—*Cond. Pres.* Morréi *or* moriréi; morrésti *or* morirésti; morrébbe, morirébbe, morría, *or* moriría. Morrémmo *or* morirémmo; morréste *or* moriréste; morrébbero, morirébbero, moriríano, *or* moriríeno.

IMP. Muóri, muója *or* muóra; muojámo *or* moríamo, moríte, muójano *or* muórano.

SUB. *Pres.* Che muója *or* muóra; che muója, muóra, móri, móra, mója; che muója *or* muóra. Che muójamo, moriámo, *or* moiámo; che muojáte, moriáte, *or* moiáte; che muójano *or* muórano.—*Imp.* Che moríssi, che moríssi, che morísse; che moríssimo, che moríste, che moríssero.

After this example conjugate the following :—

Premorire, *to die before.*	Rimorire, *to be extinguished.*

7. The irregular verb *salíre*, to go up, is thus conjugated :—

INF. *Simple Tenses.—Pres.* Salíre, *to go up.—Pres. Gerund.* Saléndo, *going up.—Past Part.* Salíto, *gone up.——Compound Tenses.—Past.* Éssere salíto, *to have gone up.—Past Gerund.* Esséndo salíto, *having gone up.*

IND. *Pres.* Sálgo *or* salísco; sáli *or* salísci; sále *or* salísce. Sagliámo *or* saliámo; salíte; sálgono, salíscono, *or* ságliono.—*Imp.* Salíva *or* salía, salívi, salíva *or* salía; salivámo, saliváte, salívanò *or* salíano.—*Ind. Pret.* Salíi *or* sálsi; salísti; sáli, sálse, *or* salío. Salímmo; salíste; salírono, sálsero, salíro, salír.—*Fut.* Salirò, salirái, salirà; salirémo, saliréte, saliránno.—*Cond. Pres.* Saliréi *or* saliría, salirésti, salirébbe *or* saliría; salirémmo, saliréste, salirébbero *or* saliríano.

IMP. Sáli, sálga *or* ságlia; sagliámo *or* salghiámo, salíte, sálgano *or* ságliano.

SUB. *Pres.* Che sálga, salísca, *or* ságlia; che sálga *or* salísca; che sálga, salísca, *or* séglia. Che sagliámo *or* saliámo; che sagliáte *or* saliáte;

che salgano, saliscano *or* ságlіano.—*Imp.* Che salissi, che salissi, che salisse; che salissimo, che saliste, che salissero.

After this example conjugate the following:—

Assalire, *to attack.*	Rassalire, *to attack again.*
Risalire, *to go up again.*	Soprasalire, *to attack unexpectedly.*

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER IX.—EGYPT BEFORE THE ERA OF ALEXANDER.

The ancient commercial history of Egypt is divided by strongly marked features into two epochs—that before and that after the time of Alexander. How far back the first period extended we know not. We see through the haze of time a nation apart and exclusive, its civilisation arrested and passive for years, emerging at length into fellowship with the outer world, chiefly through the persistence of Phœnician and Greek merchants, and much in the same manner as the peculiar nations of China and Japan are, in our own day, gradually being opened to Western commerce. There is reason to believe that Egypt was a settled nation long before the foundation of Nineveh and Babylon, and that these states derived their civilisation from Egypt; but Egypt did not enter into free intercourse with the rest of the world till after the time of Alexander. Two sea boundaries gave it an extensive line of coast. It is united to Asia by the isthmus of Suez, and lies open to the interior of Africa, the Nile forming a grand channel of communication with the south. The country, as now, was flooded three months in every year by the overflow of its river, and was likewise artificially irrigated by a network of canals, as well as from Lake Moëris, constructed by the king whose name it bears as a reservoir for the superabundant waters at the time of inundation. Inland boats and barges made of boards of papyrus were in general use on the Nile and on the canals as the common means of communication between the towns. A sailor caste is spoken of, and boats occupied a conspicuous place in the religious festivals.

Later in history Egypt owned a fleet of 400 vessels, used in the coasting trade, and even venturing as far as India. The wood, copper, and iron necessary for their construction were obtained from the Phœnicians. The Egyptians reached, perhaps, the highest development possible to a people excluding themselves from association with all others. Their system of castes confined trades and professions to certain families, and made productive skill in the various arts and handicrafts descend as an heirloom from parent to child. Resulting from this practice, a superior degree of excellence was manifested in their works of metal and wood. Their harps excelled those of modern make in beauty of form, and their chairs and couches were of chaste designs. Even in wicker-work they showed artistic skill. For many purposes of art and utility they used a compound metal of a green colour, the method of alloying which is now lost. Their cutlery and weapons of war were also made of a compound metal, a kind of brass or bronze. Elegance was specially aimed at in their pottery; the examples now in our museums are made of fine clay, and are very beautiful. Excellent cotton cloths and muslins, together with woollen fabrics and embroidered work or tapestry, were among the products of their industry. Buying and selling fell to the lot of the women. Household duties were attended to by the men. In accordance with this custom, it was the daughter, not the son, on whom devolved the duty of supporting a helpless parent. The laws promoted self-dependence. Securities for loans were contrived, usury was forbidden, and the rights of creditors were limited to the property of their debtors. They were a grave and unsociable people, of quiet, temperate habits, and submissive under control.

Every patch of the country that water could reach was cultivated, and good roads were formed. The Egyptians consumed more of vegetable than of animal food. The rich brown deposit of the Nile yielded grain, garlic, the lotus, and gourds in exuberance. The crops succeeded each other at intervals of six or eight weeks, and the whole soil was literally, as well as metaphorically, the "gift of the Nile."

Higher up the river valley were quarried the massive syenite slabs used in the erection of the temples, and the obelisks or needles, which, at a later date, took Cleopatra's name. Eastward, between the river and the Red Sea, a mountainous strip produced marble and the only metals found in Egypt. Camels were numerous; and the celebrated horses of the Delta were, from the flatness of the district, of great utility for chariots and warlike purposes. Long before Egypt owned vessels fit to navigate the sea, caravans traversed the country in all directions. Frankincense, spices, and wines were thus obtained from Arabia and Syria. Gold, ivory, feathers, skins, and slaves came through Ethiopia from Central Africa, and fine salt was also imported.

The jealousy of the Egyptians regarding the intrusion of foreigners by sea was the effect of fear. Possessing no timber for shipbuilding, and having a distaste for navigation, they were ill prepared to resist invasion; and as the first sailors were as much pirates as traders, no vessels, for a long period, were allowed to anchor in the Nile. Caravan traders only, not being formidable, were tolerated, with a kind of contempt.

Psammetichus, who ruled over Egypt B.C. 671-617, was the first king that dared to break in upon ancient prescription. He not only opened the country to Phœnician and Greek vessels, but employed Greek mercenaries in his army. These measures brought wealth to the state, but gave offence to the warrior caste, the whole of whom, in a body of about a quarter of a million of men, emigrated into Ethiopia, where they had a district assigned to them as a habitation.

Amasis, the foreigner's friend, the heir of Psammetichus, allowed the Greeks to erect temples and warehouses, and in the last year of his reign, 526 B.C., he removed all previous restrictions upon vessels by declaring the mouths of the river free to navigation. Many Greek merchants, therefore, settled in Egypt, introducing the manners and customs of their own country. Egyptian youths were placed with these families in order to learn the Greek language, and thus to facilitate trade. In this way there gradually arose a class of interpreters who became imbued with Greek habits and modes of thought, which they communicated to their own families. The Persians conquered the country, 525 B.C. Cambyses committed unheard-of atrocities, but the fate of his expedition against Ammonium and Ethiopia put an end to the commotions of war, and the gentler government of Darius Hystaspes left the Egyptians free to do as they pleased, so long as they did not fail in the payment of their yearly quota of a tribute of 700 talents, equal to £125,000, which was raised partly in Libya, Barca, and Cyrene, as well as in Egypt. Besides this, the country had to provide with corn a Persian garrison of 120,000 men, stationed at Memphis. The fishing in Lake Moëris was likewise monopolised by the conquerors. Under these comparatively easy conditions, commerce resumed its prosperous career. The Persian supremacy lasted from 525 B.C. till 332 B.C., when Alexander the Great conquered the country. During these two centuries trade and manufactures became much extended, but it is difficult to distinguish the wealth of the Greeks and Phœnicians from that of the natives. The paintings and sculptures in the tombs depict weavers and dyers using ornamented distaffs and looms. Linen and cotton fabrics, and silk from the byssus of the pinna, were worked and dyed of various tints, unmixed white, red, yellow, blue, green, or black. These stuffs were renowned for their quality and costliness in every country which Egyptian produce reached.

At this period the population of Egypt was very much larger than it is now. Greek writers affirm that 30,000 cities existed, and many millions of people. This was the era of the erection of those huge monuments whose ruins astonish the modern world. Kings fought hard against oblivion. Lifetimes were devoted to render imperishable the records of great rulers whose names are now forgotten, whose conquests are deemed fabulous, and whose embalmed bodies are indistinguishable amongst millions of other mummies. Lake Moëris, on the other hand, and the canals of Sesostris remain, as evidences of wisdom and skill applied to domestic improvement, and to the development of natural resources.

CHAPTER X.—EGYPT (*continued*) AFTER THE ERA OF ALEXANDER—ALEXANDRIA.

Alexander's ambition urged him to leave behind him permanent monuments of his fame. He destroyed some cities, but built greater. After the destruction of Tyre, Egypt submitted to the conqueror without an effort in self-defence. His keen eye, seeing the capabilities of the country, and the commanding position of the Delta, fixed upon a part of the coast opposite the island of Pharos as a site for a metropolis. Democrates, carring out the instructions of his master, connected Pharos with the mainland by a jetty or mole, and thus divided the channel into two harbours, facing the new city. Alexandria was built upon a grand plan, having, including the suburbs, a circuit of fifteen miles; while two noble roads, 100 feet broad, and adorned with temples, colonnades, and palaces, crossed it at right angles. These formed at their intersection a noble open place or square, whence could be viewed vessels sailing in from the sea to either harbour. One of the quarters thus marked out was wholly devoted to the palaces and gardens of royalty; and here, a few years afterwards, in the chief of the royal temples, was deposited the body of the great founder, in a coffin of gold.

The successors of Alexander in Egypt were the Ptolemies, who raised the city to the summit of its opulence and greatness. Ptolemy Philadelphus reared a lighthouse of white marble, on the island of Pharos, to the height of 400 feet, adorned with columns, and described as one of the seven wonders of the ancient world. Fires on its summit at night guided vessels safely into port. A modern lighthouse now stands on the same spot. Lake Marëotis, on the south of the city, was formed into a third harbour, by a canal communicating with that on the east. The western harbour was so spacious and deep, that vessels too large for any other port could there find anchorage, and load and discharge their freights. Such a ship, sent by Hiero, King of Sicily, as a present to one of the Ptolemies, is said to have had on board small gardens, with water-courses for their irrigation, an apparatus for slinging stones, and eight lofty towers, and to have taxed the utmost powers of Archimedes to make it manageable. Caravans unloaded at Lake Marëotis, whence their treasures were conveyed by canal to the adjoining harbour.

Alexandria retained its rank as a great commercial city for a thousand years. At one period it contained three-quarters of a million of inhabitants, half of whom probably were slaves. While Egypt was a Roman province its commerce declined; yet Alexandria must still have been a magnificent place when taken by the Arabs, A.D. 651, for Amrou, the victorious general, in writing to the Caliph Omar, said it was impossible to describe its beauty and the variety of its riches.

The convenience of Alexandria as a mart for trade between the East and the West, attracted merchants from every commercial country. Its inhabitants thus became quite cosmopolitan, blending the thoughts and manners of all regions. The Ptolemies, especially the first four princes of that name, fostered the development of the city. Ptolemy Lagus, or Soter, encouraged foreigners to reside there, by granting them districts to live in. As many as 100,000 Jews were at one time inhabitants of the city. Although this prince was almost constantly at war, he still made commerce his care. He owned, besides a powerful navy, a fine fleet of merchant ships, promoted expeditions to establish trade, and signed treaties of commerce with other states. His son, Ptolemy Philadelphus, who inherited the same spirit, dug a canal for ships from the Nile to the Red Sea, and, to increase the inland traffic, lined the caravan routes with wells and caravanserais. Arsinoe, Berenice, and Myos Hormos, arose on the banks of the new canal, whence commodities transferred from ship to caravan were conveyed to Coptis and Thebes. It was a boast in his reign that "no citizen was idle in Alexandria." Even the blind and lame were taught to labour. Glass-blowing, the weaving of linen, paper-making from the papyrus, and the arts connected with the shipping trade, employed the people; while the most fruitful country known to mankind provided them with abundant food.

Ptolemy Euergetes (Ptolemy III.) succeeding to the rich inheritance of his fathers, determined to make his capital the most learned as well as the most commercial city of the time. He founded a school for teaching the sciences connected with commerce, and invited philosophers of every country to make Alexandria their home. Eratosthenes, who suggested the means of measuring the earth by methods similar to our own, was among those who responded to his call. The basis of commercial prosperity thus laid was broad enough to bear, without serious peril, the devastations of the civil wars caused by the follies and incapacities of some of the succeeding Ptolemies.

Ptolemy IV. possessed a fleet of more than 400 ships. The crew of one is said to have consisted of 7,400 sailors and mariners, and the size, as described, is almost incredible. That his fleet was numerous we may be sure, for there are proofs that the Egyptian trade had extended to the Euxine; and his influence must have been great, inasmuch as he sought and obtained the abolition of the tolls at the Bosphorus. Cleopatra, the last of this celebrated dynasty, added 400 vessels to the fleet of Mark Antony; and when the great battle of Actium was lost, she was prevented from retreating to India, by the Arabs having burnt another fleet belonging to her in the Red Sea.

By the destruction of Carthage, B.C. 146, the great trade of that city was diverted to Alexandria, which thus received a great impulse to its prosperity. Possessing universal commerce, its commodities necessarily comprised almost everything marketable that could link nations together. Primarily, Alexandria drew its stores from Egypt, of which it was for the time being the capital.

Under the Ptolemies, Coptos, below Thebes, was the starting point for the caravans of Arabia and India, as Kopt, its modern representative, is now for the pilgrimages to Mecca.

Asia and India dispatched their treasures to Alexandria for further distribution; and Europe, from its remotest islands, sent to the same mart her surplus produce. From the south and west came the merchandise of Soudan. We do not trace to Alexandria any inventions that have modified commerce. There are extant coins of the Ptolemies, showing an acquaintance with money; but these, though an advance beyond the primitive silver rings and ingots of Egypt, were merely adopted from the Greeks, and are inscribed with Greek characters.

The city was long noted for the fostering care it bestowed upon art and science; and even while its trade languished under the military rule of the Romans, the library contained, it is affirmed, a volume for every inhabitant—a larger number of books than were ever collected elsewhere, before the invention of printing. The whole are, however, lost to us; the Arabs having, it is said, destroyed the entire collection when they captured the city, A.D. 640.

From this period Alexandria gradually declined.

LESSONS IN GREEK.—XLVI.

VERBS IN μι (*continued*).

VERBS IN μι WHICH, AFTER ADDING THE SYLLABLE ννῡ OR νῡ TO THE STEM-VOWEL, APPEND THE PERSONAL ENDINGS.

We give here the formation of the verbs in α, ε, ο, and of those whose stem terminates in a consonant:—

(a.) Verbs with a Stem ending in α, ε, ο (ω).

		Active.	
Pres.	σκεδα-ννῡ-μι, *I scatter.*	κορε-ννῡ-μι, *I satisfy.*	στρω-ννῡ-μι, *I spread out.*
Imp.	ε-σκεδα-ννῡ-ν.	ε-κορε-ννῡ-ν.	ε-στρω-ννῡ-ν.
Perf.	ε-σκεδᾰ-κα.	κε-κορε-κα.	ε-στρω-κα.
Plup.	ε-σκεδᾰ-κειν	ε-κε-κορε-κειν.	ε-στρω-κειν.
Fut.	σκεδά-σω.	κορε-σω.	στρω-σω.
	Attic, σκεδῶ, -ᾷs, ᾷ.	Attic, κορῶ, -εῖs, -εῖ.	
Aor.	ε-σκεδᾰ-σα.	ε-κορε-σα.	ε-στρω-σα.
		Middle.	
Pres.	σκεδα-ννῠ-μαι.	κορε-ννῠ-μαι.	στρω-ννῠ-μαι.
Imp.	ε-σκεδα-ννῠ-μην.	ε-κορε-ννῠ-μην.	ε-στρω-ννῠ-μην.
Perf.	ε-σκεδα-σ-μαι.	κε-κορε-σ-μαι.	ε-στρω-μαι.
Plup.	ε-σκεδα-σ-μην.	ε-κε-κορε-σ-μην.	ε-στρω-μην.
Fut.		κορε-σομαι.	
Aor.		ε-κορε-σαμην.	
3 Fut.		κε-κορε-σομαι.	
		Passive.	
Aor.	ε-σκεδα-σ-θην.	ε-κορε-σ-θην.	ε-στρω-θην.
Fut.	σκεδα-σ-θησομαι.	κορε-σ-θησομαι.	στρω-θησομαι.

Verbal Adj σκεδαστος, σκεδαστεος; κορεστος, κορεστεος; στρωτος, στρωτεος.

Another form of the present and imperfect is, σκεδα-ννυω, ε-σκεδα-ννυον; κορε-ννυω, ε-κορε-ννυον; στρω-ννυω, ε-στρω-ννυον; the υ being always short.

(*b.*) *Verbs with a Stem terminating in a Consonant, as* ολ-λυ-μι (ΟΛ-), I destroy, *and* ομ-νῡ-μι (ΟΜ-), I swear.

		Act.	*Mid. and Pass.*
Pres.	ολ-λῡ-μι (Lat. *perdo*). ολ-λῡ-μαι (*pereo*).	ομ-νῡ-μι ;	ομ-νῡ-μαι.
Imp.	ωλ-λῡ-ν.	ωμ-νῡ-ν ;	ωμ-νῡ-μην.
1 Perf.	ολ-ωλε-κα (ΟΛΕΩ), *perdidi.*	ομ-ωμο-κα ; (ΟΜΟΩ).	ομ-ωμο-σ-μαι.
2 Perf.	ολ-ωλ-α, *perii.*		
1 Plup.	ωλ-ωλε-κειν, *perdideram.*	ομ-ωμο-κειν ;	ομ-ωμο-σ-μην.
2 Plup.	ολ-ωλ-ειν, *perieram.*		
Fut.	ολ-ῶ, -εῖς. ολ-οῦμαι, -ῇ.	ομ-οῦμαι, -ῇ.	
1 Aor.	ωλε-σα.		
2 Aor.	ωλ-ομην.	ωμο-σα ;	ωμο-σαμην.
		1 A. P.	ωμο-σ-θην.
		1 F. P.	ομο-σ-θησομαι.

Of the present and imperfect there is another form with the υ short, namely, ολλυ-ω, ωλλυ-ον ; ομνυ-ω, ωμνυ-ον.

The present, the first perfect, and the first pluperfect have a transitive signification ; thus, pres. *I destroy*, 1 perf. *I have destroyed*, 1 plup. *I had destroyed ;* and the 2 perf. and 2 plup. have an intransitive meaning, as 2 perf. *I have perished* (*I am lost, it is all over with me*), 2 plup. *I perished.* The middle of ολλυμι, namely, ολλυμαι, signifies *I am perishing.*

(1.) In particular instances belonging to this class of verbs the stem ends in a vowel, and takes ννῡ.

Verbs whose Stem ends in α.

1. κερα-ννῡ-μι, *I mix ;* fut. κερᾰσω, Attic κερῶ ; aor. εκερᾰσα ; perf. κεκρᾱκα ; mid., *I mix for myself*, aor. εκερασαμην ; perf. mid. or pass. κεκρᾱμαι ; aor. pass. εκρᾱθην (by metathesis), also εκερασθην.
2. κρεμα-ννῡ-μι, *I hang ;* fut. κρεμᾰσω, Attic κρεμῶ ; aor. εκρεμᾰσα ; mid. or pass. κρεμαννυμαι, *I hang myself* or *am hanged*, but κρεμᾰμαι, *I hang ;* fut. pass. κρεμασθησομαι ; aor. εκρεμασθην, *I was hanged* or *I hung* (intrans.).
3. πετα-ννῡ-μι, *I spread out, I open ;* fut. πετᾰσω, Attic πετῶ ; perf. mid. or pass. πεπτᾰμαι (by syncope), aor. pass. επετασθην.

Verbs whose Stem ends in ε.

1. ἑ-ννῡ-μι, *I clothe* (in prose αμφιεννυμι) ; imperf. αμφιεννυον, without augment ; fut. αμφιεσω, Attic αμφιῶ ; aor. ημφιεσα ; perf. aor. wanting ; perf. mid. or pass. ημφιεσμαι, ημφιεσαι, ημφιεσται, etc. ; inf. ημφιεσθαι ; fut. mid. αμφιεσομαι, Attic αμφιοῦμαι.
2. ζε-ννῡ-μι, *I boil* (transitive), fut. ζεσω ; aor. εζεσα ; perf. mid. or pass. εζεσμαι ; aor. pass. εζεσθην (ζεω is commonly intransitive).
3. σβε-ννῡ-μι, *I extinguish*, fut. σβεσω ; aor. εσβεσα ; 2 aor. εσβην, *I went out, I was extinguished ;* perf. εσβηκα, *I have been put out ;* mid. σβεννυμαι, *I go out ;* perf. mid. or pass. εσβεσμαι ; aor. pass. εσβεσθην. There is no other verb in νῡμι, except this, with a second aorist.
4. στορε-ννῡ-μι, *I spread over*, fut. στορεσω, Attic στορῶ ; aor. εστορεσα.

Verbs whose Stem ends in ο, *lengthened into* ω.

1. ζω-ννῡ-μι, *I gird*, fut. ζωσω ; aor. εζωσα ; mid. *I gird myself*, aor. εζωσαμην ; perf. mid. or pass. εζωσμαι.
2. ῥω-ννῡ-μι, *I strengthen ;* fut. ῥωσω ; aor. εῤῥωσα ; perf. mid. or pass. εῤῥωμαι (εῤῥωσο, vale, *farewell*) ; inf. εῤῥωσθαι ; aor. pass. εῤῥωσθην.
3. στρω-ννῡ-μι, *I spread out ;* fut. στρωσω ; aor. εστρωσα, etc. (see στορεννυμι).
4. χρω-ννῡ-μι, *I colour ;* fut. χρωσω ; aor. εχρωσα ; perf. mid. or pass. κεχρωσμαι ; imp. εχρωσθην.

(2.) Verbs whose stem ends in a consonant and takes νῡ are the following :—

1. αγ-νῡ-μι, *I break ;* fut. αξω ; aor. εαξα ; inf. αξαι ; 2 perf. εᾱγα, *I have been broken ;* aor. pass. εᾱγην.
2. εἱργ-νυ-μι (or εἱργω), *I restrain, enclose ;* fut. εἱρξω ; aor. εἱρξα ; aor. pass. εἱρχθην ; perf. mid. or pass. εἱργμαι (but ειργω, ειρξω, ειρξα, *I exclude*).
3. ζευγ-νῡ-μι, *I yoke, bind ;* fut. ζευξω ; aor. εζευξα ; mid. *I bind for myself ;* aor. εζευξαμην ; perf. mid. or pass. εζευγμαι ; aor. pass. εζευχθην, and more commonly εζῠγην.
4. μιγ-νῡ-μι, *I mix ;* fut. μιξω ; aor. εμιξα, μιξαι ; perf. μεμιχα ; perf. mid. or pass. μεμιγμαι ; aor. pass. εμιχθην, εμῐγην ; fut pass. μιχθησομαι, μιγησομαι ; 3 fut. μεμιξομαι.
5. ῥηγ-νῡ-μι, *I break, I tear ;* fut. ῥηξω ; aor. εῤῥηξα ; 2 perf. εῤῥωγα, *I am broken ;* aor. mid. εῤῥηξαμην ; aor. pass. εῤῥᾰγην ; fut. pass. ῥᾰγησομαι.

INFLECTIONS OF THE TWO PRESENT-PERFECT FORMS, κεῖμαι, *I lie*, AND ἧμαι, *I sit*,

Perf. Ind. κεῖμαι, κεῖσαι, κεῖται, κείμεθα, κεῖσθε, κεῖνται ; subj. κεωμαι, κεῃ, κεηται, etc. ; imperat. κεῖσο, κεισθω, etc. ; inf. κεῖσθαι, part. κειμενος.

Plup. Ind. εκειμην, εκεῖσο, εκεῖτο, 3 plur. εκειντο ; opt. κεοιμην, κεοιο, κεοιτο, etc.

Fut. κεισομαι.

Ἧμαι, *I sit*, is thus conjugated :—

Perf. Ind. ἧμαι, ἧσαι, ἧσται, ἥμεθα, ἧσθε, ἧνται ; imperat. ἧσο, ἥσθω, etc. ; inf. ἧσθαι ; part. ἥμενος.

Plup. ἥμην, ἧσο, ἧτο, ἥμεθα, ἧσθε, ἧντο.

(As the perfect form has a present meaning, so in both verbs the pluperfect is equivalent to the imperfect.)

Perf. καθημαι, καθησαι, καθηται ; subj. καθῶμαι, καθῇ, καθῆται ; imperat. καθησο ; inf. καθῆσθαι ; part. καθημενος.

Plup. εκαθημην and καθημην, εκαθησο and καθησο, εκαθητο and καθηστο ; opt. καθοιμην, καθοιο, καθοιτο.

VERBS IN ω WHICH IN THE SECOND AORIST ACTIVE AND MIDDLE FOLLOW THE ANALOGY OF THE VERBS IN μι.

Several verbs, having the characteristics α, ε, ο, υ, form a second aorist active and middle after the analogy of the formations in μι, since those tenses want the mood-vowel, and append the person-endings immediately to the stem. All other parts of these verbs, however, follow the formations in ω ; thus—

βαινω (ΒΑΩ), *I step*, has 2nd aor. indic. εβην, imperat. βηθι, sub. βω, opt. βαιην, infin. βηναι ; part. βας.

σβεννυμι (ΣΒΕΩ), *I put out*, 2 aor. εσβην, imperat. σβηθι, sub. σβω ; opt. σβειην, inf. σβηναι, part. σβεις.

γιγνωσκω (ΓΝΟΩ), *I learn*, 2 aor. εγνων, imperat. γνωθι, sub. γνω, opt. γνοιην, inf. γνωναι, part. γνους.

δυω, *I cover*, 2 aor. εδῡν, imperat. δυθι, inf. δυναι, part. δυς (opt. and subj. follow the formation of verbs in ω).

The formation of this second aorist active corresponds in all the moods and the participle to that of the second aorist active of the verbs in μι. The characteristic vowel is lengthened throughout, as in εστην, ᾰ and ε being changed into η, ο into ω, and ῠ into ῡ, and so remains, as in εστην, through all the indicative, imperative, and infinitive. The imperative termination, ηθι, in verbs with α for the characteristic vowel, is abridged into ᾰ, as προβᾰ instead of προβηθι.

In ordinary style the second aorist middle is found in very few verbs, as πετομαι, *I fly ;* πριασθαι, *I purchase.*

KEY TO EXERCISES IN LESSONS IN GREEK.—XLV.

EXERCISE 133.—GREEK-ENGLISH.

1. Good men do not omit their duty through sleep. 2. Do not give up what is known and follow that which is unknown. 3. Many men desire wealth. 4. Xerxes is said to have let down fetters into the Hellespont, as if, forsooth, to punish it. 5. It is not easy to hold back a stone when you have let it go from your hand with force, or a word from your tongue. 6. Hercules, having pursued the boar of Erymanthus into a deep snow-drift with his shouting, ensnared him as he lay there. 7. The Nile empties itself into the sea by seven mouths. 8. Whatever shall come after, the gods provide for. 9. If you are (*since you are*) mortal, the best of men think also mortal thoughts. 10. While you are young, remember that you will once be old. 11. Be just, that you may obtain justice. 12. When might is present, law has no power. 13. May I be happy and dear to the gods.

EXERCISE 134.—ENGLISH-GREEK.

1. Ισθι. 2. Ιτω. 3. Ω. 4. Ειην. 5 Εφιεμενος. 6. Ιων. 7. Εστων. 8. Ιοντων. 9. Ιθι. 10. Αγαθος ισθι. 11. Αγαθοι εστε. 12. Αγαθοι εστων. 13. Εξειμι. 14. Καθιης. 15. Προσῃεσαν. 16. Εἶμι. 17. Ιασιν. 18. Ηιεις. 19. Ηιτην. 20. Ὁ αγαθος ουποτε μεθησει τα δεοντα πραττειν. 21. Πολλοι αφιεντες τα φανερα διωκουσι τα αφανη. 22. Ξερξης εις τον Ἑλλησποντον πεδας καθηκεν. 23. Ου δια της γλωσσης αλλα δι' εργων ανθρωπος φιλος εμοι αν γενοιτο. 24. Δικαιοι εστε ἱνα και δικαιων τυχητε. 25. Φιλος φιλου και αποντος φροντιζει. 26. Ὁτε οἱ πολεμιοι εις την πολιν εισῃεσαν απεφυγον οἱ πολιται. 27. Απιτε, ω παιδες. 28. Δει τους στρατιωτας απο της πολεως απιεναι. 29. Ανα στρατευματε εις την ημετεραν πατρῳαν γην εισῃτην.

HEAT.—V.

CONDUCTION—SPHEROIDAL STATE—CONVECTION—RADIANT HEAT—ABSORBING POWER—POWER OF TRANSMITTING HEAT—CONCLUSION.

WHEN a heated body has to be handled, some non-conducting material is usually interposed between it and the hand, so as to guard against burns. Thus in most teapots an ivory ring is let into the handle, for the sake of keeping it cool. Many apparently strange phenomena may be explained in this way. A kettle, for instance, that has been used some time, and become coated with fur outside, may be taken off the fire and placed with impunity on the naked palm, even though the water be boiling in it. The fur is a non-conducting material, and protects the hand from the heat.

A red-hot poker likewise may be safely struck with the hand. This partly arises from the fact that a quick blow does not allow time for the metal to burn the hand, and partly from the fact that the moisture of the hand is converted into vapour, and prevents absolute contact with the heated iron. Some remarkable phenomena have been observed which illustrate this fact. If we take a silver vessel, and having raised it to a temperature a little above 212°, immerse it in a vessel of water, it will hiss from the sudden conversion of the water into steam, and will speedily be cooled down. If, however, we heat the vessel to redness, and place it on the surface of water, no effect will at first be produced. It will quietly float for a time without any sound being heard. After a little while, however, a cloud of steam will be suddenly produced, and the usual hissing noise will be heard. A similar thing occurs if a highly heated silver weight be dipped into a vessel of water.

The reason of these apparently strange phenomena is that as soon as the heated metal touches the water, that portion which is nearest to it becomes suddenly converted into steam, and this keeps the silver from contact with the water. A layer of vapour is, in fact, interposed, which prevents actual contact. When, however, the silver is cooled down nearly to the temperature of boiling water, the separation ceases to exist, and the water comes in contact with the silver and cools it.

These effects were first observed by Leidenfrost, but have since been carefully investigated by others. A simple way of showing them is to take a platinum or silver dish, and having placed a spirit-lamp under it so as to heat it to redness, drop with a pipe a little water into it. The liquid does not spread itself out and moisten the dish as it would at ordinary temperatures, but at once assumes a globular form, and rotates rapidly. Its evaporation, too, is very much less rapid than it would be if it boiled, and its temperature appears only to be about 95° or 100°. The liquid is said to have assumed the *spheroidal state*, and will remain in this condition if the source of heat is kept under the dish. If, however, it be removed, the heat will gradually diminish, till it is no longer sufficient to maintain the globule in the spheroidal state, and then the liquid will touch the metal, and be immediately thrown into a state of violent ebullition, a large amount of steam being given off.

A remarkable experiment may be tried which will illustrate this fact very clearly. Procure a large melting-pot containing several pounds of lead, and place it over a fire until the lead is not only melted, but quite red-hot. Having washed the hand so as to free it from grease, dip it into a vessel containing strong liquor ammonia, and it may then be plunged into the molten metal, or the lead may be ladled out by it, without any danger. The only sensation produced is one of cold. This experiment is one which few have the courage to attempt, but it is perfectly safe. The heat of the metal evaporates the liquid and drives out the ammoniacal gas from it, and thus the hand is entirely enveloped in a glove of vapour, which prevents contact with the lead. The cold felt arises from the rapid evaporation. In performing this experiment, it is very important to have the lead red-hot, as otherwise it may come into contact with the hand, and a severe burn will then be produced.

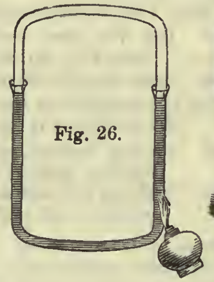


Fig. 26.


Fig. 29.

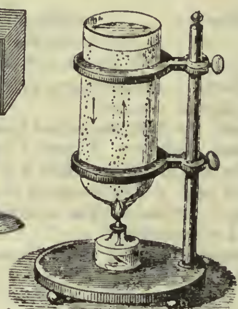


Fig. 25.

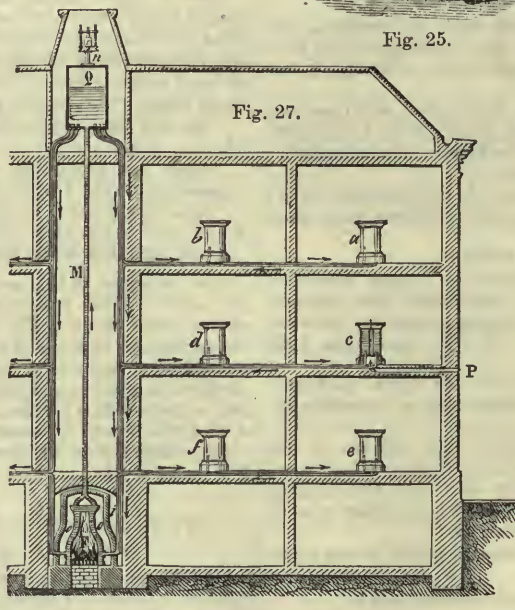


Fig. 27.

After conduction, the next mode in which heat is transmitted is by *convection*, or the setting up of currents in the liquid or gas to be heated. By this means each particle in succession is directly exposed to the source of heat, and thus has its temperature raised.

There are several ways in which convection may be illustrated:—one of the best is to take a glass vessel filled with water (Fig. 25), and having dropped in a few fragments of litmus or a little cochineal, place a spirit-lamp under it, and watch the liquid. A stream will begin to rise directly over the lamp, its course being clearly shown by the coloured particles. This stream will rise to the top of the vessel, where it will spread out and form a down current at the sides, and in this way all the liquid will in turn be exposed to the heat.

Another way in which this circulation may be shown is represented in Fig. 26. Two glass tubes are bent as there shown, the lower one being filled with coloured water; the other is filled with clear water, and is inverted into the funnel-shaped ends of the first. A spirit-lamp is now held to one side so as to warm the liquid there, and the coloured part of the liquid in that limb will at once begin to rise, and to descend in the other.

On this principle the hot-water apparatus frequently employed for warming large buildings is constructed (Fig. 27). A furnace and boiler are placed at the lower part of the building. From this a pipe, M, passes to a cistern, Q, at the top, provided with a safety-valve, *n*; and from it pipes lead to the stoves, *a*, *b*, *c*, *d*, *e*, *f*, in the various rooms. The water traverses these on its way back to the boiler, and gives up to them much of its heat. The water heated by the furnace becomes, of course, specifically lighter, and hence rises, while that which has been cooled by its passage through the pipes descends, and in this way a constant circulation is maintained.

Gases as well as liquids are heated by convection. The trade-winds are grand natural illustrations of this fact: the air having become heated by contact with the surface of the earth in tropical regions, expands, and rises, making way for the currents of colder air from the poles. In the higher regions of the atmosphere a current usually sets in the contrary direction to that on the earth's surface, and thus forms the return current. Land and sea breezes are further exemplifications of the same fact.

The third way in which heat is communicated from one body to another is by means of *radiation*. In conduction and convection the particles of matter to be heated were brought into close contact with the source of heat: we shall now find, however, that heat can pass from one body to another without actual contact, and even without altering the temperature of the medium through which it passes. A striking illustration of the latter fact is seen in the experiment of setting light to various substances by condensing the sun's rays on them through a lens of ice. The heat passes through it in sufficient quantities to inflame the substances, and yet the ice is unmelted.

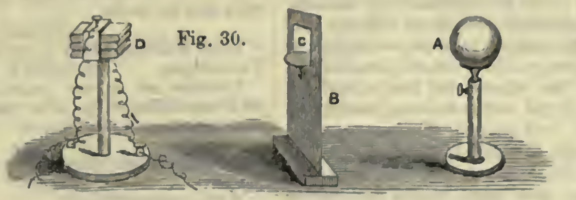


Fig. 30.

When we stand a little distance from a fire we at once experience a sensation of warmth, no particles of matter appear to pass, and yet the influence of the fire is felt. Rays of heat are given off by the burning fuel, which create in us the feeling of warmth. The presence of the air is evidently not necessary for their passage, since we experience the heat of the sun, whose rays must pass through space. We may also prove this fact experimentally by letting two charcoal points connected with a powerful battery touch under an exhausted receiver. Rays of heat will be given off despite the absence of the air, and their presence will at once be felt.

Now we find that radiant heat obeys the same laws as light does, the rays being given off in all directions, and, in a uniform medium, always travelling in a straight line. This may easily be shown by suspending a heated body in the air, and then holding a thermo-electric pile at equal distances on each side of it. If, however, a plate of metal be interposed between the pile and the source of heat, the rays will at once be intercepted, and the needle will return to zero. The power of radiant heat diminishes, as in the case of light, with the square of the distance.

If we take a heated body, such as a cubical vessel, M, filled with boiling water (Fig. 28), and place it in front of a concave mirror, we shall find that the rays of heat are reflected from its surface, in the same way as those of light are. Let a differential thermometer be placed in the focus of the mirror, a screen, A, being placed so as to keep off the direct rays from M. The indicating bubble will at once show the increase of temperature; if the bulb be moved at all out of the focus, the bubble will return to its place, clearly showing that the rays have been reflected and brought to a focus. By means of a small mirror we can easily prove that in the case of reflected heat the angle of incidence is always equal to the angle of reflection. An ordinary sheet of tin held in front of a fire will illustrate this reflection of heat, and from it we shall understand the use of reflectors in roasting. As the amount of heat reflected depends upon the brightness of the reflectors, the necessity for keeping them clean and bright will be apparent. For the same reason, the back and sides of a stove should be kept as clean as possible, so as to throw out the heat into the room.

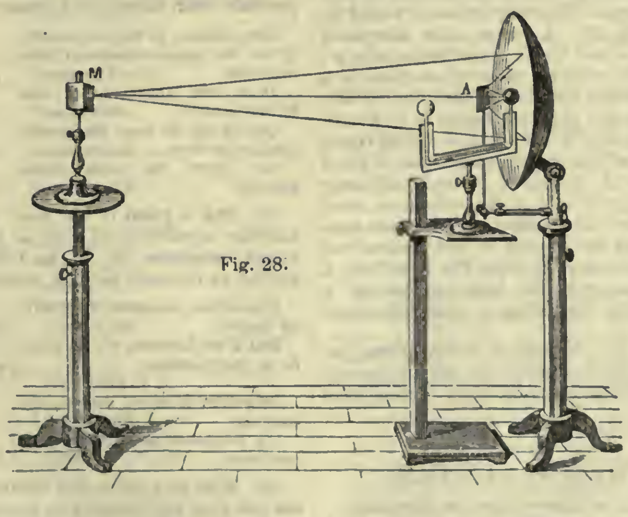


Fig. 28.

Rays of heat may be refracted as well as reflected. When a beam from an electric lamp is caused to fall upon a prism, the luminous rays are bent out of their course, and resolved into the prismatic colours; the heat-rays are likewise diverted; and if we place behind the spectrum a metal screen with a narrow slit in it, so as only to allow the rays from one part of the spectrum to pass at a time, we may, by a pile, test the heat of different parts. In doing so we find that at the violet end of the spectrum there is but little heat; even in the yellow, though that is the most luminous part, there is not much. At the red portion the heat is greater, but its intensity is greatest when the pile is moved altogether beyond the visible spectrum, so that the most intense portion of the heat is altogether non-luminous. The thermal spectrum, in fact, overlaps the visible one.

When we commence to try experiments on the radiation of heat, we soon find that different surfaces possess different powers of throwing off rays of heat. This is easily shown by means of a "Leslie" cube (Fig. 29), which consists simply of a tin or pewter cube with an opening on one side, by which it can be filled with boiling water. One side may be covered with a layer of gold-leaf, another with glass, a third with lamp-black, while the fourth is left blank. Each side is now turned in succession towards the thermo-electric pile, and the exact deflection of the needle noted. Other substances may then be laid on the sides of the cube, and in this way a table showing the radiating power of different bodies may be drawn up.

When the gilded face is towards the pile, little effect will be produced; if the pewter be a little tarnished, a greater deflection will be produced when that side is turned to the pile. When the glass side is presented, the intensity will be much more, while with the lamp-black it will be most of all. As lamp-black is the best radiator, its power is represented by 100, and then the power of gold and other brilliant metals will be between 12 and 15.

Another way in which we may show these different powers of radiation is to observe the time which water takes to cool when placed in different vessels. Take, for example, two similar cubes, and let one be covered with lamp-black while the other is left bright. Fill both with boiling water, and after some time test the temperature of each. That coated with lamp-black will be found several degrees cooler than the other. It has radiated heat more rapidly, and hence has lost a larger amount.

If we substitute a lump of ice or a cube of ice-cold water for the vessel M (Fig. 28), and place the thermometer as before, it will fall, and thus indicate an apparent radiation of cold. This is only apparent, however; both the ice and the thermometer possess a certain amount of heat, which they radiate. The thermometer, however, being at a higher temperature, throws off more intense rays, and hence, as it parts with more heat than it receives, its temperature falls. The chill felt when standing near a cold surface may be similarly explained.

When rays of heat fall upon any substance, they are divided into three parts. One portion is reflected from the surface, according to the laws already mentioned; a second part is irregularly scattered, and is known as *diffused heat*. This corresponds to the light which is irregularly reflected from any substance, and renders it visible. The third portion is absorbed by the substance, and raises its temperature. When a number of surfaces are exposed thus to the rays from a heated body, their absorbing powers will be found to differ very greatly, in some cases nearly all the heat being absorbed, while in others by far the greater portion is reflected. These two amounts will, as a rule, be inversely proportional, the best reflectors being the worst absorbers, and *vice versâ*.

The absorbing power, likewise, is just equal to the radiating power; they appear to be, in fact, almost synonymous terms. The difference caused in the absorbing power by the nature of the surface may easily be shown. Let the beam of an electric lamp fall upon the clean bulb of a differential thermometer; the rays, as they have already passed through the glass lenses and through a stratum of air, will impart no heat to the thermometer, which will remain unaffected. If now we lay a little lamp-black on the bulb, the heat will at once be absorbed, and the bubble driven to the other limb.

Many common practices can easily be explained by noticing the different absorbing and radiating powers of various substances. A dish-cover or metal teapot is kept as bright as possible, so as to prevent the escape of the heat by radiation; a black earthenware teapot, on the other hand, has a dull and dark surface, so that it may be placed on the hob and absorb the heat. So, too, if a kettle is to heat quickly, the part exposed to the fire should be covered with fur and soot, to absorb the heat; the other part should be bright, to prevent its radiation. These things, like many similar ones, were known and put in practice long before their true causes were known, but science now shows us how to account for them.

The laws of radiation likewise account for the deposition of dew at night. The air is then cooler than the surface of the earth, and the latter accordingly radiates its heat into space. Those bodies, therefore, which are the best radiators become cool most rapidly, and therefore condense the vapour which exists in the air. Plants radiate freely, and hence become coated with dew, while a smooth road remains almost dry.

Clouds, to a great extent, prevent this radiation, and hence the dew will be most plentiful on a clear and cloudless night. A very thin layer of calico or matting is likewise sufficient to retard radiation, and for this reason gardeners often place a covering of this kind over delicate plants to protect them from injury by the cold. When the temperature of the ground is very low the dew freezes as it is deposited, and constitutes hoar-frost.

When experimenting with radiant heat, we find, as already referred to, that substances differ greatly in the amount of heat they allow to pass through them. This may be easily tested by the arrangement shown in Fig. 30. A screen, B, is interposed between the source of heat, A, and the thermo-electric pile, D; all stray rays are thus cut off, and only those which pass in a straight line through the aperture C can reach the pile. Under C is a small shelf, on which we can place the bodies to be tested. A glass cell filled with bisulphide of carbon and placed there, will allow about 63 per cent. of the rays to pass, while if filled with water, it will only allow 11 per cent.; other liquids may also be tried. Among solids, rock-salt is the substance most transparent to heat, as it allows about 92 per cent. of the rays to pass. With most substances the amount of heat transmitted varies with the nature of the source of heat, the heat from a coil of incandescent platinum wire, for instance, having a greater penetrating power than that from a plate of copper at 750°.

We must, however, leave the student to pursue these inquiries further, the object of these lessons—to give a general insight into the main facts of the science of Heat—having been accomplished.

LESSONS IN FRENCH.—LXXXV.

§ 133.—Observations on the Repetition of Adverbs.

(1.) The adverbs of comparison, **plus**, **moins**, must be repeated before every adjective which they modify :—

Il est **moins** paresseux et **moins** obstiné que son frère.	*He is less idle and obstinate than his brother.*

(2.) These adverbs, and the adverbs of quantity, need not be repeated before every noun; but the preposition **de**, which must always come between **peu**, **trop**, **beaucoup**, **tant**, **plus**, **moins**, **autant**, **assez**, **combien**, and a noun or an adjective, used substantively, must be repeated in every case :—

Il n'y aurait pas **tant de** peine et **de** misère dans ce monde . . .	*There would not be so much trouble and misery in the world . . .*
Ce libraire a **beaucoup de** bons et **de** mauvais ouvrages dans son magasin.	*This bookseller has many good and bad books in his establishment.*

(3.) The adverbs **mieux**, *better*; **pis**, *worse*, must not be confounded with the adjectives **meilleur** and **pire**. *See* note § 15, (8).

§ 134.—Adverbs of Negation.

(1.) The negation is composed of **ne** placed before the verb, and **pas** or **point**, **jamais**, etc., after it in the simple tenses. The second negative comes between the auxiliary and the verb, in the compound tenses :—

Le ciel sur nos souhaits **ne** règle **pas** les choses. CORNEILLE.	*Heaven does not regulate things according to our wishes.*
Rome **n'**attache **point** le grade à la noblesse. CORNEILLE.	*Rome does not by any means confine offices to the nobility.*
L'estime est le vrai principe de la considération, qui **n'**est **pas** toujours attachée aux dignités. FONTENELLE.	*Esteem is the true principle of consideration, which is not always attached to offices.*
Les rois **ne** sont **point** protégés par les lois. CHÉNIER.	*Kings are by no means protected by laws.*
Il **n'**a jamais **dit** cela.	*He has never said that.*
Je **ne** chante **guère**.	*I do not sing much.*

It will be seen in the above examples, that the negative **point** is stronger than **pas**. The meaning of these two words, which are in fact substantives used adverbially, and express the signification of the negative **ne**, will sufficiently explain this:

N'allez pas means **n'allez un pas**, do not go or move *one pace* or *step*. **N'allez point** means **n'allez un point**, do not go or move *a point* or *dot*.

(2.) When the verb is in the present or in the past of the infinitive, the two negatives may be put together before the verb, or the verb between them :—

Pour **ne pas** sortir; *or* pour **ne** sortir **pas**.	*In order not to go out.*
Pour **ne jamais** avoir menti; *or* pour **n'**avoir **jamais** menti.	*For never having told a lie.*

The first of these two constructions is the most generally used.

(3.) The second negative may be suppressed after the verbs **pouvoir**, **oser**, **savoir**, and **cesser** :—

Non, déesse; je **ne** puis souffrir qu'un de leurs vaisseaux fasse naufrage. FÉNELON.	*No, goddess; I cannot suffer that a single one of their vessels perish.*
Dans son appartement, elle **n'**osait rentrer. VOLTAIRE.	*She durst not re-enter her apartment.*
Qui vit haï de tous, **ne** saurait longtemps vivre. CORNEILLE.	*He who lives hated by all, cannot exist long.*
La liberté **ne** cesse d'être aimable. CORNEILLE.	*Liberty cannot cease to be worthy of love.*

(4.) **Pas** or **point** is not used when the verb is modified by another negative word, such as **jamais**, **guère**, **nul**, **nullement**, **aucun**, **personne**, **ni**; by **ne** followed by **que**, meaning *only*; and by **ne** followed by **plus**, meaning *no more* :—

L'ambition, seigneur, **n'a guère** de limites. BOURSAULT.	*Ambition, my lord, has scarcely any limits.*
Nul n'est heureux, s'il ne jouit de sa propre estime. J. J. ROUSSEAU.	*No one is happy, unless he can esteem himself.*
Personne n'aime à recevoir de conseils. DE SÉGUR.	*No one likes to receive advice.*
Un méchant **ne** sait **jamais** pardonner. NOËL.	*A wicked man never knows how to forgive.*

(5.) With two verbs, the adverbs of negation are placed with the one they are intended to modify :—

Je **ne puis pas** y aller.	*I cannot go there.*
Je puis **ne pas** y **aller**.	*I may not go there.*
Il **n'ose pas** le dire.	*He does not dare to say so.*
Il ose **ne pas** le **dire**.	*He is impudent enough not to say so.*

(6.) **Ne** *used idiomatically.*

The negative **ne** is used without any negative sense after the conjunctions **à moins que**, *unless*; **de peur que**, **de crainte que**, *for fear that* :—

À moins que vous **ne** lui parliez.	*Unless you speak to him.*
De peur qu'on **ne** vous trompe. L'ACADÉMIE.	*For fear, or lest you might be deceived.*

(7.) **Ne** is used in the same manner after **autre**, *different*; **autrement**, *otherwise*; **plus**, **moins**, **mieux**, forming a compari-

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son, and after the verbs **craindre, avoir peur, trembler, appréhender, empêcher** :—

Il est tout **autre** qu'il **n'**était.	*He is very different from what he was.*
Il parle **autrement** qu'il **n'**agit.	*He speaks and acts very differently.*
Il est **plus** modeste qu'il **ne** le paraît.	*He is more modest than he appears.*
Je **crains** presque, je crains, qu'un songe **ne** m'abuse. RACINE.	*I am almost afraid that (lest) a dream is deceiving me.*
Vous **avez** bien **peur** que je **ne** change d'avis. MARIVAUX.	*You fear much, lest I may change my mind.*
La pluie **empêcha** qu'on **ne** se promenât dans les jardins. RACINE.	*The rain prevented their taking a walk in the gardens.*

(8.) *Remark :* Ne is not used when the verb of the preceding clause is accompanied by a negative :—

Il **ne parle pas** autrement qu'il agit.	*He does not speak otherwise than he acts.*
Il **n'est pas** plus modeste qu'il le paraît.	*He is not more modest than he appears.*

(9.) After **craindre, appréhender, avoir peur, trembler,** we put **pas** after **ne** when we wish for the accomplishment of the action expressed by the second verb :—

Je **crains** qu'il **ne** vienne **pas.**	*I fear that he may not come.*
J'ai peur que mon frère **n'**arrive **pas.**	*I am afraid that my brother may not come.*

§ 135.—The Preposition.—Complement of Simple and Compound Prepositions.

(1.) Prepositions may be divided according to their complement into three classes :—

1st. Prepositions governing nouns without the aid of another preposition. They are :—

À, *at,* or *to.*	**Joignant,** *joining.*
Après, *after.*	**Malgré,** *in spite of.*
À travers, *through.*	**Moyennant,** *by means of.*
Attendu, *on account of.*	**Nonobstant,** *notwithstanding.*
Avant, *before.*	**Outre,** *besides.*
Avec, *with.*	**Par,** *by.*
Chez, *with, at the house of.*	**Parmi,** *among, amongst.*
Concernant, *touching.*	**Pendant,** *during.*
Contre, *against.*	**Pour,** *for.*
Dans, *in.*	**Sans,** *without.*
De, *of, from.*	**Sauf,** *safe, save.*
Depuis, *since.*	**Selon,** *according to.*
Derrière, *behind.*	**Sous,** *under.*
Dès, *from, as soon as.*	**Suivant,** *according to.*
Devant, *before.*	**Sur,** *upon.*
Durant, *during.*	**Touchant,** *touching.*
En, *in.*	**Vers,** *towards.*
Entre, *between.*	**Voici,** *here is.*
Envers, *to, towards.*	**Voilà,** *there is.*
Excepté, *except.*	**Vu,** *considering.*
Hors, Hormis, *except* (*see* Hors *below*).	

2nd. Prepositions requiring the preposition **de** after them :—

À cause, *on account.*	**Au milieu,** *in the middle.*
À côté, *by the side.*	**Au moyen,** *by means.*
À couvert, *under cover.*	**Au niveau,** *on a level.*
À fleur, *even with.*	**Au péril,** *at the peril.*
À force, *by dint.*	**Auprès,** *near.*
À l'abri, *under shelter.*	**Au prix,** *at the price.*
À la faveur, *by means.*	**Au rez,** *on a level.*
À la mode, *according to the fashion.*	**Au risque,** *at the risk.*
À la réserve, *reserving.*	**Autour,** *around.*
À l'égard, *with regard.*	**Au travers,** *through.*
À l'exception, *excepting.*	**Aux dépens,** *at the expense.*
À l'exclusion, *excluding.*	**Aux environs,** *in the neighbourhood.*
À l'insu, *unknown.*	**En deçà,** *this way.*
À l'opposite, *contrary.*	**En dedans.** *this side, inside.*
À moins, *unless, for less.*	**En dépit,** *in spite of.*
À raison, *by reason, at the rate*	**Faute,** *for want.*
Au dedans, *within.*	**Hors,** *out of.*
Au dehors, *without.*	**Le long,** *along.*
Au delà, *that way, beyond.*	**Loin,** *far.*
Au-dessous, *under.*	**Près,** *near.*
Au-dessus, *above.*	**Proche,** *near.*
Au-devant, *before, to meet.*	**Vis-à-vis,** *opposite.*
Au lieu, *instead.*	

3rd. The prepositions followed by **à** are :—

Attenant, *joining.*	**Par rapport,** *with regard.*
Jusque, *as far as.*	**Quant,** *as to.*

§ 136.—Remark on the Government of Prepositions.

The rules which we have given [§ 89, (1.), (2.) *note,* and § 129] with regard to the government of verbs and adjectives, apply also to prepositions. When two prepositions require the same complement, it is useless to repeat this complement after each one, but if they require a different complement, it is necessary to give each the proper one. It would, therefore, be incorrect to say, **Un magistrat doit toujours juger suivant et conformément aux lois,** *A magistrate should always judge in accordance with, and conformably to, the laws;* because the preposition **suivant** does not require another preposition, and the adverb **conformément** requires to be followed by the preposition **à.** We must, therefore, say :—

Un magistrat doit toujours juger **suivant** les lois, et **conformément à** ce qu'elles prescrivent. MARMONTEL.	*A magistrate should always judge in accordance with the laws and conformably to what they prescribe.*

§ 137.—Repetition of Prepositions.

(1.) The prepositions **à, de, en,** and **sans,** must be repeated before every complement, be it a noun, a pronoun, or a verb :—

Ce monde-ci n'est qu'une loterie **de** biens, **de** rangs, **de** dignités, **de** droits. VOLTAIRE.	*This world is but a lottery of goods, of ranks, of dignities, of rights.*
L'éloquence est un art très-sérieux, destiné **à** instruire, **à** réprimer les passions, **à** corriger les mœurs, **à** soutenir les lois, etc. FÉNELON.	*Eloquence is a very important art, destined to instruct, to repress passions, to correct manners, to support the laws, etc.*
Telle est la multitude, et **sans** frein et **sans** lois. LA HARPE.	*Such is the multitude, without restraint and without laws.*

(2.) The other prepositions must also be repeated before every noun, pronoun, or verb, unless the words used as complements have a similarity of meaning; in which case the prepositions may be placed before the first complement only, or before all, at the option of the speaker :—

Je vous donne ceci **pour** vous et **pour** votre frère.	*I give you this for you and for your brother.*
Il perd sa jeunesse **dans** la mollesse et (**dans**) la volupté.	*He wastes his youth in effeminacy and voluptuousness.*

§ 138.—Observations on Several Prepositions

(1.) **Avant** marks a priority of time and place; **devant** means simply, *opposite, in front of :—*

Je marche **avant** vous.	*I walk before you,* i.e., *I walk earlier than you,* or *I have the precedence of you in walking.*
Je marche **devant** vous.	*I walk in front of you.*

(2.) **En, à, dans.**—The sense of **en** is more indefinite, more extensive than that of **dans. En** is generally used before the name of a division of the earth, a kingdom, etc.; also before nouns taken in a general sense, and which do not admit of being qualified by the definite article; **à** before the name of a town; and **dans** before a word qualified by an article or a determinative adjective :—

En Europe, **en** France, **à** Paris, **dans** ma chambre.	*In Europe, in France, in Paris, in my room.*
En Amérique ce sont les bisons qui ont une bosse sur le dos. BUFFON.	*In America the bisons have a hunch on their back.*
Dans l'Amérique méridionale le bœuf était absolument inconnu. BUFFON.	*In South America the ox was entirely unknown.*

(3.) **Chez** might be rendered in English by *at, in, to the house, of, with, among,* etc. :—

Chez votre père; **chez** vous.	*At your father's; at your house.*
La condition des comédiens était infâme **chez** les Romains, et honorable **chez** les Grecs. LA BRUYÈRE.	*The condition of comedians was infamous among the Romans, and honourable with the Greeks.*

§ 139.—General Observations on Prepositions.

(1.) Prepositions govern the verb which follows them in the infinitive mood. With the exception of **après,** which requires the past of the infinitive, of **pour** which may be followed by the present or by the past of the same mood, and of **en** which requires the present participle, the prepositions, which admit of being followed by a verb, require the present tense of the infinitive :—

En arrivant, elle se mit **à** pleurer.	*On arriving, she began to weep.*
Il riait tout **en** me **parlant**.	*He was laughing while speaking to me.*
Après avoir parlé, il sortit.	*After having spoken he went out.*
Elle sortit **après avoir diné**.	*She went out after having dined.*
Sans savoir ce qu'il faisait. . .	*Without knowing what he was doing. . .*
Je l'ai fait **pour** vous **plaire**.	*I have done it in order to please you.*
On le chassa **pour avoir** menti.	*They expelled him for having told a lie.*
Nous venions **d'arriver**.	*We had just arrived.*
Ils sont **à travailler**.	*They are working.*

(2) In French a preposition must always precede its complement: *What are you speaking of? Whom is he speaking to?* cannot be translated into French in this order; the preposition must be put in French before *what* and *whom* :—

De quoi parlez-vous ?	*Of what are you speaking?*
À qui parlez-vous ?	*To whom are you speaking?*

(3.) Prepositions are used between verbs having the same subject; conjunctions between verbs having different subjects :—

Je l'ai fait **pour** vous **plaire**.	*I have done it in order to please you*, i.e., *in order that I might please you.*
Je l'ai dit **pour qu'il** le sache.	*I have said it in order that he should know it.*

(4.) When a conjunction is used between two verbs having the same subject, the preposition **de** is added to it :—

Ils s'avancèrent **afin de** mieux **voir**.	*They advanced in order to see better.*

(5.) When a preposition is used between two verbs having different subjects **que** is added to it :—

Je l'ai fait **avant qu'**ils arrivassent.	*I have done it before they arrived.*

§ 140.—The Conjunction.—Government of Conjunctions. [See § 123.]

(1.) Conjunctions govern the verbs following them in the indicative, in the conditional, or in the subjunctive mood :—

Il est sûr **que** je **l'ai dit, car** il m'**a entendu**.	*He is sure I have said it, for he has heard me.*
Il fut décidé **qu'il partirait**.	*It was decided that he should start.*
Quoique vous le **sachiez**.	*Although you know it.*

(2.) A conjunction cannot govern the infinitive; when, therefore, a conjunction must be used between two verbs having the same subject, **de** is added to it [§ 139, (4.)] :—

Il vint ici de peur **d'être** vu.	*He came here, lest he might be seen.*

(3.) The following conjunctions always require the subjunctive after them in French, whatever mood they may take in English. Those marked with an asterisk require **ne** before the verb [§ 134, (4.)] :—

Afin que, *in order that.*	Malgré que,† *although, in spite of.*
*À moins que, *unless.*	Nonobstant que, *notwithstanding.*
Au cas que, *if.*	Non que, *not that.*
Avant que, *before that.*	Non pas que, *not that.*
Bien que, *although.*	Posé que, *supposing that.*
*De crainte que, *for fear.*	Pour que, *that, in order that.*
De peur que, *lest.*	Pourvu que, *provided that.*
En cas que, *in case.*	Quoique, *although, though.*
Encore que, *although.*	Sans que, *without that.*
Jusqu'à ce que, *till, until that.*	Soit que, *whether.*
Loin que, *far from, not that.*	Supposé que, *suppose that.*

Quoique à peine à mes maux je **puisse** résister, J'aime mieux les souffrir, que de les mériter. Racine.	*Although I can scarcely bear my misfortunes, I would rather suffer under them than deserve them.*
En cas que vous **persistiez**, il faudra que j'allègue au prince et au roi même votre mauvaise santé. Fénelon.	*In case you persist, I must mention your bad health to the prince and even to the king.*

† Only used with the verb **avoir**: **malgré qu'il en ait**, *in spite of himself.*

PLANE TRIGONOMETRY.—III.

SOLUTION OF RIGHT-ANGLED TRIANGLES—FUNDAMENTAL PRINCIPLES, ETC.

X. *Solution of Right-angled Triangles.*—Every triangle consists of six "elements," three sides and three angles. Any three of these being given, *including at least one side* (this is necessary, because triangles merely equiangular can be constructed in infinite number), Trigonometry enables us to calculate the remaining elements. The formulæ evolved as yet only enable us to do this for right-angled triangles, and as these involve one known quantity (the right angle), it is sufficient if any *two* of the other elements (including one side) be given. We may have (referring to Fig. 3), besides the right angle—

(1.) Given two sides.
(2.) Given one side and one angle.

Either of these cases may be solved by the ratios given in Section II., and by a table of natural sines and cosines, tangents and cotangents, such as that given at the end of Galbraith and Haughton's "Trigonometry." The following examples may all be solved by the annexed table of ratios for a few angles only, purposely restricted to three places of decimals :—

I.	Sines of Angles in Column I.	Tangents of Angles in Column I.	
15°	0·259	0·268	75°
24°	0·407	0·445	66°
29°	0·485	0·554	61°
30°	0·5	0·577	60°
34°	0·559	0·674	56°
36°	0·588	0·727	54°
50°	0·766	1·192	40°
54°	0·809	1·376	36°
61°	0·875	1·804	29°
75°	0·966	3·732	15°
	Cosines of Angles in Column II.	Cotangents of Angles in Column II.	II.

First, given two sides only, viz., $a = 15·58$; $b = 35$. Find A, B, and c.

$$\text{Tan. A} = \frac{a}{b} = \frac{15·58}{35} = ·445.$$

Referring to the table, we find ·445 entered as tangent of 24°.

$$\therefore \text{A} = 24°, \qquad \text{and B} = 90° - \text{A} = 66°.$$

By Euclid I. 47, $c^2 = a^2 + b^2$.

$$\therefore c = \sqrt{a^2 + b^2};$$

which may readily be calculated, a and b being known.

Again, given one side and hypothenuse, viz., $b = 5$; $c = 10$. Find A, B, and a.

$$\text{Cos. A} = \frac{b}{c} = \frac{5}{10} = ·5;$$

$$\therefore \text{by the tables, } \text{A} = 60°; \qquad \therefore \text{B} = 30°.$$

$$a \text{ (from Euclid I. 47, as before)} = \sqrt{c^2 - b^2} = \sqrt{75}.$$

Secondly, given one side and one angle, viz., $a = 100$; B = 36°. Find A, b, and c.

$$\text{A} = 90° - \text{B} = 54°.$$

$$\text{Since tan. B} = \frac{b}{a}, \quad b = a \text{ tan. B} = 100 \times ·727 = 72·7;$$

$$\text{and since cos. B} = \frac{a}{c}, \quad c = \frac{a}{\text{cos. B}} = \frac{100}{·809} = 123·609.$$

Again, given hypothenuse and one angle, viz., $c = 75$; A = 15°. Find B, a and b.

$$\text{B} = 90° - \text{A} = 75°.$$

$$\text{Since sin. A} = \frac{a}{c}, \quad a = c \text{ sin. A} = 75 \times ·259 = 19·425$$

$$\text{and since cos. A} = \frac{b}{c}, \quad b = c \text{ cos. A} = 75 \times ·966 = 72·45.$$

These are merely specimens of the ways in which the four

*

cases may be treated. It will be found that other ratios might be taken equally well in several instances.

EXERCISE 2.

1. If $a = 30{\cdot}669$ and $b = 17$, find c, A, and B.
2. If $c = 340$ and $B = 29°$, find a, b, and A.
3. If $b = 4{\cdot}5$ and $B = 54°$, find a, c, and A.
4. If $A = 61°$ and $b = 22$, find a, c, and B.
5. If $a = 670$ feet and $b = 833$ yards 1 foot, find c, A, and B.
6. If $a = 1764$ and $c = 3000$, find b, A, and B.
7. If $A = 75°$ and $c = {\cdot}005$, find a, b, and B.
8. If $b = {\cdot}875$ and $c = 1$, find A, B, and a.
9. If $c = 120$ and $a = 77\frac{1}{4}$, find A and B.
10. A house 50 feet high abuts upon a street found to measure 33·7 feet in width. Find the length of ladder required to reach the top from the opposite side of the street, and the angle the ladder will make with the wall of the house.
11. Two trains travelling, one at 20 miles an hour, the other faster, come into collision at a level crossing, where the two lines (both being free from curves) cross each other at an angle of 36°. Some time before the collision, a passenger in the slower train observes the other exactly abreast of him on the other line of railway, and judges the trains to be a quarter of a mile apart. How far from the crossing were both trains at that moment, and what was the speed of the faster train?
12. One of two boys, flying a kite in a level field, observes that he has let out the whole of his string—60 yards—just as his companion, looking up, cries out that the kite flies perpendicularly over his head. The boys found afterwards they were standing 30 yards apart. How high was the kite, and what angle did the string make with the ground?
13. The rope holding the "captive balloon" at Chelsea against a strong wind, when 400 yards were paid out, was found to incline 15° from the perpendicular. How high was the balloon, and how far from the foot of the rope would a piece of iron ballast have fallen, if dropped from the balloon?

XI. *The Fundamental Formulæ.*—We have hitherto examined only the relations between ratios of the same angle; we proceed now to trace the relations between ratios of two or more different angles. The number of formulæ expressing these relations may be extended almost at will, but they are all derived from the following formulæ for the sines and cosines of the sum and difference of two angles, known, therefore, as *the four fundamental formulæ*:—

$$\text{Sin.}(A+B) = \text{sin. } A \text{ cos. } B + \text{cos. } A \text{ sin. } B \ldots\ldots \quad (33)$$
$$\text{Sin.}(A-B) = \text{sin. } A \text{ cos. } B - \text{cos. } A \text{ sin. } B \ldots\ldots \quad (34)$$
$$\text{Cos.}(A+B) = \text{cos. } A \text{ cos. } B - \text{sin. } A \text{ sin. } B \ldots\ldots \quad (35)$$
$$\text{Cos.}(A-B) = \text{cos. } A \text{ cos. } B + \text{sin. } A \text{ sin. } B \ldots\ldots \quad (36)$$

where A and B are any angles whatever.

These formulæ may be thus expressed in words:—

(33) *The sine of the sum of two angles is equal to the sine of the first into the cosine of the second plus the cosine of the first into the sine of the second.*

(34) *The sine of the difference of two angles is equal to the sine of the first into the cosine of the second minus the cosine of the first into the sine of the second.*

(35) *The cosine of the sum of two angles is equal to the product of their cosines minus the product of their sines.*

(36) *The cosine of the difference of two angles is equal to the product of their cosines plus the product of their sines.*

To prove (33).—In Fig. 8 let AOB = A, and BOC = B; then AOC = A + B. In this case the sum of the angles exceeds one right angle, but the same construction and lettering hold good if the sum be taken as less than 90°, though the figure will be differently arranged.

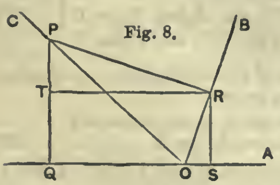

Fig. 8.

In OC take any point, P, and from it draw PQ, PR, perpendicular to AO (produced) and to BO. From R draw RT and RS perpendicular to PQ and AO.

$$\text{Sin.}(A+B) = \frac{PQ}{OP} = \frac{QT+PT}{OP}$$

$$= \frac{QT}{OP} + \frac{PT}{OP} = \frac{RS}{OP} + \frac{PT}{OP} = \frac{RS}{OR} \cdot \frac{OR}{OP} + \frac{PT}{PR} \cdot \frac{PR}{OP}.$$

Since the triangles TPR and ORS are equiangular, $\frac{PT}{PR} = \frac{OS}{OR}$.

$$\therefore \text{sin.}(A+B) = \frac{RS}{OR} \cdot \frac{OR}{OP} + \frac{OS}{OR} \cdot \frac{PR}{OP}$$

$$= \text{sin. } A \text{ cos. } B + \text{cos. } A \text{ sin. } B.$$

To prove (34).—Let AOB (Fig. 9) = A, and BOC = B; then AOC = A − B.

In OC take any point P, and draw the perpendiculars PQ, PR, and RS, RT, as before (RT to PQ produced).

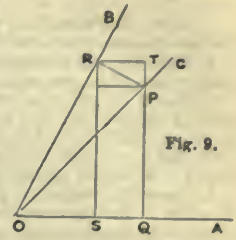

Fig. 9.

$$\text{Sin.}(A-B) = \frac{PQ}{OP} = \frac{QT-PT}{OP}$$

$$= \frac{QT}{OP} - \frac{PT}{OP} = \frac{RS}{OP} - \frac{PT}{OP} = \frac{RS}{OR} \cdot \frac{OR}{OP} - \frac{PT}{PR} \cdot \frac{PR}{OP}.$$

Since the triangles TPR and ORS are equiangular, $\frac{PT}{PR} = \frac{OS}{OR}$.

$$\therefore \text{sin.}(A-B) = \frac{RS}{OR} \cdot \frac{OR}{OP} - \frac{OS}{OR} \cdot \frac{PR}{OP}$$

$$= \text{sin. } A \text{ cos. } B - \text{cos. } A \text{ sin. } B.$$

The above proofs evidently hold good only when neither of the two angles exceeds a right angle. They can, however, be extended to angles of any size by precisely similar construction, which will, however, result in figures of very different appearance, according to the quadrants in which the angles are situated. In the demonstrations *the minus sign belonging to sines and cosines in certain quadrants* (see Section VIII.) must be borne in mind.

For instance, prove (33), in the case where A and B are both greater than right angles, but where A + B is less than three right angles. Let AOB in Fig. 10 = A, and BOC = B. In OC take any point P as before, and construct exactly as directed in the proof for (33).

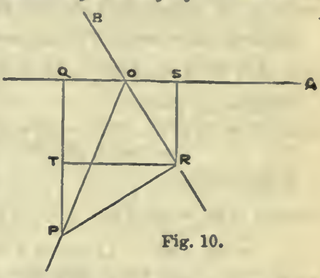

Fig. 10.

Then, since A and B together form an angle in the third quadrant, whose sine is a minus quantity—

$$\text{Sin.}(A+B) = -\frac{PQ}{OP} = \frac{-QT-PT}{OP} = -\frac{QT}{OP} - \frac{PT}{OP}$$

$$= -\frac{RS}{OP} - \frac{PT}{OP} = -\left(\frac{RS}{OR} \cdot \frac{OR}{OP}\right) - \left(\frac{PT}{PR} \cdot \frac{PR}{OP}\right).$$

Now A and B being both angles in the second quadrant, their sines are both *plus*, and their cosines *minus* quantities.

$$\therefore \frac{RS}{OR} = \text{sin. } A, \text{ for } AOR = BOQ; \quad \frac{OR}{OP} = -\text{cos } B;$$

$$\frac{PT}{PR} = \frac{OS}{OR} = -\text{cos. } A; \text{ and } \frac{PR}{OP} = \text{sin. } B;$$

$$\therefore \text{sin.}(A+B) = -(\text{sin. } A \times -\text{cos. } B) - (-\text{cos. } A \times \text{sin. } B)$$
$$= \text{sin. } A \text{ cos. } B + \text{cos. } A \text{ sin. } B.$$

Again, prove (34), where A is a trigonometrical angle in the fourth quadrant, B an angle in the second quadrant, and their difference an angle in the third quadrant.

Let AOB in Fig. 11 = A, and BOC = B; ∴ AOC = (A − B). Construct as before—

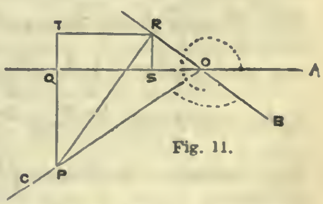

Fig. 11.

$$\text{Then sin.}(A-B) = -\frac{PQ}{OP} = -\frac{PT-QT}{OP} = \frac{QT}{OP} - \frac{PT}{OP}$$

$$= \frac{RS}{OP} - \frac{PT}{OP} = \frac{RS}{OR} \cdot \frac{OR}{OP} - \frac{PT}{PR} \cdot \frac{PR}{OP}.$$

$$\text{But } \frac{RS}{OR} = -\text{sin. } A, \text{ for } ROS = AOB; \quad \frac{OR}{OP} = -\text{cos. } B;$$

$$\frac{PT}{PR} = \frac{OS}{OR} = \text{cos. } A; \text{ and } \frac{PR}{OP} = \text{sin. } B;$$

$$\therefore \text{sin.}(A-B) = \text{sin. } A \text{ cos. } B - \text{cos. } A \text{ sin. } B.$$

These cases will probably convince the student that (33) and (34) hold good for *all* values of A and B, as can, indeed, be proved separately, in the same way, for every value. As practice, the student should prove the following cases:—

Exercise 3.

1. Prove (33), where A is an angle in the third, and B an angle in the first quadrant, but where A + B reaches to the fourth quadrant.
2. Prove the same where both A and A + B are in the third quadrant (which, of course, implies that B is less than a right angle).
3. Prove (34), when A exceeds 180°, but is less than 270°, and when B exceeds 90°, but is less than 180°. Construct the figure on the supposition that A is so near 270°, and B so much less than 180°, that A − B falls in the second quadrant. Also construct it so that A − B shall be less than 90°.
4. Prove (34), when A is an angle in the fifth quadrant, and when B = 180°. In this example AOB must, of course, be drawn as an angle in the first quadrant, and since BOC = 180°, BO and OC are in line with each other. PQ is therefore the only other line in the construction before given which it is possible to draw. A − B = the (trigonometrical) angle ADC in the third quadrant.

$$\text{Then sin. }(A - B) = -\frac{PQ}{OP} = -\text{sin. } A;$$

since POQ = AOB, and sin. A is naturally positive.

This agrees with (34), where, if we substitute the values of sin. and cos., 180°, as given in Secc. VIII., we get—

$$\text{Sin. }(A - B) = (\text{sin. } A \times -1) - (\text{cos. } A \times 0) = -\text{sin. } A.$$

5. Prove (34), where A = 180° and B exceeds 90°.

(35) and (36) can also be proved geometrically. (35) can, however, be proved more shortly, thus—

Since sin. A = cos. (90° − A), and *vice versâ*;

$$\text{Cos. }(A + B) = \text{sin. }\Big(90^\circ - (A + B)\Big) = \text{sin. }\Big((90^\circ - A) - B\Big).$$

Whence, by (34),

$$\text{Cos. }(A + B) = \text{sin. }(90^\circ - A)\text{ cos. } B - \text{cos. }(90^\circ - A)\text{ sin. } B$$
$$= \text{cos. } A \text{ cos. } B - \text{sin. } A \text{ sin. } B.$$

To prove (36):—

$$\text{Cos. }(A - B) = \text{sin. }\Big(90^\circ - (A - B)\Big) = \text{sin. }\Big((90^\circ - A) + B\Big)$$
$$= \text{sin. }(90^\circ - A)\text{ cos. } B + \text{cos. }(90^\circ - A)\text{ sin. } B$$
$$= \text{cos. } A \text{ cos. } B + \text{sin. } A \text{ sin. } B.$$

(34) can also be derived from (33) by substituting − B for B in (33). The student should work this out, remembering that sin. − B = − sin. B, but cos. − B = cos. B.

XII. *Formulæ for the Sum and Difference of the Sines and Cosines of the Sum and Difference of two Angles.*—By adding together (33) and (34), we obtain—

$$\text{Sin. }(A + B) + \text{sin. }(A - B) = 2 \text{ sin. } A \text{ cos. } B \;\ldots\ldots\; (37)$$

By subtracting (34) from (33)—

$$\text{Sin. }(A + B) - \text{sin. }(A - B) = 2 \text{ cos. } A \text{ sin. } B \;\ldots\ldots\; (38)$$

By adding (35) and (36)—

$$\text{Cos. }(A + B) + \text{cos. }(A - B) = 2 \text{ cos. } A \text{ cos. } B \;\ldots\ldots\; (39)$$

By subtracting (36) from (35)—

$$\text{Cos. }(A + B) - \text{cos. }(A - B) = -2 \text{ sin. } A \text{ sin. } B \;\ldots\; (40)$$

XIII. *Formulæ for the Sum and Difference of the Sines and Cosines of two Angles*:—

$$\text{Sin. } A = \text{sin. }\left(\frac{A + B + A - B}{2}\right) = \text{sin. }\left(\frac{A + B}{2} + \frac{A - B}{2}\right).$$

$$\therefore \text{ by (33), sin. } A = \text{sin. }\frac{A+B}{2}\text{ cos. }\frac{A-B}{2} + \text{cos. }\frac{A+B}{2}\text{ sin. }\frac{A-B}{2}.$$

$$\text{Similarly, sin. } B = \text{sin. }\left(\frac{A + B}{2} - \frac{A - B}{2}\right).$$

$$= \text{sin. }\frac{A + B}{2}\text{ cos. }\frac{A - B}{2} - \text{cos. }\frac{A + B}{2}\text{ . sin. }\frac{A - B}{2}.$$

Adding these results together, we get—

$$\text{Sin. } A + \text{sin. } B = 2 \text{ sin. }\frac{A + B}{2}\text{ . cos. }\frac{A - B}{2} \;\ldots\ldots\; (41)$$

Or, subtracting one from the other—

$$\text{Sin. } A - \text{sin. } B = 2 \text{ cos. }\frac{A + B}{2}\text{ . sin. }\frac{A - B}{2} \;\ldots\ldots\; (42)$$

Similarly, by adding and subtracting like expressions for cos. A and cos. B, we get—

$$\text{Cos. } A + \text{cos. } B = 2 \text{ cos. }\frac{A + B}{2}\text{ . cos. }\frac{A - B}{2} \;\ldots\ldots\; (43)$$

$$\text{Cos. } A - \text{cos. } B = -2 \text{ sin. }\frac{A + B}{2}\text{ . sin. }\frac{A - B}{2} \;\ldots\ldots\; (44)$$

XIV. *Relations between Sines, Cosines, and Tangents of two Angles.*—Dividing (33) by (35), we have—

$$\text{Tan. }(A + B) = \frac{\text{sin. } A \text{ cos. } B + \text{cos. } A \text{ sin. } B}{\text{cos. } A \text{ cos. } B - \text{sin. } A \text{ sin. } B}.$$

Dividing both numerator and denominator on the right-hand side by cos. A cos. B, we have—

$$\text{Tan. }(A+B) = \frac{\dfrac{\text{sin. } A}{\text{cos. } A} + \dfrac{\text{sin. } B}{\text{cos. } B}}{1 - \dfrac{\text{sin. } A}{\text{cos. } A}\cdot\dfrac{\text{sin. } B}{\text{cos. } B}};$$

$$\therefore \text{ tan. }(A + B) = \frac{\text{tan. } A + \text{tan. } B}{1 - \text{tan. } A \text{ tan. } B} \;\ldots\ldots\ldots\ldots\; (45)$$

Similarly, dividing (34) by (36), and again dividing the numerator and denominator by cos. A cos. B, we obtain—

$$\text{Tan. }(A - B) = \frac{\text{tan. } A - \text{tan. } B}{1 + \text{tan. } A \text{ tan. } B} \;\ldots\ldots\ldots\ldots\; (46)$$

Again, dividing (41) by (42), we obtain—

$$\frac{\text{Sin. } A + \text{sin. } B}{\text{Sin. } A - \text{sin. } B} = \frac{2}{2}\cdot\frac{\text{sin. }\frac{1}{2}(A + B)}{\text{cos. }\frac{1}{2}(A + B)}\cdot\frac{\text{cos. }\frac{1}{2}(A - B)}{\text{sin. }\frac{1}{2}(A - B)}$$
$$= \text{tan. }\tfrac{1}{2}(A + B)\text{ cot. }\tfrac{1}{2}(A - B);$$

$$\therefore \text{ since cot. }\tfrac{1}{2}(A - B) = \frac{1}{\text{tan. }\frac{1}{2}(A - B)},$$

$$\frac{\text{sin. } A + \text{sin. } B}{\text{sin. } A - \text{sin. } B} = \frac{\text{tan. }\frac{1}{2}(A + B)}{\text{tan. }\frac{1}{2}(A - B)} \;\ldots\ldots\ldots\ldots\; (47)$$

Or, *the sum of the sines of two angles is to the difference of their sines as the tangent of half their sum is to the tangent of half their difference.*

Similarly, by dividing (43) by (44)—

$$\frac{\text{Cos. } A + \text{cos. } B}{\text{Cos. } A - \text{cos. } B} = \frac{\text{cot. }\frac{1}{2}(A + B)}{\text{tan. }\frac{1}{2}(A - B)} \;\ldots\ldots\ldots\ldots\; (48)$$

XV. *Formulæ for the Ratios of the Sum of three Angles* may be obtained simply by splitting up the three into two, which can then be dealt with by formulæ already given; thus—

$$\text{Sin. }(A + B + C) = \text{sin. }\Big(A + (B + C)\Big)$$
$$= \text{sin. } A \text{ . cos. }(B + C) + \text{cos. } A \text{ . sin. }(B + C)$$
$$= \text{sin. } A\,(\text{cos. } B \text{ cos. } C - \text{sin. } B \text{ sin. } C) + \text{cos. } A\,(\text{sin. } B \text{ cos. } C + \text{cos. } B \text{ sin. } C).$$

Whence, by a slight change in order—

$$\left.\begin{array}{r}\text{Sin. }(A+B+C) = \text{sin. } A \text{ cos. } B \text{ cos. } C + \text{sin. } B \text{ cos. } A \text{ cos. } C \\ + \text{sin. } C \text{ cos. } A \text{ cos. } B - \text{sin. } A \text{ sin. } B \text{ sin. } C\end{array}\right\}\; (49)$$

By similar reasoning—

$$\left.\begin{array}{r}\text{Cos. }(A + B + C) = \text{cos. } A \text{ cos. } B \text{ cos. } C - \text{cos. } A \text{ sin. } B \\ \text{sin. } C - \text{cos. } B \text{ sin. } A \text{ sin. } C - \text{cos. } C \text{ sin. } A \text{ sin. } B\end{array}\right\}\; (50)$$

Dividing (49) by (50), and the numerator and denominator of the fraction thus obtained by cos. A cos. B cos. C, we obtain—

$$\left.\begin{array}{c}\text{Tan. }(A + B + C) = \\ \dfrac{\text{tan. } A + \text{tan. } B + \text{tan. } C - \text{tan. } A \text{ tan. } B \text{ tan. } C}{1 - \text{tan. } A \text{ tan. } B - \text{tan. } A \text{ tan. } C - \text{tan. } B \text{ tan. } C}\end{array}\right\}\;\ldots\; (51)$$

XVI. *Formulæ for the Ratios of the Multiples of an Angle.*—Substituting A for B in (33), we have—

$$\text{Sin. }(A + A) = \text{sin. } A \text{ cos. } A + \text{cos. } A \text{ sin. } A;$$
$$\therefore \text{ sin. } 2A = 2 \text{ sin. } A \text{ cos. } A \;\ldots\ldots\ldots\ldots\ldots\ldots\; (52)$$

Similarly, by (35), cos. (A+A) = cos. A cos. A − sin. A sin. A;

$$\therefore \text{ cos. } 2A = \text{cos.}^2 A - \text{sin.}^2 A \;\ldots\ldots\ldots\ldots\ldots\; (53)$$

By (7), $1 = \text{sin.}^2 A + \text{cos.}^2 A$; adding this to (53)—

$$\text{Cos. } 2A = 2 \text{ cos.}^2 A - 1 \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\; (54)$$

Subtracting (7) from (53)—

$$\text{Cos. } 2A = 1 - 2 \text{ sin.}^2 A \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\; (55)$$

Again, substituting A for B in (45), we have—

$$\text{Tan. } 2A = \frac{2 \text{ tan. } A}{1 - \text{tan.}^2 A} \;\ldots\ldots\ldots\ldots\ldots\ldots\; (56)$$

Assuming $A = B = C$ in (49),

$$\text{Sin. } 3A = 3 \sin. A \cos.^2 A - \sin.^3 A$$
$$= 3 \sin. A (1 - \sin.^2 A) - \sin.^3 A$$
$$= 3 \sin. A - 3 \sin.^3 A - \sin.^3 A;$$
$$\therefore \sin. 3A = 3 \sin. A - 4 \sin.^3 A \ldots\ldots\ldots\ldots (57)$$

Similarly, from (50), $\cos. 3A = 4 \cos.^3 A - 3 \cos. A \ldots\ldots (58)$

$$\text{and from (51), } \tan. 3A = \frac{3 \tan. A - \tan.^3 A}{1 - 3 \tan.^2 A} \ldots\ldots (59)$$

XVII. *Formulæ for the Ratios of an Angle in terms of the Ratios of the Sub-multiples of that Angle.*—Substituting A for 2A on the left-hand side of (52) to (56), and therefore $\frac{A}{2}$ for A on the right-hand side, we have—

$$\text{Sin. } A = 2 \sin. \frac{A}{2} \cos. \frac{A}{2} \ldots\ldots\ldots\ldots (60)$$

$$\text{Cos. } A = \cos.^2 \frac{A}{2} - \sin.^2 \frac{A}{2} \ldots\ldots\ldots\ldots (61)$$

$$\text{Cos. } A = 2 \cos.^2 \frac{A}{2} - 1 \ldots\ldots\ldots\ldots (62)$$

$$\text{Cos. } A = 1 - 2 \sin.^2 \frac{A}{2} \ldots\ldots\ldots\ldots (63)$$

$$\text{Tan. } A = \frac{2 \tan. \frac{1}{2} A}{1 - \tan.^2 \frac{1}{2} A} \ldots\ldots\ldots\ldots (64)$$

From (57), (58), and (59), like formulæ may be obtained, by like means, for sin. A, cos. A, tan. A, in terms of the same ratios of $\frac{A}{3}$. The student should do this for himself.

In this lesson have been given those formulæ most likely to occur in after-practice. The student should not be content with reading the demonstrations, but should in every case write them out as he follows the proof, inserting any intermediate steps which, from their simple character, may have been omitted to save space. He should also arrange new formulæ for himself, as may be done to any extent by simple substitutions, or by additions, subtractions, and divisions of formulæ already given.

KEY TO EXERCISES IN LESSONS IN PLANE TRIGONOMETRY.—I.

1. Sin. A = ·6247. 2. Sin. A = ·8930. 3. Cos. A = ·9766.
4. Sin. A = ·8. 5. Cot. A = 2.
6. Sin. A = ·866; cos. A = ·5; tan. A = 1·732; cot. A = ·5773; sec. A = 2; cosec. A = 1·1547; covers. A = ·134.
7. $= \frac{1}{\sin. A} - \sin. A = \frac{1 - \sin.^2 A}{\sin. A} = \frac{\cos.^2 A}{\sin. A} = \cos. A . \frac{\cos. A}{\sin. A}$ $= \cos. A . \cot. A.$
8. $= \frac{1 + \cos. A}{1 - \cos.^2 A} = \frac{1}{1 - \cos. A}.$

LESSONS IN ASTRONOMY.—XVIII.

THE FIXED STARS: THEIR MAGNITUDES AND DISTANCES—SHAPE OF OUR CLUSTER—DOUBLE STARS—COLOURED STARS—VARIABLE STARS.

We must now turn our attention from the planets to the fixed stars which so thickly stud the sky. It is very difficult by mere inspection to form any estimate of the number of these bodies; it appears, however, from catalogues which have been compiled, that the total number visible to the naked eye is about 6,000. Only half of the sky, however, can be seen at one time, and the number visible on a clear night may therefore be set down roughly at 3,000. These stars vary very greatly in brilliancy and apparent size, and have accordingly been divided into six classes, the brightest being said to be of the first magnitude, while the faintest visible to the naked eye are classed as the sixth, the rest being divided into the remaining four magnitudes.

As a general rule, it is computed that stars of the first magnitude are about 100 times as brilliant as those of the sixth. The light of Sirius, the brightest star in the sky, is, however, estimated to be equal to that of 324 of the latter.

Though the number of stars seen by the naked eye is thus limited, we must not suppose that these are all that exist. If we direct a telescope to any part of the sky, we shall at once perceive that the field of view is covered with points of light, and the number of these telescopic stars is found to be immensely greater than that of those visible to the naked eye. These stars are classed into magnitudes down to the fifteenth and sixteenth, or even lower, according to the power of the telescope required to show them. The total number down to the fourteenth magnitude is estimated at 20,000,000.

The question now suggests itself whether these different degrees of brightness result from differences in the size of the stars, or in their distances. To this we cannot give an answer with absolute certainty, as there are only a few stars whose distances have been measured. There appears, however, to be little doubt that the difference is chiefly in their distances. The stars, instead of being ranged in a sphere around us, as at first sight they seem to be, are scattered through boundless space, and placed at varying distances from us and from one another. They are all likewise in motion round the centre of gravity of the whole cluster.

The distances of the stars are ascertained in the same manner as those of the Sun and planets—that is, by parallax. Instead, however, of taking two stations at different parts of the Earth's surface, and laying down a base line between them, we take the diameter of the Earth's orbit, or 183,000,000 miles, as the base, the observations being taken at intervals of six months.

Even with this immense line, however, the parallax is so small that it can only be detected by the most careful observations and accurate instruments. In no case has it been found to be greater than 1"; and if this be its value, the distance of the star must be 206,000 times as great as that of the Sun. The parallax of about a dozen stars has now been ascertained, and is found to vary between 0·919" and 0·046". The star α Centauri is the nearest to the Earth, and its distance is estimated at 20,496,000,000,000, or more than 20 billions of miles; while the average distance of stars of the first magnitude is probably three or four times as great as this. These figures, however, fail to convey to the mind any definite idea as to the real distance; perhaps the best mode of expressing it is by stating that light, with its speed of 184,000 miles a second, takes 3½ years to travel from that star to us; while the smaller telescopic stars are so remote that it must require upwards of 5,000 years for their light to reach us.

The rays by which we now see these stars must have left them soon after the creation of Adam; and, for aught we know, some of them may for ages have ceased to exist. At the contemplation of these things, however, the mind is altogether lost in wonder; we are verging on the infinite, and are led to feel that this planet is indeed but a minute speck in the immensity of creation.

In studying the stars we need some mode of identifying them, and in this there is some little difficulty. Special names have been assigned to many of the more brilliant ones, but these have a tendency to confuse. At a very early period they were divided into constellations; many new ones have since been added, so as to make in all 109. Several of these, however, are very small and unimportant, and hence are rejected by some astronomers.

In 1604, a German astronomer, named Bayer, published a celestial atlas in which he designated the stars in each constellation by the letters of the Greek alphabet, the brightest being called α, the next β, and so on. This plan was found to answer so well that it has been continued to the present time. In some constellations, however, the number of stars now catalogued is so great that more letters are required to denote them; the English alphabet therefore follows the Greek, and if both prove insufficient, the remaining stars are denoted by numbers.

In a few instances the stars are not arranged quite in the order of brightness, either from want of accuracy in Bayer's observations, or from a change in the light of the star since his time; it is considered better, however, not to attempt to amend this, as it would only produce confusion.

The best plan for the student to become practically familiar with the different constellations is to study the sky itself, with the aid of some maps or of a globe. Several of the constellations—as, for instance, the Pleiades, the V-shaped cluster of the Hyades, and Orion (Fig. 43), with the three stars in the belt, commonly known as the Yard Measure—are familiar to almost every one; these will serve as a guide in determining others.

The stars are all of them bright, self-luminous bodies like our Sun, which in all probability appears to other worlds to be one of the stars. Delicate observations show us that they have proper motions, but it is very difficult to determine these. We can, however, ascertain the motion of the Sun by observing the relative distances of the stars. We find that in one part of the sky the stars seem to be very gradually opening out, and getting further apart, while in the opposite quarter they are as gradually closing up, evidently showing that we are moving towards the former part, just as when we are travelling in a wood the trees in front seem opening out, while those we have passed appear to be getting closer together.

Astronomers have naturally been anxious to ascertain something of the shape of the whole cluster of stars which constitutes our system, and have employed the telescope as a sounding-line to learn the depth in different directions. If the stars are scattered at all uniformly in space, they will, of course, appear more sparse in those parts where we look through the thinnest layer of them. Now when we observe the sky on a clear night, we at once notice a pale belt passing round it, commonly known as the *Milky Way*. In one part of its course it divides into two branches, which, after separating a little way, and passing about a third round the sky, again unite into one. Powerful telescopes show us that this consists of a dense mass of minute stars. The greater portion, indeed, of those visible are clustered along this line, while in those parts of the sky removed from it the number of telescopic stars is comparatively small; hence we may reasonably assume that this belt indicates to us the direction in which the greatest number of the stars lie, and in which our cluster extends furthest.

Fig. 43.—THE CONSTELLATION ORION.

From this we may form an idea of our system, and it seems that the best representation of it may be obtained by taking a flat circular body—as, for example, a cheese—and splitting it by passing a knife about one-third of the way through, the two parts being made to diverge a little, as shown at *a*, *b* (Fig. 44). The Sun, (*s*) is situated somewhere near the centre, and the split side causes the divided appearance of the Milky Way. One of the nebulæ, when seen through a powerful telescope, is found to present a somewhat similar appearance, and is considered to be a cluster closely resembling our own.

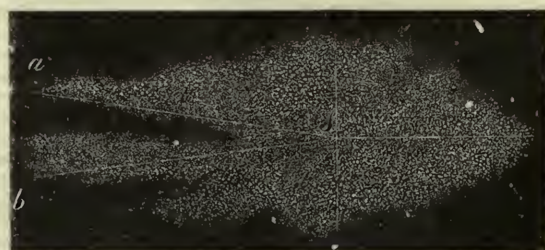

Fig. 44.—SECTION OF THE MILKY WAY.

When we look at the heavens on a clear night, we observe here and there two stars in very close proximity: the telescope further reveals to us that very many of these which appear to the naked eye as single stars, consist in reality of two or more so close together that they appear as one. Sir W. Herschel was the first to direct special attention to these objects, of which he compiled a list. He hoped that by very accurate measurements of the apparent distances between them, he might be able in some instances to detect a variation, and thus ascertain their parallax, and by that their distances. The idea then was that these stars merely appeared close together because they happened to lie in a straight line directed almost towards the Earth; that they were, in fact, merely optical couples, one being an immense distance behind the other. After many observations, Herschel found that their distances and relative positions did vary, but instead of it being, as he expected, an annual fluctuation caused by the Earth's motion, it was a progressive change. He thus found that in some cases the two stars were revolving round one another in elliptical orbits, and that they were physical couples, the two forming one system. These he called binary stars or couples, to distinguish them from optical pairs. Other observers have followed up these investigations, and there are now upwards of 600 binary stars known and noted, and in many cases their times of revolution have been calculated.

One of the best examples of this class is afforded by ϵ Lyræ, which is sometimes called the Double-double Star. To the naked eye it appears a somewhat faint star, but a telescope of very little power will show it to be double. When, however, a more powerful instrument is employed, each of these components is in turn found to consist of two smaller ones, as shown in Fig. 45. The lower pair revolves in about 2,000 years, and the upper in about half that time, while the two couples take a very long period to revolve around their common centre of gravity.

One remarkable feature in connection with the double stars is the fact that in some instances the component stars are of different colours. In R Leporis, for instance, one is white, while the other is a deep red; in β Cygni again, the colours are yellow and blue; and in γ Andromedæ, they are orange and green.

When we come to note the colour of different stars, and compare it with former records, we find that in a few instances a change has taken place. Thus Sirius, which now shines with a pure white light, is spoken of by old observers as a ruddy star. There are also many others which exhibit changes in brilliancy, and these changes seem, in most cases, to be periodical. The star on which this discovery was made is *o* Ceti, called also Mira, or the Wonderful Star, a name it well deserves. At the time of its greatest brightness it is usually of the first or second magnitude, it then decreases for two or three months, till it becomes invisible, and remains so for about five months, its minimum brightness being about equal to that of a twelfth magnitude star. It then again appears, and the whole period occupied by these changes is about 331 days.

Algol, or β Persei, is another variable star, remarkable for its short period and rapid changes. It ordinarily appears as a star of the second magnitude, but in a period of three and a half hours it diminishes in brightness to the fourth magnitude, and after a few minutes begins again to increase, attaining its former brilliancy in another period of three and a half hours. At this it remains two days thirteen hours, and then the same series of changes recurs.

RECREATIVE NATURAL HISTORY.

THE DEATH-WATCH.

HAPPILY the clouds of superstition, which in bygone days cast a gloom over the hearths and homes of England, have gradually passed away before the light of scientific truth and the effects of patient research amongst the mysterious yet simple and beautiful manifestations of Divine wisdom which we familiarly speak of as the facts of natural history. Still there are, so to speak, dark and benighted nooks and corners not yet thoroughly freed from the baleful mist which so obstinately clings to the unenlightened lurking-places in which ignorance is found to dwell.

The belief that the sound known as the tick of the death-watch betokened the speedy dissolution of some inhabitant of the house in which it was heard appears to be of very ancient origin; and that it widely, or rather generally, prevailed throughout the length and breadth of England up to a comparatively recent date there can be but little doubt. Even now it is by no means uncommon to find the fears of aged gossips excited by pigmy tappings of the tiny insect creature who seeks shelter in some crevice of the wainscot or wall. It would be difficult to find a more noteworthy proof of the tenacity with which superstition once indulged in clings to its victims than is to be found in the remarks on the death-watch made by Richard Baxter, the well-known divine and author, born in the year 1615, who laboured during the days of the Nonconformists. Speaking of the tappings of the much-dreaded insect, he says:—"There are many things that ignorance causeth multitudes to take for prodigies. I have had many discreet friends that have been affrighted with the noise called a death-watch, whereas I have, since near three years ago, oft found by trial that it is a noise made upon paper by a little nimble running worm just like a louse, but whiter and quicker; and it is most usually behind a paper pasted to a wall, especially to wainscot, and it is rarely if ever heard but in the heat of the summer." We here see that Baxter, having brought his hard-working and resolute mind to bear on the matter at issue, had managed to render a most clear and satisfactory account of it; but now comes the stumble of the guide over the very block against which he warns others. Continuing his subject, he says:—"But who can deny it to be a prodigy which is recorded by Melchior Adamus of a great and good man who had a clock-watch that had lain in a chest many years unused, and when he lay dying, at eleven o'clock, of itself in that chest it struck eleven in the hearing of many." It will be observed that Baxter, in speaking of the insect by which the ticking was, in his opinion, made, describes it as a little nimble running worm, just like a louse, but whiter and quicker.

Fig. 1.

Fig. 2.

Now, Sir Thomas Browne, writing on the same subject, says:—"Few ears have escaped the noise of the death-watch—that is, the little clicking sound heard often in many rooms somewhat resembling that of a watch, and this is conceived to be of evil omen or prediction of some person's death, wherein notwithstanding there is nothing of rational presage or just cause of terror unto melancholy or meticulous heads. For this *noise is made by a little, sheath-winged, grey insect*, found often in wainscot, benches, and woodwork in the summer. We have taken many thereof, and kept them in thin boxes, wherein we have heard and seen them work and knock with a little proboscis or trunk against the sides of the box like a *picus martius* or woodpecker against a tree. It worketh best in warm weather, and, for the most part, giveth not over under nine or eleven strokes at a time. He that could extinguish the terrifying apprehensions hereof might prevent the passions of the heart and many cold sweats in grandmothers and nurses who, in the sickness of children, are so startled with their noises."

It will be observed that the habits of the insect just described are identical with those of the death-watch mentioned by Baxter; yet when we come to a description of the insect itself, it becomes clear that the two investigators had selected members of distinct species as being the producers of the sinister sound. On consulting the writings of Swammerdam, we find him speaking of an insect which he calls, "A small beetle which, having strongly fixed its foremost legs, and bent and put its head through the space between them, makes a continued noise in old pieces of wood, walls, and ceilings, which is sometimes so loud, that upon hearing it people have been persuaded that nocturnal hobgoblins, ghosts, and fairies wandered about them." He then goes on to favour us with his views regarding this odd creature who raps his head so industriously on the hard board between his own fore-legs, and says, "I think that this may be properly called *Sonicephalus*, or the noisy-headed beetle." Swammerdam's evidence, therefore, agrees with that given by Sir Thomas Browne, and clearly points to some member of the *Anobium* family as the liliputian spirit-rapper. In the "History of Northumberland," written by Wallis, it will be found that by him the tickings of the so-called death-watch are attributed clearly and distinctly to an *anobium*. Writing of it, he says, "The small scarab called death-watch (*Scarabæus galeatus pulsator*) is frequent among dust, and in decayed rotten wood, lonely and retired. It is one of the smallest of the *vaginopenni*, of a dark brown, with irregular light-brown spots, the belly plicated, and the wings under the cases pellucid like other beetles; the helmet turned, as is supposed, for hearing; the upper lip hard and shining. By its regular pulsations, like the ticking of a watch, it sometimes surprises those that are strangers to its nature and properties, who fancy its beating portends a family change and the shortening of the thread of life. Put into a box it may be heard and seen in the act of pulsation, with a small proboscis, against the side of it, for food more probably than for hymeneal pleasure, as some have fancied." Then there have been acute observers who have been of opinion that the insect, in its larva or grub stage of existence, possessed the power of emitting ticking sounds. Amongst these we may class the Dean of St. Patrick's, who writes as follows on the subject:—

"A wood-worm
That lies in old wood, like a hare in her form;
With teeth or with claws it will bite or will scratch,
And chambermaids christen this worm a death-watch,
Because, like a watch, it always cries 'click;'
Then woe be to those in the house who are sick:
For as sure as a gun they will give up the ghost
If the maggot cries 'click' when it scratches the post.
But a kettle of scalding hot water injected,
Infallibly cures the timber affected;
The omen is broken, the danger is over,
The maggot will die, and the sick will recover."

Mr. Duncan Campbell, whose memoirs were written between 1730 and 1740, also says, with regard to the tickings of that which he evidently believes to be a grub or larva, "How many people have I seen in the most terrible palpitations for months together, expecting every hour the approach of some calamity, only by a little worm which breeds in wainscots, and, endeavouring to eat its way out, makes a noise like the movements of a watch." Notwithstanding the statements thus advanced regarding the ability of the insect in its immature form to emit or cause ticking sounds, there appears little doubt that they were made in error. Mr. W. Derham, who forwarded a communication on the subject of death-watches to the *Philosophical Transactions*, July 21st, 1701, appears to have been the first who discovered that the clear, white, and nimble little creature described by Baxter (*Atropos pulsatorius*) and the little beetle-like insect (*Anobium tessellatum*), stated by both Swammerdam and Wallis as being the true death-watches, were both capable of producing the ticking sound. Writing of his discovery, he says, "The other death-watch is an insect in appearance quite different from the last (*Anobium tesselatum*), which I lately discovered about the beginning of this July; the other death-watch (the beetle) beateth only about seven or eight strokes at a time, and quicker, but this will beat some hours together without intermission, and his strokes are more leisurely and like the beats of a watch. I have several years observed these two sorts of beating, but took it to be made by one and the same animal. The insect which makes this long beating is a small greyish insect, much resembling a louse when looked on only with the naked eye, for which reason, for want of another name, I call it *Pediculus pulsatorius*. It is very nimble in running to seek shelter when disturbed. It is very common in all parts of the house in the summer months. They are all extremely shy of beating when disturbed, but will beat freely enough before you, and also answer you when you beat, if you can view them without giving them disturbance or shaking the place where they lie. I cannot tell whether they beat on any other thing, but I have heard this noise only in or near paper. Concerning their noise, I am somewhat in doubt whether it be made by beating their heads, or rather snouts, against the paper, or whether it be not made after some such manner as grasshoppers and crickets make their noise. I rather incline to the former opinion. But my reason for doubting is because I have observed the animal's body to shake or give a sudden jerk at every stroke, but I could scarce perceive any part of the body to touch the paper. It is possible it might beat the paper and I not perceive it, by reason its body is small, and tear the paper when it beateth, and its motion in beating is sudden and swift."

Our own observations lead us to the conclusion that both the insects just described unquestionably possess ticking powers, but we do not think the sounds emitted are produced by each insect in the same manner. Mr. Carpenter appears inclined to the same. He writes as follows regarding the sound :—"This singular noise proceeds from two different insects. One of these (*Anobium tesselatum*) is coleopterous, of a dark colour, and about a quarter of an inch in length. It is chiefly in the latter end of spring that it commences its noise, which may be considered analogous to the call of birds. This is caused by beating on hard substances with the shield or fore-part of its head. The general number of successive distinct strokes is from seven to nine or eleven. These are given in pretty quick succession, and are repeated at uncertain intervals. In old houses, where the insects are numerous, they may be heard, if the weather be warm, almost every hour of the day. In beating the insect raises itself upon its hinder legs, and, with its body somewhat inclined, beats its head with great force and agility against the place on which it stands. This insect, which is the real death-watch of the vulgar, must not be confounded with a minuter insect not much unlike a louse, which makes a ticking noise like a watch, but instead of beating at intervals it continues its noise for a considerable length of time without intermission. This latter insect, the *Termes pulsatorius*, Linn., belongs to a very different tribe (*Neuroptera*). It is usually found in old wood, decayed furniture, museums, and neglected books.

The female lays her eggs, which are exceedingly small, in dry, dusty places, where they are likely to meet with least disturbance. They are generally hatched about the beginning of March, a little sooner or later, according to the weather. After leaving the egg the insects are so small as scarcely to be discerned without the use of a glass. They remain in this larva state about two months, somewhat resembling in appearance the mites in cheese, after which they undergo their change into the perfect insect. They feed on dead flies and other insects, and often, from their numbers and voracity, very much deface cabinets of natural history. They subsist on various other substances, and may often be observed carefully hunting for nutritious particles amongst the dust in which they are found, turning it over with their heads, and searching about somewhat in the manner of swine. Many live through the winter buried deep in the dust to avoid the frost. Here, then, we have clearly enough the natural history of the clear, white, nimble insect; but as he is unprovided with a hard, shell-like coat of mail, and has no helmet front to protect his delicate little head from the hammer, or rather battering-ram-like blows which the ticking beetle appears rather to revel in and enjoy, we are therefore at a loss to account for the sharp, clear, metallic, watch-like ticking which it most assuredly produces. It may be that by rapidly and suddenly raising its body from the well-chosen substance on which it rests, and then bringing it sharply down again by muscular effort, that the sound is given forth. Those of our readers who have had an opportunity of listening to the incredibly loud sound produced by the common wasp when in the act of nipping nest-making materials from the woodwork of a window-sash, will be quite prepared to believe that *Atropos pulsatorius*, small as he is, is capable of following the example of his rap-delivering fellow-alarmist (*Anobium tesselatum*), without the aid of either a professed medium or supernatural agency. Fig. 1 in the illustration in the preceding page represents the former insect magnified from one line in length, and Fig. 2 gives an enlarged view of the latter.

LESSONS IN SPANISH.—XVIII.

THE ADJECTIVE.

AGREEMENT AND POSITION OF ADJECTIVES.

THE adjective must always agree in gender and number with the noun to which it belongs; as—

El hombre sábio, *the wise man.*	Los hombres sábios, *the wise men.*
La muger sábia, *the wise woman.*	Las mugeres sábias, *the wise women.*

Participles used as adjectives agree in gender and number with the noun to which they belong; as—

El engañado rey, *the deluded king.*	Las engañadas criadas, *the deluded female servants.*
La engañada reina, *the deluded queen.*	

An adjective does not agree with the gender of the title of a person, but with the gender of the person to whom it is applied; as—

Su majestad está enfermo, *his majesty is ill.*	Su majestad está enferma, *her majesty is ill.*

Nada, *nothing*, requires a masculine adjective; as—

Nada hay límpio,	*There is nothing pure.*

Two or more nouns in the singular require the adjective which belongs to them to be in the plural, and if the nouns are of different genders, the adjective must be in the masculine; as—

Juana y María están calladas, *Jane and Mary are silent.*	Lucía y Cárlos están cansados, *Lucy and Charles are tired.*

When an adjective comes before or after two or more plural nouns of different genders, it must agree in gender with the noun nearest to it; as—

Buenos diccionários y gramáticas, *good dictionaries and grammars.*	Diccionários y gramáticas buenas, *good dictionaries and grammars.*

The Spanish Academy recommends that in cases in which an adjective is to be used with two or more nouns differing in gender and number, it would be better to use a different adjective of similar meaning for every noun, or an adjective which does not change its ending to form its feminine for the plural.

The material of which a thing is made, as well as the country in which it is made or produced, are seldom used as adjectives, but as a noun preceded by the preposition *de*; thus—

Paño de laña, *woollen cloth.*	Hoja de plata, *silver leaf.*
Cueros de Méjico, *Mexican hides.*	Cerveza de Lóndres, *London beer.*

The profession or dignity of a person may be qualified by an adjective derived from the name of a nation preceded by the preposition as above; thus—

General de España, *Spanish general (general of Spain).*	General Mejicano, *Mexican general.*

The title of the chief ruler of a country is not qualified by an adjective expressing the nation, but by the name of the country, preceded by the preposition; as—

El rey de España, *the king of Spain.*	El presidente de los Estados Unidos, *the president of the United States.*
La reina de Inglaterra, *the queen of England.*	

Adjectives of both numbers and genders are often used as nouns, being in such cases preceded by the article; as—

Un rico, *a rich (man).*	Los ricos, *the rich (men).*
Una rica, *a rich (woman).*	Las ricas, *the rich (women).*
Los doctos, *the learned.*	

The neuter article (as it is called) *lo* precedes adjectives in the singular number, used as nouns, when taken in a general sense, without reference to either gender; as—

Lo escrito, *the written,* i.e., *that which is written.*	Lo siguente, *the following,* i.e., *that which follows.*
Lo malo, *the bad,* i.e., *that which is bad.*	

Adjectives and participial adjectives are much oftener placed after the noun to which they belong than before it; as—

Hombre sábio, *a wise man.*	Guárdia avanzada, *advanced guard.*
Furor poético, *poetical fury.*	

In many cases it is left entirely to the taste of the writer to place the adjective before or after the noun to which it belongs. But cardinal numbers, adjectives expressing some inherent or peculiar property, habit, or practice of the noun to which they belong, and adjectives employed as particular epithets with a proper name, are generally placed before the noun: so likewise adjectives accented on the antepenult; as in these examples:—

Una dulce frescura, *a pleasant coolness.*	La tímida oveja, *the timid sheep.*
Cristalina água, *crystalline water.*	El ambicioso Jefferson, *the ambitious Jefferson.*
La blanca nieve, *the white snow.*	

The above rule is liable to many exceptions. Indeed, no certain rules can be given for the position of adjectives. Attention on the part of the pupil to the practice of the best Castilian writers will prove the best means of teaching him the most proper arrangement for adjectives.

Tanto, *as much;* cuanto, *so much;* mucho, *much;* todo, *all;* poco, *little,* are always placed before the noun.

In some few cases the same adjective has a different meaning, according as it is placed before or after the noun; as—

Cuenta cierta, *a true (certain) narrative.*	Cierta señora, *a certain lady.*

COMPARATIVES AND SUPERLATIVES, ETC.

There are some irregular comparatives; as, mayor, *greater;* mejor, *better;* menor, *smaller;* peor, *worse.*

As the superlative relative is formed by placing the article before the comparative, of course "el mayor" means *the greatest;* el mejor, *the best;* el menor, *the least;* el peor, *the worst.*

There are some irregular superlatives; as, máximo, *greatest;* óptimo, *best;* mínimo, *least;* pésimo, *worst;* ínfimo, *lowest.*

There are some superlatives in *ísimo* not regularly formed; as, bonísimo, *very good;* novísimo, *very new;* fortísimo, *very strong;* fidelísimo, *very faithful;* sapientísimo, *very wise;* these being the superlatives of the adjectives *bueno, nuevo, fuerte, fiel, sábio.*

There are a few superlatives otherwise irregular; as, paupérrimo, *very poor;* misérrimo, *very miserable;* integérrimo, *very honest;* celebérrimo, *very celebrated;* salubérrimo, *very salubrious;* libérrimo, *very free.*

The superlative of the above adjectives can also be formed with *muy;* as, muy grande, *very great;* muy pobre, *very poor;* muy bueno, *very good,* etc. And such as do not already end in *ísimo* or *érrimo* can have their regular form in *ísimo;* as, malísimo, *very bad;* poquísimo, *very small,* etc.

With political or other titles of dignity, *muy* before an adjective expresses somewhat less than the termination *ísimo* affixed to it; thus, muy ílustre, *very illustrious,* is less than ilustrísimo, *most illustrious.*

When a superlative relative follows the noun to which it refers, it is sufficient that the article be used before the noun, and not repeated before the superlative; as—

Los Catalanes son los pueblos mas industriosos de España,	*The Catalans are the most industrious people of Spain.*

One noun can be compared with another in the same manner as adjectives; as—

Juan es mas niño que su nieto,	*John is more (of a) child than his grandson.*

In forming a comparison, in affirmative sentences, *de* is used instead of *que* before an adjective of quantity or number, or before the pronouns *what* or *that which,* expressed or understood; as—

Juan tiene mas de lo que necesita, *John has more than what he needs.*	Mi hijo tiene mas de seis años, *my son is more than six years old.*

If the sentence be negative, *de* or *que* may either of them be used before an adjective of quantity or number, or the pronouns *what* or *that which;* as—

Mi hijo no tiene mas que (or de) seis años,	*My son is not more than six years old.*

When the adjective is placed after a proper name as a distinguishing epithet, such as "Tarquin the Proud," the article precedes it in Spanish as in English; as—

Alexandro el Magno, *Alexander the Great.*	Guzman el Bueno, *Guzman the Good.*

Numeral adjectives of order form an exception to the above rule; as—

Francisco Primero, *Francis the First.*	Cárlos Doce, *Charles the Twelfth.*

The preposition *de* is generally used after an adjective or participle which is followed by a noun expressive of the cause, manner, means, or instrument, and also after adjectives denoting distance; as—

Agudo de ingénio, *sharp in intellect.*	Sordo de un oido, *deaf with one ear.*
Apurado de médios, *exhausted in means.*	Palido de miedo, *pale with fear.*
Ageno de verdad, *foreign to truth.*	Defectos comunes de su juventud, *faults common to his youth.*
Bajo de cuerpo, *low in stature.*	Ancho de boca, *wide in the mouth (wide-mouthed).*
Boto de punto, *blunt at the point.*	Angosto de manga, *narrow in the sleeve (narrow-sleeved).*
Curtido del sol, *tanned by the sun.*	

The preposition *in* after a superlative is to be rendered into Spanish by *de;* as—

Los mas sábios hombres del mundo,	*The wisest men in the world.*

Tanto, and not *tan,* is used before a noun in comparisons of equality; as—

María tiene tanta prudéncia como Juana,	*Mary has as much prudence as Jane.*

NUMERALS.

The numeral adjectives are divided into *cardinal* and *ordinal.* The cardinal numerals express numbers; as *one, two, three;* and the ordinal numerals express order or rank; as *first, second, third.*

There are also some numeral nouns, such as the collective numbers, una docena, *a dozen;* una veintena, *a score;* and the fractional numbers, la mitad, *the half;* un cuarto, *a fourth.*

The following is a list of the cardinal and ordinal numeral adjectives:—

CARDINAL NUMBERS.	ORDINAL NUMBERS.
Uno, una, *one.*	Primero, *first.*
Dos, *two.*	Segundo, *second.*
Tres, *three.*	Tercero, *third.*
Cuatro, *four.*	Cuarto, *fourth.*
Cinco, *five.*	Quinto, *fifth.*
Seis, *six.*	Sexto or sesto, *sixth.*
Siete, *seven.*	Séptimo, *seventh.*
Ocho, *eight.*	Octavo, *eighth.*
Nueve, *nine.*	Noveno or nono, *ninth.*
Diez, *ten.*	Décimo, *tenth.*
Once, *eleven.*	Undécimo, *eleventh.*
Doce, *twelve.*	Duodécimo, *twelfth.*
Trece, *thirteen.*	Décimo tércio, *thirteenth.*
Catorce, *fourteen.*	Décimo cuarto, *fourteenth.*
Quince, *fifteen.*	Décimo quinto, *fifteenth.*
Diez y seis, *sixteen.*	Décimo sesto, *sixteenth.*
Diez y siete, *seventeen.*	Décimo séptimo, *seventeenth.*
Diez y ocho, *eighteen.*	Décimo octavo, *eighteenth.*
Diez y nueve, *nineteen.*	Décimo nono, *nineteenth.*
Veinte, *twenty.*	Vigésimo, *twentieth.*
Veinte y uno,* *twenty-one.*	Vigésimo primo, *twenty-first.*
Veinte y dos, *twenty-two.*	Vigésimo segundo, *twenty-second.*
Veinte y tres, *twenty-three.*	Vigésimo tércio, *twenty-third.*
Veinte y cuatro, *twenty-four.*	Vigésimo cuarto, *twenty-fourth.*
Veinte y cinco, *twenty-five.*	Vigésimo quinto, *twenty-fifth.*

* Sometimes found written as one word, as *veintiuno, veintidos.*

Veinte y seis, *twenty-six.*	Vigésimo sesto, *twenty-sixth.*
Veinte y siete, *twenty-seven.*	Vigésimo séptimo, *twenty-seventh.*
Veinte y ocho, *twenty-eight.*	Vigésimo octavo, *twenty-eighth.*
Veinte y nueve, *twenty-nine.*	Vigésimo nono, *twenty-ninth.*
Treinta, *thirty.*	Trigésimo, *thirtieth.*
Cuarenta, *forty.*	Cuadragésimo, *fortieth.*
Cincuenta, *fifty.*	Quincuagésimo, *fiftieth.*
Sesenta, *sixty.*	Sexagésimo, *sixtieth.*
Setenta, *seventy.*	Septuagésimo, *seventieth.*
Ochenta, *eighty.*	Octogésimo, *eightieth.*
Noventa, *ninety.*	Nonagésimo, *ninetieth.*
Ciento, *a hundred.*	Centésimo, *hundredth.*
Docientos, *two hundred.*	Docentésimo, *two hundredth.*
Trecientos, *three hundred.*	Trecentésimo, *three hundredth.*
Cuatrocientos, *four hundred.*	Cuadragéntesimo, *four hundredth.*
Quincientos, *five hundred.*	Quingentésimo, *five hundredth.*
Seiscientos, *six hundred.*	Sexentésimo, *six hundredth.*
Setecientos, *seven hundred.*	Septengentésimo, *seven hundredth.*
Ochocientos, *eight hundred.*	Octogentésimo, *eight hundredth.*
Novecientos, *nine hundred.*	Nonagentésimo, *nine hundredth.*
Mil, *a thousand.*	Milésimo, *thousandth.*

The cardinal numbers for *eleven hundred, twelve hundred, two thousand, three thousand,* etc., are *mil y ciento, mil y docientos, dos mil, tres mil;* for *a hundred thousand, two hundred thousand,* etc., *cien mil, docientos mil;* for *a million, two millions,* etc., *un millon, dos millones. Millon* is not an adjective, but a noun.

Uno is declinable, changing the final *o* into *a* whenever it refers to a feminine noun. All of the cardinal numbers ending in *ientos* form their feminine in *as;* as, docientas mugeres, *two hundred women.* The rest are indeclinable.

All the ordinal numbers change the last *o* into *a* to form their feminine.

Uno drops the last letter when it comes before a noun.

Ciento drops its last syllable when it comes immediately before a noun, but not when any other word comes between it and the noun; thus, cien soldados, *a hundred soldiers;* and ciento y tres soldados, *a hundred and three soldiers.*

Primero and *tercero,* among the ordinals, drop the final *o* before a noun.

The cardinal numbers (and not the ordinal) are generally used in Spanish to express order or rank, when the number exceeds nine; when under nine, the ordinals are employed; thus—

Enrique Octavo, *Henry Eight (the Eighth).*	Tomo diez y ocho, *volume eighteen (the eighteenth).*
Cárlos Doce, *Charles Twelve (the Twelfth).*	Página septima, *page seventh (the seventh).*

In mentioning the days of the month, the Spanish use the cardinal adjectives and not the ordinal, as in English, except in the first day, in which *primero* and not *un* is used; thus—

El primero de Enero, *the first of January.*	El tres de Marzo, *the three (third) of March.*
El dos de Febrero, *the two (second) of February.*	El diez y seis de Mayo, *the sixteen (sixteenth) of May.*

In dates where figures are used, the article is omitted, and except the first day of the month, the cardinal numbers are used; as—

Madrid, 1° de Júnio de 1845,	*Madrid, June 1st, 1845.*
Paris, 4 de Júlio de 1846,	*Paris, July 4th, 1846.*
Lóndres, 27 de Agosto de 1847,	*London, August 27th, 1847.*

The hour of the day is expressed by the ordinal numbers preceded by the definite article, which must in such a case agree with horas, *hours,* understood (unless the hour be one, when it agrees with the singular, *hora*); thus—

¿ Que hora es? *what o'clock is it?*	Son las tres ménos diez minutos, *it is ten minutes before three.*
Es la una, *it is one o'clock.*	
Son las dos, *it is two o'clock.*	Son las ocho y veinte minutos, *it is twenty minutes after eight.*
Son las diez, *it is ten.*	

In speaking of the age of persons or things, the verb *tener* is employed in Spanish; as—

El Señor Tournay no tiene cincuenta años, *Mr. Tournay is not fifty years of age.*	Cárlos tiene doce años, *Charles is twelve years old.*

In Spanish it is not said, in expressing measurement, "twenty feet high," or "ten feet long;" but "twenty feet of height," "ten feet of length;" as—

La casa tenía sesenta codos de largo, y veinte codos de ancho, y treinta codos de altura,	*The house was (had) sixty cubits long, and twenty cubits wide, and thirty cubits in height.*

LESSONS IN FRENCH.—LXXXVI.

§ 140.—The Conjunction.—Government of Conjunctions. [See § 123] (*continued*).

(4.) The following conjunctions:—**De manière que, de sorte que, en sorte que,** *so that;* **tellement que,** *in such a manner that;* **si ce n'est que, sinon que,** *unless that, but that;* govern the following verb in the indicative or conditional mood, when the preceding verb expresses a positive assertion; but they govern the subjunctive when the preceding verb expresses a desire or a command:—

Il se conduisit très mal, **de sorte qu**'il **fût** contraint de se retirer.	*He behaved very ill, so that he was obliged to withdraw.*
Faites **en sorte qu**'on **soit** content de vous.	*Behave in such a manner that people may be pleased with you.*

(5.) When there are in a sentence two or more verbs governed by a conjunction, **que** must be placed before the second and the following verbs, or the conjunction itself may be repeated:—

Puisqu'on **plaide, qu**'on **meurt,** et **qu**'on **devient** malade, Il faut des médecins, il faut des avocats. La Fontaine.	*Since we plead, we die, and we become sick, we must have physicians, we must have lawyers.*
Si vous **partez** et **que** vous **vouliez** me prendre avec vous. Bescherelle.	*If you go and wish to take me with you.*

(6.) The other conjunctions generally govern the same tense in French as in English:—

Fais du bien aujourd'hui **puisque** tu **vis** encore. Villefré.	*Do good to-day, since thou yet livest.*
Rien n'éblouit les grandes âmes, **parce que** rien **n'est** plus haut qu'elles. Massillon.	*Nothing dazzles great minds, because nothing is higher than they.*

With regard to the conjunction **si,** *see* § 121, (3.), (4.).

§ 141.—Collocation of Words.

(1.) The place of the different parts of speech has been mentioned in the Syntax under their several heads, and in various other parts of the work. A summary of the principal rules of construction may, however, not be unacceptable here.

(2.) The collocation of words is the order according to which the several words which form a sentence should follow one another. This order is fixed for the several forms of sentences, affirmative, negative, and interrogative, by the genius of the language, and the practice of the best writers.

(3.) The construction of the affirmative sentence is as simple in French as it is in English. The following is the arrangement of the words:—

1. *The Subject.*	2. *The Verb.*	3. *The Adverb.*
Le marchand	est	ici.
The merchant	*is*	*here.*

(4.) When the subject is accompanied by an adjective, or another attribute, the order is as follows:—

1. *The Subject.*	2. *Its Attribute.*	3. *The Verb.*	4. *The Adverb.*
Le marchand	anglais	est	ici.
The merchant	*English*	*is*	*here.*
Le fils	de votre ami	est	là.
The son	*of your friend*	*is*	*there.*
La marteau	de fer	est	ici.
The hammer	*of iron*	*is*	*here.*
Le bateau	à vapeur	est	là.
The boat	*steam*	*is*	*there.*

(5.) When the attribute of the subject is placed in apposition with the verb, the construction is the same in the two languages:—

1. *The Subject.*	2. *The Verb.*	3. *The Attribute.*
Le marchand	est	anglais.
The merchant	*is*	*English.*

(6.) When the verb is in a compound tense, many adverbs are placed between the auxiliary and the participle:—

1. *The Subject.*	2. *The Auxiliary.*	3. *The Adverb.*	4. *The Participle.*
Nous	avons	souvent	lu.
We	*have*	*often*	*read.*

(7.) Long adverbs of manner, ending in *ment*, other long adverbs, and the adverbs of time and place, **aujourd'hui, demain, hier, ici, là,** are not placed between the auxiliary and the participle [§ 132, Sect. 41, (5.)] :—

Nous avons écrit aujourd'hui.	*We have written to-day.*

(8.) When there is a direct object in the sentence, it is placed after the verb :—

1. *Subject.*	2. *Attribute.*	3. *Verb.*	4. *Adverb.*	5. *Direct Object.*
L'écolier	attentif	apprend	toujours	sa leçon.
The scholar	*attentive*	*learns*	*always*	*his lesson.*

(9.) When there are two objects of equal length, or nearly so, the direct precedes the indirect :—

1. *Subject.*	2. *Verb.*	3. *Direct Object.*	4. *Indirect Object.*
Jean	a donné	le livre	à mon père.
John	*has given*	*the book.*	*to my father.*

(10.) Should the direct object be followed by a relative pronoun, or by attributes rendering it longer than the indirect object, the latter is placed first :—

1. *Subj.*	2. *Verb.*	3. *Ind. Object.*	4. *Direct Object.*
Jean	a donné	à mon père	le livre qu'il lui avait promis.
John	*has given*	*to my father*	*the book which he had promised him.*

(11.) The pronouns representing the direct object, and those representing the indirect object, preceded by *to*, expressed or understood in English, are placed before the verb in French :—

1. *Subj.*	2. *Direct. Obj.*	3. *Verb.*	1. *Subj.*	2. *Ind. Obj.*	3. *Verb.*
Nous	les	voyons.	Nous	leur	parlons.
We	*them*	*see.*	*We*	*to them*	*speak.*

(12.) In the imperative used affirmatively, those pronouns follow the verb :—

1. *Verb.*	2. *Direct Obj.*	1. *Verb.*	2. *Ind. Obj.*
Voyez-	les.	Parlez-	leur.
See	*them.*	*Speak*	*to them.*

(13.) When two personal pronouns are used as objects in a sentence, the indirect, if in the first or second person, precedes the direct :—

1. *Subject.*	2. *Ind. Obj.*	3. *Direct Obj.*	4. *Verb.*
Paul	nous	le	donne.
Paul	*to us*	*it*	*gives.*
Paul	vous	le	donne.
Paul	*to you*	*it*	*gives.*

(14.) Should, however, the indirect and the direct objects be in the third person, the indirect is placed after the direct :—

1. *Subject.*	2. *Direct Obj.*	3. *Ind. Obj.*	4. *Verb.*
Paul	le	lui	donne.
Paul	*it*	*to him*	*gives.*

(15.) In the imperative used affirmatively, the direct object always precedes the indirect :—

1. *Verb.*	2. *Dir. Obj.*	3. *Ind. Obj.*
Donnez-	les	nous.
Give	*them*	*to us.*
Donnez-	les	lui.
Give	*them*	*to him.*

(16.) The pronoun representing a noun in an oblique case, generally preceded in English by a preposition other than *to*, is, in French, placed after the verb :—

1. *Subj.*	2. *Verb.*	3. *Ind. Obj.*
Je	parle	de lui.
I	*speak*	*of him.*
Je	parle	avec lui.
I	*speak*	*with him.*

(17.) To render a sentence negative, **ne** is placed immediately before the verb, and **pas, jamais, rien,** etc., after it : —

1. *Subj.*	2. *Negat.*	3. *Verb.*	4. *Negat.*
Je	ne	vois	pas.
I	*not*	*see*	*not.*
Je	ne	lis	jamais.
I	*not*	*read*	*never.*

(18.) When the verb is in a compound tense, the first negative is placed before the auxiliary, and the second between that auxiliary and the participle :—

1. *Subj.*	2. *Negat.*	3. *Obj.*	4. *Aux.*	5. *Negat.*	6. *Part.*
Je	ne	l'	ai	pas	vu.
I	*not*	*him*	*have*	*not*	*seen.*
Je	ne	leur	ai	jamais	parlé.
I	*not*	*to them*	*have*	*never*	*spoken.*
Je	ne	leur	ai	rien	donné.
I	*not*	*to them*	*have*	*nothing*	*given.*

(19.) The pronouns used as direct and indirect objects are placed before the imperative, used negatively. They are subject to the rules of precedence, (13.) and (14.) :—

	1. *Negat.*	2. *Obj.*	3. *Obj.*	4. *Verb.*	5. *Negat.*
[Rule (13.)]	Ne	nous	le	donnez	pas.
	Not	*to us*	*it*	*give*	*not.*
[Rule (14.)]	Ne	le	lui	donnez	pas.
	Not	*it*	*to him*	*give*	*not.*

(20.) The construction of an interrogative sentence, which has a noun for its subject, differs in the two languages. The following examples will show the order of the words in French :—

1. *The Subj.*	2. *Verb.*	3. *Duplicate Subj.*	4. *Object.*
Le marchand	reçoit-	il	son argent ?
The merchant	*receives*	*he*	*his money ?*
Mon frère	écrit-	il	des lettres ?
My brother	*writes*	*he*	*letters ?*

(21.) When the sentence commences with **où**, *where ;* **que**, *what ;* **quel**, *what, which ;* **combien**, *how much, how many ;* the noun may be placed after the verb :—

Où est votre **ami** ?	*Where is your friend ?*
Que dit votre **pere** ?	*What says your father ?*

(22.) The construction of interrogative sentences, in which the subject is a pronoun, is very simple. The pronoun is placed after the verb in simple tenses, and after the auxiliary in compound tenses :—

1. *Indir. Obj.*	2. *Verb.*	3. *Subject.*	4. *Dir. Object.*
Nous	envoyez-	vous	notre argent ?
To us	*send*	*you*	*our money ?*

1. *Ind. Obj.*	2. *Aux.*	3. *Subj.*	4. *Part.*	5. *Direct. Obj.*
Leur	avez-	vous	donné	cet argent ?
To them	*have*	*you*	*given*	*that money ?*

(23.) The order of the words in a sentence at once negative and interrogative is as follows :—

1. *1st Neg.*	2. *Ind. Obj.*	3. *Verb.*	4. *Subj.*	5. *2nd Neg.*	6. *Direct Obj.*
Ne	nous	envoyez-	vous	pas	de l'argent ?
Not	*to us*	*send*	*you*	*not*	*money ?*

(24.) In a compound tense :—

1. *1st Neg.*	2. *Ind. Obj.*	3. *Verb.*	4. *Subj.*	5. *2nd Neg.*	6. *Part.*	7. *Dir. Obj.*
Ne	nous	avez-	vous	pas	envoyé	de l'argent ?
Not	*to us*	*have*	*you*	*not*	*sent*	*money ?*

(25.) The first person singular of the present of the indicative of most verbs, which have in that person only one syllable, and of a few others having more than one syllable, cannot admit of the construction mentioned in the 22nd rule of this paragraph. To render the sentence interrogative, **est-ce que** is prefixed to the affirmative form of the verb :—

Est-ce que vous parlez ?
Is it that you speak ?
Do you speak ?

Est-ce que je prétends lui parler ?
Is it that I pretend to speak to him ?
Do I pretend to speak to him ?

(26.) Every person of a tense susceptible of being conjugated interrogatively admits of this construction :—

Est-ce que vous lisez ?	*Do you read ?*
Est-ce que votre frère est arrivé ?	*Is your brother arrived ?*

(27.) In poetry and elevated prose, the subject of an affirmative sentence is sometimes placed after the verb :—

Tout à coup au jour vif et brillant de la zône torride, succède **une nuit** universelle et profonde; à la parure d'un printemps éternel, **la nudité** des plus tristes hivers. RAYNAL.	*Suddenly to the vivid and brilliant day of the torrid zone, succeeds a universal and profound night; to the attire of an eternal spring, the nakedness of the saddest winters.*

(28.) The article, the demonstrative, and the possessive adjective are repeated before every word that they determine [Sect. 86].

(29.) Pronouns, used as subjects of verbs, may be repeated before every verb [§ 96; Sect. 87].

(30.) Pronouns, used as objects, must be repeated before every verb [§ 102].

(31.) Prepositions are generally repeated before every word which they govern [§ 137].

§ 142.—USE OF CAPITAL LETTERS.

The only important difference existing in the two languages in the use of capital letters, is that the French do not use a capital for an adjective, unless it be used substantively, and in reference to persons, or unless it form an integral part of a name :—

Ce monsieur est-il **français**?	*Is that gentleman French?*
C'est un **Français**.	*He is a Frenchman.*
Est-il **français**?	*Is he French?*
Cette dame est-elle **anglaise**?	*Is that lady English?*
C'est une **Anglaise**.	*She is an English lady.*
Elle est **anglaise**.	*She is English.*
Apprenez-vous le **français**?	*Do you learn French?*
Je n'apprends pas l'**anglais**.	*I do not learn English.*
J'attends le **Français** qui demeure ici.	*I am waiting for the Frenchman who lives here.*
Le département des **Basses-Alpes**.	*The department of the Lower Alps.*
Le royaume des **Pays-Bas**.	*The kingdom of the Netherlands.*

§ 143.—ELISION.

(1.) Elision is the suppression of the final vowel of a word, and the substitution of an apostrophe (') before words commencing with a vowel or an *h* mute :—

The vowels thus elided are **a, e, i** :—

a is only elided in **la**, article or pronoun—**L'âme**, *the soul*; instead of *la âme*; **l'humilité**, *humility*; instead of *la humilité*; je **l'admire**, je **l'honore**, *I admire her, I honour her*; instead of *je la admire, je la honore*.

NOTE.—The **a** of **la**, pronoun, is elided only when it precedes its verb.

e is elided in **le**, article or pronoun, in **je, te, me, se, ce** (meaning *it*, dem. prn.), **de, ne, que, parce que, quoique, puisque, jusque, quelque,—l'ami**, *the friend*; **l'homme**, *the man*; also in **presque** in the compound noun **presqu'île**; also in **entre** in compound words such as **entr'acte, s'entr'aider**; also in **grande** in feminine compound nouns: **grand'tante, grand'messe.**

NOTE.—The **e** of the pronouns **je, me, le,** and **ce** is elided only when they precede their verb.

i is only elided in **si** coming before **il**, *he*; **ils**, *they*.

(2.) Although the words **onze, onzième, oui, ouate, yatagan, yard, yacht, yoga, yole, yucca** commence with a vowel, the article is not elided before them.

LESSONS IN GERMAN.—LXVII.

§ 83.—PARADIGMS OF IRREGULAR VERBS.

(1.) In order to a better display of the irregularities of some of these verbs, we append the following paradigms. They will be found exceedingly convenient for ready reference. Some of these verbs, also, have certain peculiar uses which require special attention. For this reason we have, immediately after each verb, added a series of explanatory remarks, with copious examples illustrating the several ways in which they are employed.

(2.) Dürfen, *to be permitted, to dare.*

IND. *Pres.* Ich darf, du darfst, er darf; wir dürfen, ihr dürft, sie dürfen.—*Imp.* Ich durfte, du durftest, er durfte; wir durften, ihr durftet, sie durften.—*Perf.* Ich habe gedurft; wir haben gedurft.—*Plup.* Ich hatte gedurft; wir hatten gedurft.—*First Fut.* Ich werde dürfen; wir werden dürfen.—*Second Fut.* Ich werde gedurft haben; wir werden gedurft haben.

SUB. *Pres.* Ich dürfe, du dürfest, er dürfe; wir dürfen, ihr dürfet, sie dürfen.—*Imp.* Ich dürfte, du dürftest, er dürfte; wir dürften, ihr dürftet, sie dürften.—*Perf.* Ich habe gedurft; wir haben gedurft.—*Plup.* Ich hätte gedurft; wir hätten gedurft.—*First Fut.* Ich werde dürfen; wir werden dürfen.—*Second Fut.* Ich werde gedurft haben; wir werden gedurft haben.

COND. *First Fut.* Ich würde dürfen; wir würden dürfen.—*Second Fut.* Ich würde gedurft haben; wir würden gedurft haben.

INF. *Pres.* Dürfen, to be permitted.—*Perf.* Gedurft haben, to have been permitted.

PART. *Pres.* Dürfend, being permitted.—*Perf.* Gedurft, permitted.

REMARKS ON Dürfen.—This verb is generally to be rendered by *to be permitted.* The verb is also employed (only in the imperfect subjunctive, however) to denote what *probably may be*, and may then be translated by such words as *might, need, would*, etc.; thus, Es dürfte jetzt zu spät sein, it *may* or *might be* too late now; Es dürfte vielleicht wahr sein, it *might* perchance *be* true. It also signifies, *to need, to have occasion*, etc.; as, Er darf nur reden, he *needs* only speak; Er darf sich darüber nicht wundern, he *must* not or *should* not wonder at that. When used without an infinitive after it, one must be supplied to complete the construction; thus, Er darf nicht in das Haus (kommen), he is not allowed (to come) into the house.

(3.) Können, *to be able.*

IND. *Pres.* Ich kann, du kannst, er kann; wir können, ihr könnt, sie können.—*Imp.* Ich konnte, du konntest, er konnte; wir konnten, ihr konntet, sie konnten.—*Perf.* Ich habe gekonnt; wir haben gekonnt.—*Plup.* Ich hatte gekonnt; wir hatten gekonnt.—*First Fut.* Ich werde können; wir werden können.—*Second Fut.* Ich werde gekonnt haben; wir werden gekonnt haben

SUB. *Pres.* Ich könne, du könnest, er könne; wir können, ihr könnet, sie können.—*Imp.* Ich könnte, du könntest, er könnte; wir könnten, ihr könntet, sie könnten.—*Perf.* Ich habe gekonnt; wir haben gekonnt.—*Plup.* Ich hätte gekonnt; wir hätten gekonnt.—*First Fut.* Ich werde können; wir werden können.—*Second Fut.* Ich werde gekonnt haben; wir werden gekonnt haben.

COND. *First Fut.* Ich würde können; wir würden können.—*Second Fut.* Ich würde gekonnt haben; wir würden gekonnt haben.

INF. *Pres.* Können, to be able.—*Perf.* Gekonnt haben, to have been able.

PART. *Pres.* Könnend, being able.—*Perf.* Gekonnt, been able.

REMARKS ON Können.—The original signification of können was *to know*, or *to know how*; hence the present sense, to be *at liberty* to do a thing, to be *able*; as, ich kann lesen und schreiben, I can (know how to) read and write. Its chief power now is to indicate bare possibility, and hence it is often aptly translated by the English *may*; as, Er kann es verstanden haben, he *may* (possibly) have understood it. It differs, therefore, from dürfen, when it (dürfen) is used (in the imperfect subjunctive) to express possibility; for dürfen not only signifies that the thing *may* be, but that it *probably is* or *will* be. Können, like dürfen, has sometimes an infinitive understood after it, to complete the construction.

(4.) Mögen, *to be allowed, to have liberty.*

IND. *Pres.* Ich mag, du magst, er mag; wir mögen, ihr mögt, sie mögen.—*Imp.* Ich mochte, du mochtest, er mochte; wir mochten, ihr mochtet, sie mochten.—*Perf.* Ich habe gemocht; wir haben gemocht.—*Plup.* Ich hatte gemocht; wir hatten gemocht.—*First Fut.* Ich werde mögen; wir werden mögen.—*Second Fut.* Ich werde gemocht haben; wir werden gemocht haben.

SUB. *Pres.* Ich möge, du mögest, er möge; wir mögen, ihr möget, sie mögen.—*Imp.* Ich möchte, du möchtest, er möchte; wir möchten, ihr möchtet, sie möchten.—*Perf.* Ich habe gemocht; wir haben gemocht.—*Plup.* Ich hätte gemocht; wir hätten gemocht.—*First Fut.* Ich werde mögen, wir werden mögen.—*Second Fut.* Ich werde gemocht haben; wir werden gemocht haben.

COND. *First Fut.* Ich würde mögen; wir würden mögen.—*Second Fut.* Ich würde gemocht haben; wir würden gemocht haben.

INF. *Pres.* Mögen, to be allowed.—*Perf.* Gemocht haben, to have been allowed.

PART. *Pres.* Mögend, being allowed.—*Perf.* Gemocht, allowed.

REMARKS ON Mögen.—Mögen marks *possibility* under allow ance or concession from another; as, Er mag lachen, he *may* laugh; that is, he has permission to laugh, no one hinders him. Er mag ein braver Mann sein, he *may* (I grant) be a brave man; where the *possibility* of his being a brave man is a thing conceded. Kindred to this are the other significations (chance, inclination, wish, etc.) usually attributed to this verb; thus, es möchte regnen, it *might* rain; that is, the causes that seem to forbid are likely not to operate; ich möchte es bezweifeln, I am *disposed* or *inclined* to doubt it; that is, *I might* doubt it altogether, but for certain circumstances seeming to forbid; möge es der Himmel geben, *may* Heaven grant it; ich mag es nicht thun, I do not *like* to do it, that is, I am not permitted by my feelings to do it cheerfully, etc.

(5.) Müssen, *to be obliged, must.*

IND. *Pres.* Ich muß, du mußt, er muß; wir müssen, ihr müßt, sie müssen.—*Imp.* Ich mußte, du mußtest, er mußte; wir mußten, ihr mußtet, sie mußten.—*Perf.* Ich habe gemußt; wir haben gemußt.—*Plup.* Ich hatte gemußt; wir hatten gemußt.—*First Fut.* Ich werde müssen; wir werden müssen.—*Second Fut.* Ich werde gemußt haben; wir werden gemußt haben.

SUB. *Pres.* Ich müsse, du müssest, er müsse; wir müssen, ihr müsset, sie müssen.—*Imp.* Ich müßte, du müßtest, er müßte; wir müßten, ihr müßtet, sie müßten.—*Perf.* Ich habe gemußt; wir haben gemußt.—*Plup.* Ich hätte gemußt; wir hätten gemußt.—*First Fut.* Ich werde müssen; wir werden müssen.—*Second Fut.* Ich werde gemußt haben; wir werden gemußt haben.

COND. *First Fut.* Ich würde müssen; wir würden müssen.—*Second Fut.* Ich würde gemußt haben; wir würden gemußt haben

INF. *Pres.* Müssen, to be obliged.—*Perf.* Gemußt haben, to have been obliged.

PART. *Pres.* Müssend, being obliged.—*Perf.* Gemußt, obliged.

REMARKS ON Müssen.—The German müssen and the English *must* are very nearly equivalents. The predominant power of the word is everywhere that of obligation or necessity, and this being kept in mind, it will often be convenient to employ in translating it such words as *be obliged, am to, have need to,* and the like. Often an infinitive is understood with it; as, ich muß zurück, I must (go) back.

(6.) Sollen, *to be obliged.*

IND. *Pres.* Ich soll, du sollst, er soll; wir sollen, ihr sollt, sie sollen.—*Imp.* Ich sollte, du solltest, er sollte; wir sollten, ihr solltet, sie sollten.—*Perf.* Ich habe gesollt; wir haben gesollt.—*Plup.* Ich hatte gesollt; wir hatten gesollt.—*First Fut.* Ich werde sollen; wir werden sollen.—*Second Fut.* Ich werde gesollt haben; wir werden gesollt haben.

SUB. *Pres.* Ich solle, du sollest, er solle; wir sollen, ihr sollet, sie sollen.—*Imp.* Ich sollte, du solltest, er sollte; wir sollten, ihr sollten, sie sollten.—*Perf.* Ich habe gesollt; wir haben gesollt.—*Plup.* Ich hätte gesollt; wir hätten gesollt.—*First Fut.* Ich werde sollen; wir werden sollen.—*Second Fut.* Ich werde gesollt haben; wir werden gesollt haben.

COND. *First Fut.* Ich würde sollen; wir würden sollen.—*Second Fut.* Ich würde gesollt haben; wir würden gesollt haben.

INF. *Pres.* Sollen, to be obliged.—*Perf.* Gesollt haben, to have been obliged.

PART. *Pres.* Sollend, being obliged.—*Perf.* Gesollt, obliged.

REMARKS ON Sollen.—The primary and prevalent use of sollen is to indicate *obligation* or *command.* What particular word or phrase shall be employed to translate it, in any given case, must be determined by circumstances. The following examples will be sufficient to show this :—

Du sollst das thun, thou *art to* (*i.e.*, art *commanded* to) do that.

Er soll gehen, he *is to* (*i.e.*, is *bidden* to) go.

Soll ich es haben? *am I to* have it.

Die Flotte soll geschlagen worden sein, the fleet *is said* or *reported to* be beaten.

Sie sollen ihn nicht beleidigt haben, you are *supposed* or *admitted* not to have offended him.

Was soll der Hut? what *means* the hat?

Wenn er kommen sollte, so will ich es ihm sagen, if he *should* come I will tell him so.

So with an infinitive understood; was soll ich? what *am I to* (*do*)? was soll das? what *signifies* that? (*i.e.*, supplying sein, *what is that to be?*)

Er weiß nicht, was er thun soll, he does not know what to do.

(7.) Wissen, *to know.*

IND. *Pres.* Ich weiß, du weißt, er weiß; wir wissen, ihr wißt, sie wissen.—*Imp.* Ich wußte, du wußtest, er wußte; wir wußten, ihr wußtet, sie wußten.—*Perf.* Ich habe gewußt; wir haben gewußt.—*Plup.* Ich hatte gewußt; wir hatten gewußt.—*First Fut.* Ich werde wissen, wir werden wissen.—*Second Fut.* Ich werde gewußt haben; wir werden gewußt haben.

SUB. *Pres.* Ich wisse, du wissest, er wisse; wir wissen, ihr wisset, sie wissen.—*Imp.* Ich wüßte, du wüßtest, er wüßte; wir wüßten, ihr wüßtet, sie wüßten.—*Perf.* Ich habe gewußt; wir haben gewußt.—*Plup.* Ich hätte gewußt; wir hätten gewußt.—*First Fut.* Ich werde wissen; wir werden wissen.—*Second Fut.* Ich werde gewußt haben; wir werden gewußt haben.

COND. *First Fut.* Ich würde wissen; wir würden wissen.—*Second Fut.* Ich würde gewußt haben; wir würden gewußt haben.

IMP. *Pres.* Wisse (du), wisse er; wissen wir, wisset (ihr), wissen sie.

INF. *Pres.* Wissen, to know.—*Perf.* Gewußt haben, to have known.

PART. *Pres.* Wissend, knowing.—*Perf.* Gewußt, known.

(8.) Wollen, *to be willing.*

IND. *Pres.* Ich will, du willst, er will, wir wollen, ihr wollt, sie wollen.—*Imp.* Ich wollte, du wolltest, er wollte; wir wollten, ihr wolltet, sie wollten.—*Perf.* Ich habe gewollt; wir haben gewollt.—*Plup.* Ich hatte gewollt; wir hatten gewollt.—*First Fut.* Ich werde wollen; wir werden wollen.—*Second Fut.* Ich werde gewollt haben, wir werden gewollt haben.

SUB. *Pres.* Ich wolle, du wollest, er wolle; wir wollen, ihr wollet, sie wollen.—*Imp.* Ich wollte, du wolltest, er wollte; wir wollten, ihr wolltet, sie wollten.—*Perf.* Ich habe gewollt, wir haben gewollt.—*Plup.* Ich hätte gewollt, wir hätten gewollt.—*First Fut.* Ich werde wollen; wir werden wollen.—*Second Fut.* Ich werde gewollt haben; wir werden gewollt haben.

COND. *First Fut.* Ich würde wollen; wir würden wollen.—*Second Fut.* Ich würde gewollt haben; wir würden gewollt haben.

IMP. *Pres.* Wolle, wollet.

INF. *Pres.* Wollen, to be willing.—*Perf.* Gewollt haben, to have been willing.

PART. *Pres.* Wollend, willing.—*Per.* Gewollt, willed.

REMARKS ON Wollen.—Wollen implies future *purpose;* thus, ich will gehen, I will (to) go, *i.e.*, my *purpose* is to go. The expression of mere futurity would be, ich werde gehen. Kindred to this is another signification of wollen; as, er will dich gesehen haben, he wills to have seen you, that is, he *will have it*, or *affirms*, that he saw you.

EXAMPLES FURTHER ILLUSTRATING THE USES OF THE PRECEDING VERBS.

Ich darf es thun.	I am allowed to do it.
Es dürfte wohl geschehen.	It might easily happen.
Du darfst es nur fordern.	You need only ask for it.
Er kann weder lesen noch schreiben.	He can neither read nor write.
Ich kann mich irren.	I may be mistaken.
Ich konnte ihn nicht verstehen.	I could not understand him.
Können Sie heute zu mir kommen?	Can you come to me to-day?
Ich mag das nicht.	I do not like that.
Ich möchte gern wissen, wieviel Uhr es ist.	I should like to know what o'clock it is.
Ich möchte wohl etwas davon haben.	I should like to have some of it.
Es mag sein.	It may be.
Ich möchte lieber.	I had rather; I would rather.
Möge er lange leben!	Long may he live!
Ich muß es thun.	I must do it.
Er müßte sich seines Betragens schämen.	He would be ashamed of his conduct.
Mußte es nicht so kommen?	Could it happen otherwise?
Wenn ich sterben müßte, würde ich es nicht thun.	If I had to die, I would not do it.
Ich wollte gerne gehen.	I would willingly (*i.e.*, would like to) go.
Ich will zu Fuße gehen.	I will go on foot.
Ich wollte, daß wir gehen sollten.	I was for our going.
Sie sollen schreiben.	You are to write.
Was soll das heißen?	What does that mean?
Es soll sich zugetragen haben.	It is said to have happened.
Der König soll angekommen sein.	The king is said to have arrived.
Wenn er morgen sterben sollte.	If he should die to-morrow.
Wenn das so sein sollte.	If that should be so.

VOLTAIC ELECTRICITY.—XIII.

MODERN DYNAMO-ELECTRIC MACHINES—THOSE OF GRAMME, SIEMENS, ETC.—TRANSMISSION OF POWER BY ELECTRICITY—ELECTRICAL RAILWAYS.

Up to the time of Siemens' and Wheatstone's proposition that there existed naturally in iron sufficient residual magnetism to initiate a current in a revolving armature placed in proper relation to an electro-magnet, permanent steel magnets had been almost universally employed in the construction of magneto-electric machines. With the exception of one or two machines which still employ them, permanent magnets have gone out of use, and are replaced by the far more powerful electro-magnets. Modern machines employing these latter are now known as dynamo-electric machines, to distinguish them from those which employ permanent magnets. Bnt it must be understood that both classes of machines are nrged into action by the dynamical power of a steam-engine, a gas engine, or other kind of motor.

In Fig. 81 we have a representation of the celebrated Gramme machine, and although this particular form of it is intended merely for demonstration, and is worked by hand, the relation of its various parts can, perhaps, be better understood than if we placed before the reader one of the larger machines designed for steam power, which are now in snch extended use for various purposes. The power of this little lecture-table machine is equal to eight ordinary Bunsen cells, and as it can be put in motion at any time without the tiresome preliminary of charging a battery, it is a great boon to experimenters. The magnet, instead of being one solid piece of steel, is made up of steel ribbons, as advocated by Jamin, by which greater power is obtained. But the essential and most important feature of the Gramme machine is the armature. This, instead of being of the bobbin or shuttle form, is ring-shaped. To understand its action, let us snppose that we have before ns a straight bar magnet, and that we slide upon it a coil of wire from left to right. Following the passage of this coil as we slowly drag it along the magnet, we can easily understand that a current will be induced in it as we move it in the vicinity of the foremost pole. As soon as the coil passes the centre of the bar, which we may look upon as a neutral line, it will become subject to another induced cnrrent, but in the reversed direction. Continuing the experiment with two bar magnets placed end to end, in contact by poles of the same name, we shall find that when the coil traverses the combination it will have induced in it at first say a positive current, until it is near the point of junction, when the current will be negative—to be positive once more when the coil approaches the end of its course. Now, if we imagine two such bars bent into half circles, so that when their ends are in contact they form a perfect circle, precisely the same indnced currents will traverse a coil moving npon them.

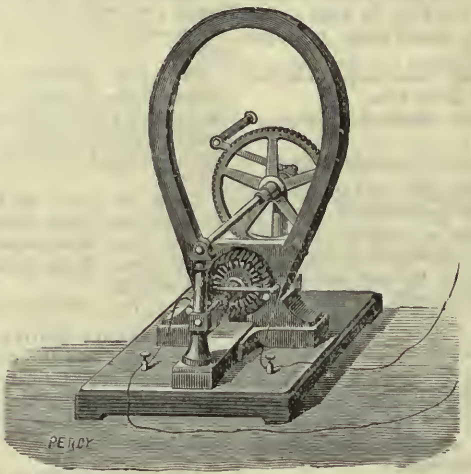

Fig. 81.

To still better elucidate the action of the Gramme armature, let us further suppose that we take a ring formed of soft iron, and wind npon it an insnlated copper helix or coil. This helix is quite continuons, its extremities being soldered together so as to form an endless wire. Now let ns see how snch an arrangement behaves when revolved between the poles of a magnet. The soft iron is of conrse magnetised by indnction, and the side of the ring nearest to the N pole of the magnet will have developed in it a south pole; the opposite side, next to the S of the magnet, being north. As the ring turns, these poles developed in it maintain the same relation to the magnet poles, and therefore snffer displacement in the iron itself so long as the movement of the armature continues. The copper helix becomes snbject to currents having two contrary directions, one half being traversed by positive currents, and the other half by negative currents. Now it is obvious that by dividing such a helix into sections we shall obtain several currents, and that it will be possible to gather up these currents much in the same way as we can obtain the combined effect of several battery cells.

In the Gramme armature, the interior is formed of a bnndle of iron wires, which can be magnetised and demagnetised more quickly than if a solid core were employed. And upon it is wound in sections insulated copper wire, the ends of which are brought to the axis upon which the ring revolves, bnt which still remain insulated from one another. Referring once more to Fig. 81, we can see how two metallic brushes rub against this cylinder, one above and the other below. The duty of these brushes is to collect the induced currents, one taking off the positive and the other the negative. The current thus afforded is like that from a battery, for its direction is constant; whereas, it will be remembered, that in machines of the old type the currents were alternate in direction, and reqnired the help of a commutator.

The introduction of the Gramme machine may be looked npon as opening a new and very important chapter in the history of electricity. The older machines had been brought to a certain pitch of perfection, and progress seemed there to stop. They were adopted for a few lighthouses, but their cumbrous nature and the large amount of power required to set them in motion, limited their use almost solely to that purpose. There was then a lapse of a few years, during which the magneto machine seemed to be almost forgotten, when suddenly the Gramme machine was brought forward. Being the invention of a Frenchman, the machine was naturally adopted in France long before it was seen in England. We believe its first appearance here was in 1873, when it was used for the purpose of prodncing an electric light on the summit of the clock-tower at Westminster. Bnt in 1878, at the time of the Great Exhibition at Paris, all the world was invited to see how the Gramme machine conld be adapted for lighting streets and large public buildings. From that time the science of electricity has taken a fresh lease of life; and we may safely say, that between that date and the present time more has been added to our knowledge of the science than could have been reasonably looked for in three times the period.

It is right to mention, that the principle of the Gramme ring was discovered as early as the year 1860, by an Italian named Pacinotti; and a rough model of the original machine constructed by him attracted a great deal of interest at the late Paris electrical exhibition. But there is no qnestion that Gramme re-discovered the same principle quite independently, and without any knowledge of his Italian forerunner. As we have seen, the current given by the Gramme machine is continuous, and this is of great advantage for many purposes, and indispensable to some, such as the electro deposition of metals. But the machine is sometimes made to give alternating currents, which of conrse can easily be done by tapping the ring at the right places; for we have already seen that currents of contrary direction exist in it at the same time. This modification of the Gramme machine has been adopted for the Jablochkoff lights on the Thames Embankment and elsewhere, for that system of lighting requires alternate currents. Indeed, when the Jablochkoff plan was first tried in London, an old Alliance machine was unearthed from somewhere, because no machine of the modern type could be found that would answer the purpose. In this modified form, the ring is generally made stationary, the magnets revolving within it. It is, of course, merely a matter of convenience whether the coils or the magnets shall be the movable parts of these machines, and usually the coils, being the lighter bodies, are the parts which are caused to rotate.

Our other illustration, Fig. 82, represents a modern Siemens' machine, which is largely employed in this and other countries. The details which we have given with regard to the Gramme ring will apply to the armature used in this machine, which, although not identical with the Siemens' armature, adverted to in a former lesson, exhibit the same principle in a modified form. In the old form of armature, the currents given were subject to slight variations; but in the multiple armature now under consideration, this difficulty is obviated. The core upon which the coils are wound is a hollow iron cylinder, and the magnetic poles induced in it maintain a constant relation to the poles of the magnets, as in the Gramme ring. There are usually in this machine four field magnets—two pairs with their north poles near together, and two on the opposite side of the armature, with their south poles adjacent—so that really there is one north and one south pole to act upon the revolving armature.

Although there is thus some resemblance between the Gramme and Siemens' armatures, there is one point of important difference. The Gramme ring is wound in and out with the coils of wire, whilst the Siemens' armature is wound wholly on the outside. We have chosen these two machines for illustration, because they represent types which most other machines follow. Thus the largely employed Brush machine has a ring armature, which differs only in points of detail, which are certainly considerable, from the Gramme. In Jablochkoff's machine we find a modification of the alternate current Gramme described above. In the Burgin machine, again, we find another armature built on the direct current model, but with important differences; and so on with different machines without end. In like manner the Siemens' machine has found admirers who have been pleased to regard it as a model which they could alter, and perhaps improve. In the enormous dynamo constructed by Edison, and destined to furnish energy for the illumination of extensive districts, we find a distinct modification of the Siemens' multiple armature, only the wires give place to flat bars of copper about half an inch broad, which are connected together by discs. The large magnets employed in the Edison dynamo machine weigh several tons, and the general appearance of the monstrous contrivance will be familiar to those who visited the late electrical exhibition at the Crystal Palace. The wonderful and splendid display of lights which owed their power to the machine in question, at once proved that it was efficient for the purpose for which it was designed.

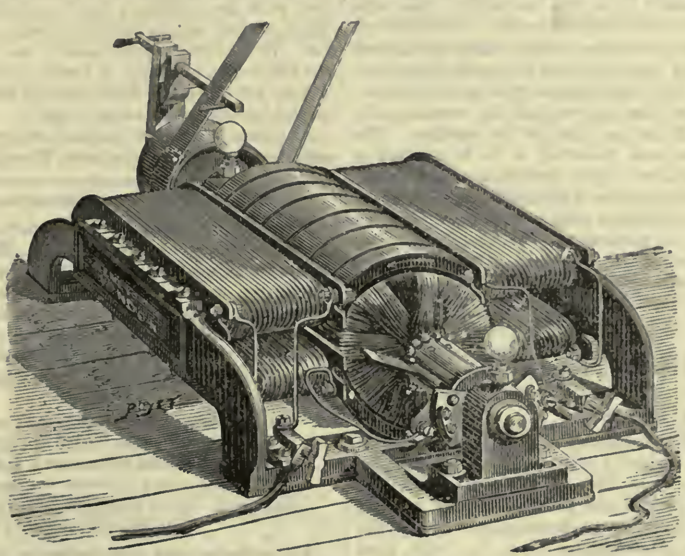

Fig. 82.

In studying the phenomena by which dynamo machines are governed, we must not so much regard the condition of the wires and magnets, as the space which surrounds them, for to that space we must look for the energy represented by the magnetic attractions. We can in a manner view the condition of this space, or magnetic field as it is called, and by very simple means. We need only a magnet—and any little toy magnet will do for the purpose—a sheet of cardboard, and a few iron filings contained in a piece of muslin. Laying the magnet flat on the table, we place the card above it, and scatter over the white surface some filings from our little muslin bag. When the card is pretty equally covered with the dust, we can gently tap it at one corner with the finger-nail, when we shall see a strange and beautiful sight. The little particles of iron marshal themselves into apparently regular figures, forming curves of beautiful feathery outline, which seem to spring from the two magnet poles below, and to bend towards each other in symmetrical lines. These curves are known as the curves of magnetic force, which exist in space round the poles of any magnet. Even a steel knitting needle which has been magnetised by a few touches of a permanent magnet will exhibit these curves. We may vary the experiment by placing the magnet in different positions, or by placing pieces of metal in its vicinity, and by such experiments we can learn much of the mysterious force called magnetism. By dusting the filings over a piece of glass which has been previously covered with gum water and thoroughly dried, instead of using cardboard, and by afterwards breathing upon the glass so as to soften the gum and fix the iron filings in the positions they have taken up, we can obtain a most interesting slide for projection by means of a lantern. In all dynamo machines the armatures are placed as close as possible to the field magnets, so that as they turn they cut the lines of force. Thus in our two illustrations of the Gramme and Siemens' machines, we find in the first that the magnet has projections or cheek-pieces which closely embrace the ring armature, and that in the other case the magnets are so bent as to closely surround the moving coils.

We have seen in a former lesson that the voltaic battery cell is in a manner reversible — that is to say, it can be so constructed as to furnish a secondary current after being charged by an ordinary cell. Such arrangements are called secondary batteries or accumulators, and a great deal is expected from their future development. A still more important discovery is represented by the circumstance that the Gramme and kindred machines are reversible. In other words, any dynamo machine giving a direct current can be made to act as an electromotor. Thus, supposing we take the little machine shown at Fig. 81, and connect it with an ordinary Bunsen or Grove battery. It will immediately begin to turn round on its own account, but in the *reverse* direction to that it would have if we were using it for ordinary experiments. It is clear, therefore, that if by means of a belt we were to connect the machine with a lathe, a sewing machine, or any contrivance where power is required, we could easily set such contrivance in motion. But, as we have already shown that the Gramme machine acts in all respects like a battery in its current-affording properties, it is obvious that by coupling up two such machines together, and by turning one of them, the other will immediately be set in motion. This discovery of the reversibility of the dynamo machine has been regarded by many eminent electricians as one of the most important discoveries of the nineteenth century; but this high estimate of its importance will not at once be rendered evident to the casual reader, but a few considerations will serve to justify it.

We are constantly hearing of new applications of electricity, and recent years have brought forward electrical railways, tramcars, launches, and even tricycles. Now, one and all of these depend for their existence upon the discovery we are considering. In other words, they employ a dynamo machine as a motor, instead of steam or muscular power, as the case may be. Taking the case of the electrical launch, which was tried for the first time on the Thames, we find an ordinary boat such as is usually propelled by steam. But instead of the best part of the space being occupied by a boiler and engine, all is clear. There is no visible machinery, for it is all hidden beneath the boarding. Could we look inside, we should find a Siemens' dynamo machine coupled up by gearing with the boat's propeller. Arranged on either side of it would be seen rows of boxes containing the secondary batteries, which had received their charge from a stationary dynamo machine some hours, or perhaps days, before. These batteries give up their stored energy to turning the Siemens' motor, and this in turn rotates the screw. So that we have all the advantages of a steam launch, without the noise, smoke, smell, and dirt, and with far more available space. At first sight such a system seems perfection, but we must not forget that the batteries require charging at intervals of a few hours, and that at present the boat must return to the one station where conveniences exist for the purpose. The same arrangement of parts is followed on the electrical tramcar, but electrical railways are worked upon a different method.

In the electrical railway first constructed at Berlin by Dr. Siemens, the rails were carefully insulated from one another, and actually formed cables by which the current from a stationary dynamo machine could be conveyed to and from the travelling one representing the locomotive. But in more recent schemes, a separate conductor is placed at the side of the railway, with a sliding attachment from the locomotive, the rails acting only as conductors for the return current. In the north of Ireland, a railway on this principle—which, when completed, will be twelve miles long—is now in course of construction, and its progress and working will be watched with great interest. In one respect it illustrates how power can be economically transmitted by electricity from one district to another. The power represented by a natural waterfall is to be utilised in turning a water-wheel, which will give motion to a stationary dynamo machine. It is this machine which will be in connection with the railway, thus utilising a source of energy too often allowed to run to waste. It is obvious that there are many such sources of unused power in this and other countries, which could be brought by means of copper cables and dynamo machines to industrial centres.

LESSONS IN LATIN.—LIV.

GOVERNMENT OF THE CASES (*continued*).

THE ABLATIVE.

As the idea conveyed by the accusative case is that of motion towards an object, so the ablative denotes motion from an object, and generally answers to the question *whence?* But the question *whence?* may involve the source or cause, so that the ablative is the case of the cause or instrument. Hence the relations expressed by our prepositions *from*, *by*, *with* (and other relations), are contained in the ablative. But to speak in detail :—

As the fundamental idea of the ablative is that which is conveyed by our *out of*, or *from*, so the ablative is used in Latin after verbs of motion in names of cities, small islands, peninsulas ; as also in *domus*, *rus*, and *humus ;* as—

Dionysius Platonem *Athenis* arcessivit,
Dionysius invited Plato from Athens.

Observe that no preposition is employed. Had it been said that Plato was invited to Athens, the accusative would have been used.

It may be convenient to put together here the rules relating to names of place. The idea of place implies the relation where, whither, and whence. A man may be at or in a place, hence the question *where? where is he?* A man may go to a place—*whither?* A man may come from a place—*whence?* The following, then, are the rules—first without a preposition :—

1. The question *where?* requires (1) names of cities in the singular number of the first and the second declension to be *in the genitive ;* as, Romæ, *at Rome ;* Corinthi, *at Corinth ;* (2) but all others *in the ablative;* as, Athenis, *at Athens.*

2. The question *whither?* requires the accusative constantly; as, Romam, *to Rome;* Sardes, *to Sardis;* Lacedæmonem, *to Lacedemon.*

3. The question *whence?* requires the ablative constantly; as, Româ, *from Rome;* Corintho, *from Corinth;* Athenis, *from Athens.*

Domus and *rus*, in the relations implied by all the three questions, are constructed according to the analogy of names of cities or towns ; thus, domi is *at home;* domum, *home*, as *he goes home;* domo, *from home.* In the same way, ruri is *in the country ;* rus, *into the country ;* rure, *from the country.* By the same analogy, humi means *on the ground ;* belli domique, *in war (abroad) and at home;* or, as we say, *at home and abroad.* Sometimes the phrase stands thus—domi bellique ; also domi militiæque. Belli and militiæ are separately found without domi.

Secondly, prepositions are employed with names of places in these instances :—

1. When an appellative or general noun, such as *urbs*, *oppidum*, *locus*, is added ; as, *ex* oppido Gergoviâ, *from the town Gergovia.* A noun in apposition to the genitive of place stands either with or, what is more common, without *in.*

2. If the direction whence and whither is put in strong contrast; as, usque *a* Dianio *ad* Sinopem navigarunt, *they sailed all the way from Dianium to Sinopé.*

3. When only a part of a city or its suburbs are meant ; as, Libo discessit a Brundisio, *Libo departed from the port of Brundisium.*

4. When origin in a place is denoted, in which case *ab* is used with the ablative ; as, Volsci obsides dant trecentos principum *a Corâ* atque *Pometiâ* liberos—that is, *natives of Cora*, etc. With *domus*, prepositions are used when not the home, but the house, building, or family is meant ; as, *in domo* furtum factum est ab eo qui *domi* fuit, *in the house a robbery was committed by him who was at home.*

As place, or a point in space, so a point of time, or time when considered as a point, requires the ablative ; as—

Time when.—Color lusciniarum *autumno* mutatur,
The colour of nightingales changes in autumn.

From the ablative of place arises the ablative of the cause out of which anything springs. The ablative of the cause occurs in connection with verbs and adjectives, pointing out the source, the means, the instrument, and even the manner in or by which a thing takes place or an action is done. In general, this is called "the ablative of the cause, manner, and instrument;" by which you are to understand that a noun expressive of either the cause, the manner, or the instrument is put in the ablative case ; as—

Cause.—Darius *senectute* diem obiit supremum,
Darius came to his end by reason of old age.

Manner.—Injuria fit *duobus modis*, aut *vi* aut *fraude*,
An injury is done in two ways, either by force or fraud.

Instrument.—Feræ domantur *fame* atque *verberibus*,
Wild beasts are tamed by hunger and stripes.

An accompanying circumstance is also put in the ablative. This usage is very similar to the ablative of manner ; as—

Id *æquo animo* non feret civitas, *the city will not bear that patiently.*

The quality of an object is, moreover, put in the ablative. This is called the ablative of quality ; as—

Quality.—Legiones sunt *alacri animo*, *the legions are of lively spirits.*

With the ablative of quality, the genitive of quality is nearly related ; but the latter seems to denote what is essential, the former what is accidental ; the latter internal, the former external qualities. The distinction, however, is not always traceable.

Especially is the ablative of the means required by these verbs and adjectives ; namely, to gift with, to supply with, to present, load, etc. ; as, donare, instruere, ornare, juvare, preditus, onustus, etc. ; as—

Means.—Onerare naves *commeatu*, *stipendio*, *armis*,
To load the vessels with provisions, pay, arms.

There is also the ablative of price employed with verbs denoting to buy or sell, when the exact sum paid is mentioned; as—

Price.—*Viginti talentis* unam orationem Isocrates vendidit,
Isocrates sold one oration for twenty talents.

The price, also, when in a figurative sense, is put in the ablative ; as—

Multo sanguine Pœnis victoria stetit,
The victory cost the Carthaginians much blood.

The deponents *fruor*, *fungor*, *potior*, and *vescor*, together with their compounds, require their object in the ablative case ; as—

Sapiens *ratione* optime utitur,
The wise man employs reason in the best manner.

Also, the adjectives *dignus* and *indignus* take the ablative; as—

Virtus *imitatione* non *invidiâ* digna est,
Virtue is worthy of imitation, not of envy.

The ablative absolute has already been explained. But observe, the ablative absolute is an abbreviated sentence. Being an abbreviated sentence, it has a subject of its own. Consequently, its subject is different from the subject of the complete sentence of which it forms a part. There must, then, in this construction be two subjects, that of the ablative absolute and that of the full sentence. To exemplify these remarks, you may say, with both sentences complete—

First Sentence. *Second Sentence.*

Full Construction.—Romæ reges exacti sunt, et consules creati sunt.

One Sentence.

Ablative Absolute.—Romæ, regibus exactis, consules creati sunt.

Here you see that the ablative absolute holds the place of the first sentence, and is that sentence in an abbreviated form. You also see that the ablative absolute construction involves two subjects; here, for instance, *regibus* and *consules*. Consequently, there cannot be an ablative absolute construction without two subjects.

VERBS GOVERNED BY VERBS.

Verbs may govern verbs. A verb governs another verb when the second verb is dependent on the first. The simplest case of verb-government is that which is expressed in the general form or rule:—

One verb governs another in the infinitive mood; as—

Cæsar *maturat* ab urbe *proficisci*, *Cæsar hastens to go from the city;*

where *proficisci* in the infinitive mood is governed by *maturat*.

The infinitive may be the subject of a verb as well as the object; as—

Humanum est *errare*, *To err is human.*

Errare is the subject to *est*; in sense *errare* is nearly the same as the noun *error*.

A noun may accompany the infinitive, whether it is the subject or the object; as—

SUBJECT.	OBJECT.
Homines errare non mirum est,	Scio *ducem* esse fortem,
For men to err is not wonderful.	*I know that the general is brave.*

Should the infinitive be accompanied by an adjective, noun, or pronoun intended to complete the meaning, the accompanying word must agree with the subject, if it is to be taken with the subject; and with the object, if it is to be taken with the object; as—

SUBJECT.	OBJECT.
Cœpi tibi *molestus esse*,	Jubeo *te* esse *fortem*,
I began to be troublesome to thee.	*I command thee to be brave.*

If the verb governs a dative case, the accompanying word or words may be in the dative; as—

Mihi negligenti esse non *licet*, *I must not be negligent.*

We may exhibit a similar construction with an accusative:—

Me negligentem esse non licet, *It is not proper for me to be negligent.*

A few verbs govern a subjunctive mood.

This construction must be distinguished from the construction in which a subjunctive mood is connected with a verb in the indicative mood together with a conjunction. In the construction now before us there is no conjunction; at least none is expressed, though in all probability the construction is elliptical; as—

Magnum *fac* animum *habeas*, *Take care to keep a high mind.*

That *ut* was originally used in such constructions may appear from its still continuing to be occasionally employed; as—

Cura *ut* valeas, *Take care to keep well.*

The verbs with which the construction is found are volo, malo, nolo, curo, censeo, permitto; also oro, quæso, rogo, precor, postulor, peto, hortor, suadeo, moneo, mando, decerno; and again the imperatives fac, cura, having the force of our *do*, or *be sure to do*, *take care that you*, etc. Volo, etc., may stand in the subjunctive, having the force of a kind of softened command or wish; as—

Diligens *sis* velim, *I should like you to be industrious.*

Indeed both constructions occur; as may be seen, for example, in the following sentences:—

Accusative.—Licet *Themistoclem* esse *otiosum*,
It is permitted that Themistocles be idle.

Dative.—*Themistocli* licuit esse *otioso*,
It was permitted to Themistocles to be idle.

Instead of the infinitive with the accusative, some verbs take also the indicative with *quod*; as—

Gaudeo te valere, *or*
Gaudeo quod vales, *I am glad that you are well.*

In this case the *quod* is the relative pronoun, the object to the verb *gaudeo*, thus, I rejoice at this (namely) that you are well. *Quod* in such instances as the present is commonly called a conjunction, and as a conjunction may it here be regarded; not the less is it traceable to the relative force which is its essential meaning. Of our *that* and of our *because* [be (by) and cause] similar remarks may be made.

LESSONS IN ALGEBRA.—XXXVIII.

GEOMETRICAL PROPORTION AND PROGRESSION.

If four quantities are in *geometrical proportion*, *the product of the extremes is equal to the product of the means.* Thus,

$12 : 8 :: 15 : 10$; therefore $12 \times 10 = 8 \times 15$. Hence,

Any *factor* may be transferred from one of the means to the other, or from one extreme to the other, without affecting the proportion.

Thus, if $a : mb :: x : y$, then $a : b :: mx : y$; for the product of the means in both cases is the same.

So, if $na : b :: x : y$, then $a : b :: x : ny$.

On the other hand, if the product of two quantities is equal to the product of two others, the four quantities will form a proportion, if they are so arranged that those on one side of the equation shall constitute the means, and those on the other side the extremes. Thus, since $6 \times 12 = 8 \times 9$, then $6 : 8 :: 9 : 12$.

Corollary.—The same must be true of *any factors* which form the two sides of an equation. Thus, if

$(a + b) \times c = (d - m) \times y$, then $a + b : d - m :: y : c$.

If *three* quantities are proportional, the product of the extremes is equal to the *square* of the mean. For this mean proportional is, at the same time, the consequent of the first couplet, and the antecedent of the last. It is, therefore, to be multiplied *into itself*; that is, it is to be *squared*.

Thus, $4 : 6 :: 6 : 9$; therefore, $4 \times 9 = 6 \times 6$.

If $a : b :: b : c$, then multiply extremes and means, $ac = b^2$.

Hence, *a mean proportional* between two quantities may be found by *extracting the square root of their product.*

If $a : x :: x : c$, then $x^2 = ac$, and $x = \sqrt{ac}$.

In a proportion, either extreme is equal to the product of the means, divided by the other extreme; and either of the means is equal to the product of the extremes, divided by the other mean.

1. If $a : b :: c : d$, then	$ad = bc$.
2. Dividing by d,	$a = bc \div d$.
3. Dividing the first by c,	$b = ad \div c$.
4. Dividing it by b,	$c = ad \div b$.
5. Dividing it by a,	$d = bc \div a$.

That is, the *fourth* term is equal to the *product of the second and third divided by the first.*

N.B. On this principle is founded the rule of simple proportion in arithmetic, commonly called the "Rule of Three." Three numbers are given to find a fourth, which is obtained by multiplying together the second and third, and dividing by the first.

The propositions respecting the products of the means and of the extremes, furnish a very simple and convenient criterion for determining whether any four quantities are proportional. We have only to multiply the means together, and also the extremes. If the products are equal, the quantities are proportional. If the products are not equal, the quantities are not proportional.

It is evident that the terms of a proportion may undergo any *change* which will not destroy the *equality* of the *ratios*, or which will leave the product of the *means* equal to the product of the *extremes*. These changes are *numerous*, but they may be reduced to a few general principles.

Case I.—Changes in the Order of the Terms.

If four quantities are proportional, *the order of the means, or of the extremes, or of the terms of both couplets, may be inverted without destroying the proportion.*

Thus, if $a : b :: c : d$, and $12 : 8 :: 6 : 4$, then,

1. *Inverting the means*,* $\left\{\begin{array}{l} a : c :: b : d \\ 12 : 6 :: 8 : 4 \end{array}\right\}$ the 1st is to the 3rd as the 2nd to the 4th.
2. *Inverting the extremes*, $\left\{\begin{array}{l} d : b :: c : a \\ 4 : 8 :: 6 : 12 \end{array}\right\}$ the 4th is to the 2nd as the 3rd to the 1st.
3. *Inverting the terms of each couplet*,† $\left\{\begin{array}{l} b : a :: d : c \\ 8 : 12 :: 4 : 6 \end{array}\right\}$ the 2nd is to the 1st as the 4th to the 3rd.
4. We may change the *order* of the *two couplets.*

Cor.—The order of the *whole proportion* may be inverted.

N.B. If the terms of only *one* of the couplets are inverted, the proportion becomes *reciprocal* or *inverse.*

If $a : b :: c : d$, then a is to b, reciprocally or inversely, as d to c.

Case II.—Multiplying or Dividing by the Same Quantity.

If four quantities are proportional, *two analogous or two homologous terms may be multiplied or divided by the same quantity, without destroying the proportion.* Thus,

If $a : b :: c : d$, then, if *analogous* terms are multiplied or divided, the ratios will not be altered.

1. $ma : mb :: c : d.$ 2. $a : b :: mc : md.$

3. $\frac{a}{m} : \frac{b}{m} :: c : d.$ 4. $a : b :: \frac{c}{m} : \frac{d}{m}.$

If *homologous* terms be multiplied or divided, both ratios will be equally increased or diminished.

5. $ma : b :: mc : d.$ 6. $a : mb :: c : md.$

7. $\frac{a}{m} : b :: \frac{c}{m} : d.$ 8. $a : \frac{b}{m} :: c : \frac{d}{m}.$

Cor.—All the terms may be multiplied or divided by the same quantity. Thus, $ma : mb :: mc : md$, or $\frac{a}{m} : \frac{b}{m} :: \frac{c}{m} : \frac{d}{m}$.

Case III.—Comparing One Proportion with Another.

If two ratios are respectively equal to a third, they are equal to each other. (Euclid V., Def. 11.)

This is nothing more than an application of the axiom, that things which are equal to the same are equal to one another.

1. $\left.\begin{array}{l} \text{If } \quad a : b :: m : n \\ \text{And } c : d :: m : n \end{array}\right\}$ then $a : b :: c : d$, or $a : c :: b : d$.
2. $\left.\begin{array}{l} \text{If } \quad a : b :: m : n \\ \text{And } m : n :: c : d \end{array}\right\}$ then $a : b :: c : d$, or $a : c :: b : d$.

Cor.—$\left.\begin{array}{l} \text{If } a : b :: m : n \\ \quad m : n > c : d \end{array}\right\}$ then $a : b > c : d$. (Euclid V., Def. 13.)

For if the ratio of $m : n$ is greater than that of $c : d$, it is manifest that the ratio of $a : b$, which is *equal* to that of $m : n$, is also greater than that of $c : d$.

N.B. In these instances, the terms which are alike in the two proportions are the *first* two and the *last* two, and the resulting proportion is uniformly direct. But this arrangement is not essential. The order of the terms may be changed in various ways, without affecting the equality of the ratios.

The proposition to which these instances of equality belong is usually cited by the words, "*ex æquo*," or "*ex æquali.*" (Euclid V., Def. 23.)

Any number of proportions may be compared in the same manner, if the first two or the last two terms in each preceding proportion are the same with the first two or the last two in the following one.

$$\left.\begin{array}{l} \text{Thus, if } a : b :: c : d \\ \text{And } \quad c : d :: h : l \\ \text{And } \quad h : l :: m : n \\ \text{And } \quad m : n :: x : y \end{array}\right\} \text{then } a : b :: x : y.$$

That is, the first two terms of the first proportion have the same ratio as the last two terms of the last proportion. For it is manifest that the ratio of *all* the couplets is the same.

But if the two means or the two extremes in one proportion be the same with the means or the extremes in another, the four remaining terms will be *reciprocally proportional.*

$$\left.\begin{array}{l} \text{If } \quad a : m :: n : b \\ \text{And } c : m :: n : d \end{array}\right\} \text{then } a : c :: \frac{1}{b} : \frac{1}{d}, \text{ or } a : c :: d : b.$$

$$\left.\begin{array}{l} \text{For } ab = mn \\ \text{And } cd = mn \end{array}\right\} \text{therefore } ab = cd, \text{ and } a : c :: d : b.$$

In this example, the two means in one proportion are like those in the other. But the principle will be the same if the *extremes* are alike, or if the extremes in one proportion are like the means in the other.

$$\left.\begin{array}{l} \text{If } \quad m : a :: b : n \\ \text{And } m : c :: d : n \end{array}\right\} \text{then } a : c :: d : b.$$

$$\left.\begin{array}{l} \text{Or if } a : m :: n : b \\ \text{And } m : c :: d : n \end{array}\right\} \text{then } a : c :: d : b.$$

The proposition in Geometry which applies to this case is usually cited by the words, "*ex æquo perturbata.*" (Euclid V., Def. 23.)

* This is called *alternation.* (Euclid V., Def. 16.)

† This is technically called *inversion.*

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XXXVII.

Exercise 68.

1. 440.	8. £3339 15s.	15. 3.
2. 10100 yards, or 5 miles 1300 yards.	9. 156.	16. 19.
3. 3775.	10. 300.	17. 6, 13 20, 27, 34, 41, and 48.
4. 3.	11. 10000 and n^2.	18. 8, 12, 16, 20, 24, 28, 32 and 36.
5. 21.	12. 730 and $2n$.	
6. 280.	13. 301 and $3n + 1$.	
7. £1104 10s.	14. Interest, £2 8s.; amount, £3 8s.	

Exercise 69.

1. 1, 3 and 5.	3. ± 14, ± 10, ± 6 and 2.	4. 3, 5, 7 and 9.
2. 3, 5 and 7.		5. 1, 5, 9 and 13

LESSONS IN MORAL SCIENCE.—III.

INTUITIVE OR SENTIMENTAL MORALITY.

The innate school of moralists are further accustomed to rely upon the universality of the moral faculty, or the power of discriminating between two classes of actions, one right and the other wrong, as a proof that it is not the result of any experience, however extended, but was inherent in our minds at their first coming into being. It is to be found, they say, amongst all nations and in all ages of the world's history, always the same in kind, however there may be a difference in the strictness with which it is thought proper actions should conform to the test which it supplies.

It has, of course, on the other hand been argued that certain nations have, at certain periods, sanctioned or even commended actions which all civilised persons now look upon as heinous crimes. Even down to the present day, child-murder in India is openly practised without shame or scruple; and numerous instances of the same kind, if space permitted, could easily be brought forward, even from the history of our own country. Hence, it is said, this apparent universality of the moral sense is only apparent after all.

It may be, and often is, argued that such perverted ideas only exist amongst savage and uncivilised peoples, and that these are not to be taken as the test by which to pronounce an opinion upon mankind in general, or upon what ideas they do or do not universally possess. The true test is to be found only amongst civilised nations; and in process of time, as nations develop from the savage state to a state of civilisation, all this perversion gradually disappears, and they tend to the adoption of one common standard of morality. Against this, however, it may be fairly said, as it is stated by Professor Bain, in his well-known work on "Mental and Moral Science," that "this argument would have great weight, in any discussion as to what is good, useful, expedient, or what is in accordance with the cultivated reason or intelligence of mankind; because civilisation consists in the exercise of men's intellectual faculties to improve their condition. But in a controversy as to what is given us by Nature, what we possess independently of intelligent search and experience, the appeal to civilisation does not apply. What civilised men agree upon amongst themselves, as opposed to savages, is likely to be the reverse of a natural instinct; in other words, something suggested by reason and experience." And, in fairness, it must be also added, that it is not simply to the savage and uncivilised man that the appeal is made, when it is desired to ascertain if existence, unity, succession, and other ideas than moral ideas are natural or acquired, innate or the result of experience.

In addition to this it can fairly be said that there can be found amongst nations, both in former times and at the present day, differences upon points which we, and other civilised nations, now regard as fundamental points of difference in regard to moral right and wrong. A strange position, perhaps, in some respects is that of those who assert the true explanation to be this—that although men have differed and do differ greatly in their ideas of what is to be considered right and wrong, yet that there has been in all ages, and is universally, an agreement universally that there *is* a difference between actions, according to which they may be denominated right or wrong, virtuous or vicious. All "people, nations, and languages," have *some* notion of a difference between right and wrong, though all may not agree exactly as to what that difference is. "This is," to adopt Bain's statement, "to surrender the only position of any real importance. The simple and underived character of the moral faculty is maintained because of the superior authority attached to what is natural, as opposed to what is merely conventional. But if nothing be natural but the mere fact of right and wrong, while all the details, which alone have any value, are settled by convention and custom, we are as much at sea on one system as the other." So that it may be fairly said that thus the only position of any real importance is surrendered.

Another argument brought forward by those who maintain the moral sentiment to be innate in the human mind is this, that it is in its nature different from any other "fact or phenomenon" to be found in the mind. If this faculty be so simple and uncompounded in its nature that it cannot be resolved into any other and simpler elements, then it may be urged with some force that it is natural and not acquired. The faculty which discriminates right from wrong, and which "determines itself to be the guide of action and of life, in contradistinction from all other faculties, or natural principles of action, in the very same manner as speculative reason *directly* and naturally judges of speculative truth and falsehood; and at the same time is attended with a consciousness, *upon reflection*, that the natural right to judge of them belongs to it;"—this faculty is not unnaturally considered to differ not only in degree but in kind from all other faculties of the human mind. We often act from motives quite other than and different from those furnished by this moral faculty. We are influenced by hunger and thirst, love and hatred, and many other motives besides these; but the influence of the moral faculty, or conscience, differs from them all. The former *can* and *do* induce us to act, but the latter, in addition to this power, which it possesses in common with the former, carries also with it a feeling of right, or a feeling that it *ought* to influence us, in addition to our consciousness that it does, a feeling which forms no part of what is present to our mind in the former case.

To this it may be answered, that what is generally understood by a system of morals is a set of general rules to guide us in action, and which are so extensive and complicated as to require a maturity of comprehension and intellect to understand them completely. We are not able to sum up the whole of morals in one or two simple rules which shall be level with the comprehension of a child; or, if we were to make the attempt, the complications which would result when we came to test these rules in practice would demonstrate its futility. Our idea of space, however extended and vast, may, indeed, be reduced to the simple data of sight and touch, but there are no corresponding simple elements, to which our ideas of duty or "oughtness" as to actions can be reduced.

No doubt, at a late period of the world's history men learnt that almost the whole sum of morals was contained in the fulfilment of their duty towards their neighbour—in the golden rule of doing to others what they would that they should do to them; but we must not forget that it took revelation to teach them a lesson apparently so simple; and in addition that the application of a rule so wide and comprehensive must unavoidably be inapplicable *immediately* to many of the particular and complicated circumstances which occur in daily life. And even granting the application of the rule to be a very simple matter when once we have clearly ascertained the true circumstances to which it is to be applied, the very ascertainment of these circumstances, disentangled from all extraneous considerations, is often the most difficult part of the operation. As an illustration of this let us take *truth*. "If," says Bain, "any part of morals had the simplicity of an instinct, it would be regard to truth. The difference between truth and falsehood might almost be regarded as a primitive susceptibility, like the difference between light and dark, between resistance and non-resistance. That each person should say what is, instead of what is not, may well seem a primitive and natural impulse. In circumstances of perfect indifference, this would be the obvious and usual course of conduct; being, like the straight line, the shortest distance between two points. Let a motive arise, however, in favour of the lie, and there is nothing to ensure the truth. Reference must be made to other parts of the mind, from which no counter-motives may be furnished; and the intuition in favour of truth, not being able to support itself, has to repose on the general foundation of all virtue, the instituted recognition of the claims of others."

Besides this, intuition is unable to settle without the aid of experience many questions of the greatest importance in morals, and often not without considerable controversy. Such a question, for instance, as how far the State has a right to enforce the profession of certain religious opinions, and to punish criminally or civilly those who refuse to conform to its commands, is one that we are not conscious, it is said, of any faculty which can determine in a moment. Many moral principles are capable of being invoked on each side, by those who advocate persecution, and those who condemn it as opposed to all true notions of morality. Almost all the questions with which the ancient casuists used to perplex themselves were of the same nature, *i.e.*, they could not be determined by any apparently instinctive or innate principle or faculty of our nature.

No doubt, in many of such cases the principal difficulty, as has been already observed, arises from the difficulty of ascertaining all the circumstances, or, in other words, of learning exactly what it really is upon which we are called on to decide. No sane man can doubt that it will be highly injurious, if not fatal to him, to take a large dose of poison; but he may often have considerable difficulty, from an imperfect knowledge of its properties, in determining whether a particular substance is or is not a poison. That this line of argument fails to answer the objection is, of course, maintained by the opponents of the intuition school.

Nor, upon examination, will it be so evident that the moral faculty or moral sense, or at any rate our perception of actions as right and wrong, is so simple and uncompounded as might at first sight appear. In determining upon the propriety of a particular act or course of conduct we are, at all events, often influenced by and inclined to act from various other causes besides the mere abstract question of right and wrong. Self-love and sympathy and our various passions often form no considerable part of what makes us act. We do not now speak of cases in which these motives induce us to act wrongly or viciously; but of instances in which they lead us to act virtuously, and where it is therefore difficult to distinguish the relative strength in which they operate, and how much of the particular act is to be attributed to them, and how much to the simple desire to follow the dictates of the moral faculty, or do right. Self-love is, as Bishop Butler remarks, a proper and natural motive of action when kept within proper limits; and when it works strongly along with the moral sense it is not often easy to say that we would not have followed its promptings alone, even if the course it advocated were not clearly right. The case is the same with sympathy, from which it may almost be said that a great portion of human virtue, or rather of human acts that are virtuous, directly spring. The various passions and affections, such as fear and love, have a like influence in many instances too numerous to be mentioned here.

Naturally, against all this it may be urged that the fact of various other motives co-existing in a particular act with the perception of the act as right, and a determination to do it on that account, fails to prove either that the latter motive does not exist separately and is different in kind from the others, or that it may be ultimately resolved into them. Indeed, according to Butler, if we understand our true happiness, conscience and self-love do always lead in the same way, and we are conscious of violating our nature, in a totally different sense, when we refuse to obey the dictates of conscience or our moral sense, and when we refuse to obey any of the other numerous motives to action, some of which have been already mentioned. In fact, to use Butler's own words, "this moral discernment implies in the notion of it a rule of action, and a rule of a very peculiar kind; for it carries in it authority and a right of direction—authority in such a sense that we cannot depart from it without being self-condemned;" and his theory of conscience is this: "that principle by which we survey, and either approve or disapprove our own heart, temper, and actions, is not only to be considered as what is in its turn to have some influence—which may be said of every passion, of the lowest appetites—but likewise as being superior; as, from its very nature, manifestly claiming superiority over all others, insomuch that you cannot form a notion of this faculty, conscience, without taking in judgment, direction, superintendency. This is a constituent part of the idea, that is, of the faculty itself; and to preside and to govern, from the very economy and constitution of man, belongs to it. Had it strength as it had right, had it power as it had manifest authority, it would absolutely govern the world."

Having spoken of sympathy as one of the motives to virtuous action, it is but natural to consider briefly the theory of morals propounded by Adam Smith. This celebrated writer resolves virtue into sympathy. According to his theory, to approve of another man's opinions or conduct is the same thing as believing that we ourselves should, under like circumstances, have acted in a like manner. "In the suitableness or unsuitableness, in the proportion or disproportion, which the affection seems to bear to the cause or object which excites it, consists the propriety or impropriety, the decency or ungracefulness of the consequent action:" and he tells us, with reference to our measurement of this proportionateness, that "when we judge of any affection as proportioned or disproportioned to the cause which excites it, it is scarcely possible that we should make use of any other rule or canon but the correspondent affection in ourselves. If, upon bringing the case home to our own heart, we find that the sentiments which it gives occasion to coincide and tally with our own, we necessarily approve of them, as proportioned and suitable to their objects; if otherwise, we necessarily disapprove of them, as extravagant and out of proportion." When we examine our own conduct, for the purpose of passing sentence upon it, the standard, by reference to which we judge our acts, is the sentiment which they would excite in us, if looked at from the point of view of another; and it is according to this standard that we pronounce them right or wrong. Such in substance is Smith's famous theory of sympathy.

To prove the failure and inadequateness of this theory to account for all the phenomena involved in what is called the morality of actions, many arguments may be adduced. Chiefly three objections may be noticed: (1.) We are not conscious of placing ourselves in the place of others, when we would judge of our own actions, or of placing others in the place of ourselves when we would judge of theirs. On the contrary, we are conscious of passing immediately in our mind from the action to its morality, without any such substitution, however instantaneous, as the sympathetic theory supposes; and it can hardly be supposed that such a forced and elaborate process would take place without our being conscious of it, at any rate at times. (2.) This theory also, even assuming the process which it supposes to take place, affords no real answer to the question, why we approve of some actions and disapprove of others. If I merely say that I approve of the act of another man when, having imagined myself, for the moment, in his place, I determine that I would have acted similarly, I have not advanced really any further towards the solution of the true difficulty. This proves nothing as to the rightness or wrongness, the virtuousness or viciousness of the particular act itself; unless, indeed, the true reason I would approve of such conduct in the other person is because I believe and judge that such would have been in that case the *right* course of conduct for him to adopt. If this, however, be what is meant, it presupposes an already ascertained distinction between right and wrong, existing in the mind previous to and independent of any such imaginary substitution. But (3) this theory, however clearly and satisfactorily it might account for everything else, could never account for the idea of obligation which accompanies the idea of right. It fails to show how it is I feel I *ought* to do what is right and refrain from what is wrong; it fails to account for what has been termed "the imperativeness of moral rectitude."

Amongst the different theories which have been put forward from time to time by writers who are opposed to the notion of an intuitive moral sentiment, we should notice that which resolves our sentiments of virtue and duty into the "association of ideas." This explanation of the growth of our ideas of right and wrong seems to have been first offered by Hume and Smith, but was afterwards developed by Hartley, and more recently still by Mackintosh.

By the "association of ideas" is meant the law that ideas which have been in the mind at the same time have a tendency afterwards to call up each other, which tendency increases with the frequency and duration of the period for which they have been together in the mind. But in using this phrase, in reference to the formation of the moral sentiment, it is understood in a wider sense than that of the simple *association* of mere *ideas.* "Ideas" must be taken generally to include passions, volitions, and emotions; and "association" to include a union which, when once formed, is so close as that we are unable to detect its component elements and resolve it again into the ideas, passions, or emotions by which it was formed.

According to Mackintosh's view, the chief elements which go to make up the moral sentiments are gratitude, pity, resentment, and shame. Let us first take gratitude as an example. When an act of kindness or benevolence is done towards us, we receive pleasure from it, and associate that pleasure with the idea of the benefactor, so as to regard him with a feeling of complacency; and then, when we afterwards see similar acts of kindness or benevolence done to others, there is called up in our minds the pleasure we felt when ourselves the object of similar acts. Then as to pity. We transfer the pleasure we receive from this to others, and that even more fully than in the case of gratitude, for the reason that the outward signs of the emotion are the same. We feel so strong a sympathy with a person whom we conceive to suffer, that we cannot help approving of the actions and dispositions which tend to relieve, and disapproving of those which tend to neglect or increase the suffering.

Besides these primary causes which tend to form the moral sense, there are secondary or auxiliary causes of its growth, which are education, imitation, general opinion, laws, and government, upon which we cannot enter into details, but which naturally lead to the consideration, in conclusion, in as brief a manner as possible of the connection of morality with civil laws and government.

The rules laid down by Ethics, to be observed in human action, are of two kinds. First, those whose observance is enforced by a penalty or punishment of one kind or another; and secondly, those whose observance is merely stimulated by the hope of reward. Those coming under the first class are termed the laws of morality proper, or obligatory morality; those coming under the second, the laws of optional morality.

In the former class of rules, the laws of morality and the laws of the land, or the sanction of civil government, exactly coincide. Morality condemns as a vice what the magistrate visits with punishment as a crime against the state. There are, however, many cases in which society is forced to gain its ends, not by punishing men for failing to fulfil a particular obligation, but by rewarding them, directly or indirectly, for fulfilling it. Society does not punish men for not being charitable, or benevolent, or forgiving, but rewards them, by praise or otherwise, when they are so—which is done almost entirely by individuals, not in a public but in a private capacity. These are the class of duties inculcated by the second class of moral rules.

This division of morality into obligatory and non-obligatory leads us to notice that *every* rule of morality is obligatory in one sense; *i.e.*, we cannot violate it without being self-condemned, and without conscience telling us that we are acting wrongly. But "obligation," as Warburton says, "necessarily implies an obliger, who must be different from, and not one and the same with the obliged;" or, to use the language of Paley, "obligation is nothing more than an inducement of sufficient strength, and resulting in some way from the command of another." Hence that which obliges us to virtue is the sense we have of being under the moral law; and it is our realising the existence and rule of God as a moral governor which gives this obligation its greatest force. Hence it comes that religion is the surest promoter of morals, and, as Hooker said, "that all true virtues are to honour true religion as their parent, and all well-ordered commonwealths to have her as their chiefest stay."

LESSONS IN ENGLISH LITERATURE.—XIX.

SAMUEL BUTLER.

There is one great poet still to be spoken of, with regard to whom it may well be doubted whether he should be classed with those of the period now under review, that of the Civil War and Commonwealth, or with those of the new era which began with the Restoration. Butler's great work was published wholly after the Restoration; indeed, it could hardly have been safely published before. But it is probable that it had been in great part written many years before; and, at any rate, the longer and more active portion of his life was passed during the civil conflict and under the Commonwealth: the principles, the sympathies, and habits of thought which we find reflected in his works were formed under the severe discipline of those stern times, a very different school from that of the Restoration. And in subject his great work distinctly belongs to the age of Puritan supremacy. It seems to us, therefore, better to treat Butler as a poet belonging to the earlier era, pointing out at the same time that no part of his great poem actually saw the light till after the Restoration.

Of the personal history of Samuel Butler we know very little. He was born in 1612, in the village of Strensham in Worcestershire, his parents being probably of humble rank and in needy circumstances. He received his early education at the Grammar School at Worcester. Whether he afterwards went to either University, or received any further direct teaching beyond what he enjoyed at school, has not been determined. In early life he appears to have acted as clerk to a Mr. Jeffreys, a magistrate of the county of Worcester. Subsequently he formed one of the household of the Countess of Kent, in what capacity is not quite clear; and here he engaged the friendship and society of the great Selden, a man not less eminent for the nobility of his character than for his learning and ability. At a later period Butler resided—it would seem as tutor—in the house of Sir Samuel Luke, a Cromwellian officer, an ardent republican, and a strong Presbyterian. Sir Samuel Luke undoubtedly furnished some features for our author's portrait of Hudibras; and his life in Luke's service was not, we may presume, a happy one. In truth Butler's life was throughout a hard one. He was a royalist and a devoted churchman. He hated the Puritans: their austerity repelled him; their frequent coarseness of thought and manners offended his taste; their theological controversies excited his contempt; their religion seemed to him hypocrisy; their arrogance, narrowmindedness, and pedantry were disgusting to him. Yet it seems to have been his fate to spend most of his life among Puritans, poor, dependent, the servant of the very men whom he hated. It was not till towards the close of his life that he found his revenge. In "Hudibras," at last, he poured out all the pent-up bitterness of years. The Restoration gave victory to the cause which Butler had always espoused, and, three years afterwards, in 1663, he published the first part of "Hudibras." The second part was published in 1664; and the third in 1678. Immediately upon the publication of the first part of the great satire, its success was established; it became the fashion of the day. But Butler himself remained without any solid reward, and he died in London in 1680, it is said in extreme poverty.

With what degree of outward assistance we cannot certainly say, but certainly at some time and by some means Butler succeeded in acquiring an extraordinary mass of learning, especially in the more obscure and less-frequented branches of science and literature. His opportunities, too, of observing the faults and eccentricities of the class of men whom he was afterwards to satirise were, as we have pointed out, very abundant. The circumstances of his career gave energy and concentration to his satiric powers. And these, added to powers of humour rare not only in their unfailing strength but in the extraordinary variety of their character, qualified him to take his place as the great satirist of the seventeenth century, and one of the greatest satirists of modern Europe.

The satire of "Hudibras" is unquestionably the most remarkable book written on the Royalist and anti-Puritan side of the great conflict of its author's days. Its object is to present the Puritan party in the most ludicrous, the most odious, and contemptible light. This is effected by describing the character and adventures of the two heroes of the poem, Sir Hudibras, the representative of the Presbyterian section of the Puritans, and his squire, Ralph, who represents the Independents. It has sometimes been suggested that Butler was largely indebted to "Don Quixote" for the conception of his satire; and no doubt the idea of choosing a knight and his squire as the heroes of the poem was suggested by the great Spanish satire. But beyond this there is nothing in common between the two works. In fact, "Pickwick" has much more in common with "Don Quixote" than "Hudibras" has. Quixote is the picture of "a noble mind o'erthrown;" a character really brave and chivalrous, but rendered ludicrous by its illusions; a career essentially noble, but out of place. Hudibras is the portrait of a creature utterly base, mean, false, and cowardly, a hypocrite and a pedant. Every line in the description of him and his squire, every ludicrous adventure through which they are led, is designed to render them not merely ridiculous, but hateful and contemptible. Every comparison which Butler's fertile imagination could devise, every allusion which his vast learning could suggest (and in learning Butler might almost rival Milton), is directed to heighten this effect. "Hudibras" is the bitterest, and by far the most learned, as well as one of the most humorous of satires. The peculiar jingling metre in which it is written is admirably suited for the subject.

The poem opens with a description, occupying between four and five hundred lines, of Hudibras himself, his gifts and endowments, outward and inward, a description as remarkable as anything in the whole poem. This, and a somewhat similar description of Ralpho, the squire, occupy the greater part of the first canto.

The knight himself is introduced as

"Chief of domestic knights and errant,
Either for charlet or for warrant;
That could as well bind o'er as swaddle.*
Great on the bench, great in the saddle,
Mighty he was in both of these,
And styled of war as well as peace;
So some rats, of amphibious nature,
Are either for the land or water."

In the same strain the poet describes his talents and his learning:—

"'Tis known he could speak Greek
As naturally as pigs squeak;
That Latin was no more difficile
Than to a blackbird 'tis to whistle."

Next we hear of his logic and rhetoric, his pedantry and barbarous language:—

"A Babylonish dialect,
Which learned pedants much affect;
It was a party-coloured dress
Of patched and pye-balled languages; [Latin,
'Twas English cut on Greek and
Like fustian heretofore on satin."

His "school divinity," metaphysical speculations, and all the vain ingenuity which marred the scholastic system, are thus detailed:—

"He a rope of sand could twist
As tough as learned Sorbonist;
And weave fine cobwebs fit for skull
That's empty when the moon is full;
Such as take lodgings in a head
That's to be let unfurnished
He could raise scruples dark and nice,
And often solve 'em in a trice;
As if divinity had catched
The itch on purpose to be scratched;
Or, like a mountebank, did wound
And stab herself with doubts profound,
Only to show with how small pain
The wounds of faith are cured again;
Although by woeful proof we find
They always leave a scar behind."

The sketch which follows of the knight's religion—caustic and, of course, in one sense, unfair as it is—is so fine a piece of satire that we quote it entire:—

"For his religion, it was fit
To match his learning and his wit:
'Twas Presbyterian true blue;
For he was of the stubborn crew
Of errant saints, whom all men grant
To be the true Church militant;
Such as do build their faith upon
The holy text of pike and gun;
Decide all controversies by
Infallible artillery;
And prove their doctrine orthodox

* To *swaddle* is to fight. The meaning is, he was equally distinguished as a magistrate and as a warrior.

By apostolic blows and knocks;
Call fire and sword and desolation
A godly, thorough reformation,
Which always must be carried on,
And still be doing, never done:
As if religion were intended
For nothing else but to be mended.
A sect whose chief devotion lies
In odd perverse antipathies;
In falling out with that or this,
And finding somewhat still amiss;
More peevish, cross, and splenetic
Than dog distract or monkey sick;
That with more zeal keep holyday
The wrong than others the right way;
Compound for sins they are inclined to
By damning those they have no mind to;
Still so perverse and opposite,
As if they worshipped God for spite.
The selfsame thing they will abhor
One way, and long another for.
Freewill they one way disavow,
Another nothing else allow
All piety consists therein
In them, in other men all sin.
Rather than fail, they will decry
That which they love most tenderly;
Quarrel with minced pies, and disparage
Their best and dearest friend, plum porridge;
Fat pig and goose itself oppose,
And blaspheme custard through the nose.
The apostles of this fierce religion,
Like Mahomet's, were ass and widgeon;
To whom our knight by fast instinct
Of wit and temper was so linked,
As if hypocrisy and nonsense
Had got the advowson of his conscience."

Not less sarcasm and contempt are displayed in describing the external appearance and equipments of Hudibras; his tawny beard, which he had vowed not to cut till the monarchy should fall, and which is accordingly compared, in an intensely humorous passage, to the "supplemental noses" which "learned Taliacotius" cut from the flesh of one person and affixed to the face of another, and which lived as long as and died with him from whom they were cut; his clumsy, unwieldy figure; his loose breeches crammed with stores of provisions, and so frequently robbed by rats and mice; his rusty sword, dagger, and pistols; and his steed, no less ungainly than its master—

"Sturdy, large, and tall, with mouth of meal and eye of wall."

Less elaborate but not less pointed and humorous is the portrait of Ralph, the squire, and his qualities of mind and body—

"His knowledge was not far behind
The knight's, but of another kind,
And he another way came by it,
Which some call *gifts*, and some *new light*;
A liberal art, that costs no pains
Of study, industry, or brains."

Ralph is a tailor by trade, whose chief gift is that religious "new light" already mentioned, and a supposed profound skill in astrology and other occult sciences. He could

"Feel the pulses of the stars
To find out agues, coughs, catarrhs;
And tell what crisis does divine
The rot in sheep and mange in swine."

The adventures, base, cowardly, and ridiculous, through which this pair of worthies are led by the author, are quite in keeping with their character. Their first attempt is to put down a bear-baiting at Brentford, and bring the offenders to justice, the whole being, of course, intended to display in a ludicrous light the Puritans' aversion to this and all other public amusements. The leaders of the party opposed to the knight—Crowdero, a wooden-legged fiddler; Orsin, the bear leader; the bear himself; Talgol, a butcher, "mortal foe to cows;" Magnano, a tinker; Trulla, "a bold virago stout and tall;" Cerdon, a cobbler; and Colon, an ostler—and the various incidents of the combat are all described with mock-heroic dignity. At last the first fight ends in the seeming triumph of the knight and squire, who carry off the wooden-legged fiddler to

"An ancient castle that commands
The adjacent parts. In all the fabric
You shall not see one stone, nor a brick;
But all of wood, by powerful spell
Of magic made impregnable.
There's neither iron bar nor grate,
Portcullis, chain, nor bolt, nor gate,
And yet men durance there abide
In dungeon scarce three inches wide;
With roof so low that under it
They never stand, but lie or sit;
And yet so foul, that whoso is in
Is to the middle fast in prison;
In circle magical confined,
With walls of subtle air and wind,
Which none are able to break thorough
Until they're freed by head of borough.
Thither arrived, the adventurous knight
And bold squire from their steeds alight
At the outward wall, near which there stands
A bastile, built to imprison hands;
By strange enchantment made to fetter
The lesser part, and free the greater;
For though the body may pass through
The hands in grate are fast enough.

* * * * * * *

They ope the trap-door gate,
And let Crowdero down thereat;
Crowdero making doleful face,
Like hermit poor in pensive place;
To dungeon they the wretch commit,
And the survivor of his feet."

This dungeon is the parish stocks, in which they leave their vanquished enemy. But their triumph is short. The scattered foes rally, the fight is renewed, and at last Hudibras, overthrown by the "virago stout and tall," and Ralph, his squire, are led away, and placed in the same stocks in which the fiddler had lain before. There the conclusion of the first part leaves them consoling themselves for their bruises and disgrace by a ludicrous controversy upon points of doctrine.

We have spoken in some detail of the story of the first part of the poem, in the hope that such an introduction may be found useful by the student who wishes to make himself acquainted with "Hudibras." The latter parts of the poem are, perhaps, not quite on a level with the first, but they fall very little short of it. The knight's adventures with the lady of whom he is enamoured, with the conjuror Sidrophel, and the other incidents of the second and third parts, are supremely humorous, and attain to the full Butler's object of rendering Hudibras and his squire contemptible, and give ample scope for the poet's learning and imagination. We cannot examine these latter parts with any minuteness. A very few extracts are all for which we can find space. The passages which we select require no explanation or introduction to render their meaning clear:—

"Our brethren of New England use
Choice malefactors to excuse
And hang the guiltless in their stead,
Of whom the churches have less need;
As lately it happened, in a town
There lived a cobbler, and but one,
That out of doctrine could cut use,
And mend men's lives as well as shoes.
This precious brother having slain,
In time of peace, an Indian,
Not out of malice, but mere zeal,
Because he was an infidel,
The mighty Tottipottymoy
Sent to our elders an envoy,
Complaining, sorely, of the breach
Of league held forth by brother Patch
Against the articles in force
Between both churches, his and ours;
For which he craved the saints to render
Into his hands, or hang the offender.
But they maturely having weighed
They had no more but him o' the trade
(A man that served them in a double
Capacity, to teach and cobble),
Resolved to spare him; yet to do
The Indian, Hoghgan Moghgan, too,
Impartial justice, in his stead did
Hang an old weaver that was bed-rid."

"Doubtless the pleasure is as great
Of being cheated as to cheat;
As lookers-on feel most delight
That least perceive a juggler's sleight;
And still the less they understand
The more they admire his sleight of hand.
Some with a noise and greasy light
Are snapped, as men catch larks by night;
Ensnared and hampered by the soul,
As nooses by their legs catch fowl;
Some with a medicine and receipt
Are drawn to nibble at the bait;
And, though it be a two-foot trout,
Are with a single hair pulled out.
Others believe no voice to an organ
So sweet as lawyer's in his bar-gown,
Until, with subtle cobweb cheats,
They're catched in knotted law like nets;
In which, when once they are embrangled,
The more they stir, the more they're tangled;
And while their purses can dispute,
There's no end of the immortal suit."

We have spoken already of the great and immediate popularity of "Hudibras." There is one result of that popularity which ought not to pass unnoticed. Few things are more striking than the completeness with which, down to a few years ago, one particular view of the Puritan character maintained undisputed predominance in English literature, and that view an exaggeration and caricature of one side only of their many-sided character. The view of which we speak is exactly that of "Hudibras;" and we believe that Butler, by his great satire, contributed more than any other man to stamp upon English literature that impression which only in the present generation has been completely removed.

LESSONS IN GEOLOGY.—XXV.

THE TERTIARY SYSTEM.

WE now enter, geologically speaking, modern times. The beds of the Tertiary, and their fossil contents, offer many a sight at least not unfamiliar to modern observation. From the similarity of the forms of life of the Tertiary epoch to those animals which now people the earth, the period, looking at it from this point of view, has been termed *Cainozoic*. The exact scale of the inclination by which the past rises into the present has been used by Lyell to separate the Tertiary into three divisions. M. Deshayes examined some 3,000 Tertiary shells, comparing them with existing species. In the *lower* Tertiary, which is found in the neighbourhoods of London and Paris, 3·5 per cent. of the fossils proved to be of species still in existence. From the *middle* Tertiary of the Loire and Gironde 17 per cent. were found to have representatives now alive; while the *upper* Tertiary or sub-Apennine beds yielded from 37 to 50 per cent. of existing species. Further south, in Sicily, are much newer Tertiary beds, rising above the sea to a great thickness, and the fossils in these exhibited, with a very few exceptions—only 5 per cent.—the same life as is to-day existing in the Mediterranean Sea. This brought the deposition of these beds into recent times, and consequently geologists have separated them away from the Tertiary, and classed them with recent deposits, under the name of *post-Tertiary*.

The lower, middle, and upper Tertiaries, mentioned above, are now known by names bestowed upon them by Lyell. The lowest is termed *Eocene*, from ηως (e'-ose, the *dawn*) and καινος (ki'-nos, *recent*)—the dawn of new or recent times. The central division is the *Miocene* (μειον, mi'-on, *less*, and καινος, *recent*)—a term intended to express a *minor* proportion of recent species. The upper division is the *Pliocene* (πλειον, pli'-on, *more*; and καινος, *recent*), as it contains *more* recent species than any of the lower beds. It is needless, perhaps, to observe that the words in brackets following the Greek forms are merely intended to give the reader who is unacquainted with Greek a suitable idea of the way in which these words should be *pronounced*. As in other parts of the POPULAR EDUCATOR, the sounds of the Greek words are represented phonetically.

The Tertiary, as a whole, is not so clearly defined as the deposits of the preceding periods. However, the following synopsis will give the student some indication of the localities and the appearances of the beds. The limits of our space compel us to treat of the English Tertiaries mainly, although the deposits do not find in our island a typical development.


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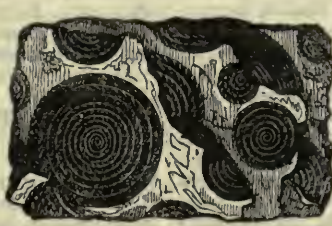
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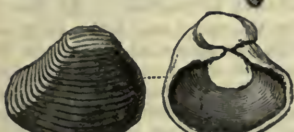
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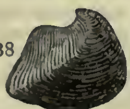
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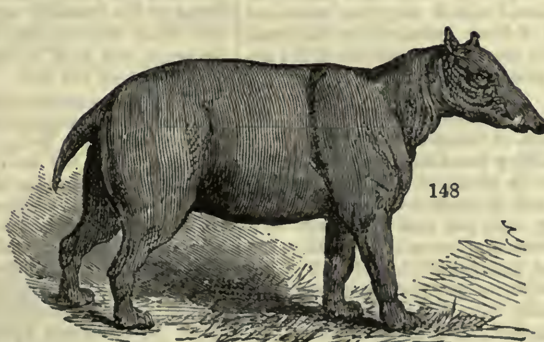
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PLIOCENE.	*Norwich crag*, which entombs the bones of extinct mammals, and consists of beds of sand, clay, and gravel.
	Red crag of Suffolk is a loamy sand, tinted with iron oxide.
	Coralline crag of Suffolk, a concrete of shells and corals, now loose in calcareous sand, now consolidated into limestone beds, sometimes sufficiently compact for building-stone.
MIOCENE.	*Hempstead beds*, Isle of Wight, are of this period, and reach some 170 feet in thickness.
	The Lignites of Bovey Tracey.
	The Leaf beds of Mull.
	Lignites of Antrim.
EOCENE.	*Fluvio-marine beds* of Hampshire and the Isle of Wight.
	Bagshot sands.
	London clay.
	Bognor beds.
	Woolwich clays.
	Thanet sands.

TABLE OF THE EOCENE SERIES (JUKES).

Upper.	Hempstead series.	Corbula beds.
		Upper fresh-water and estuary marls.
		Middle ditto.
		Lower ditto.
	Bembridge series.	Marls and oyster beds.
		Limestones.
Middle, or Paris.	Osborne series.	St. Helens' sands.
		Nettlestone grits.
	Headon series.	Upper fresh-water.
		Middle Marine.
		Lower fresh-water.
	Bagshot series.	Upper Bagshot.
		Barton clay.
		Bracklesham beds.
		Lower Bagshot.
Lower, or London.		London clay.
		Plastic clay and sands.
		Thanet sands.

Total thickness, 2,555 feet.

This formation is developed in the neighbourhood of London. If two lines be drawn from a point some twenty miles west of Reading, one passing through Norwich and the other through Canterbury, crossing the channel to the Netherlands, this area of the Eocene will be embraced by them. The north of the Isle of Wight and a triangular patch, extending a little to the north of Salisbury, west to Dorchester, and east to Newhaven, gives the delineation of the other Eocene area. The deposit is shown in the Paris basin, and then is traced south as far as the uppermost bend of the Loire.

The Thanet Sands.—In the Hampshire area, the Eocene clay often rests on the chalk; but in the Isle of Thanet, between Herne Bay and the Reculvers, appears a bed of sand some seventy or eighty feet thick, which contains *Pholadomya, Cyprina, Corbula*, and *Scalaria*. The true position of this bed has been proved by Mr. Prestwich to be between the chalk and

The *Woolwich clays*, which were evidently deposited by a great river emptying itself into the Eocene sea near the present site of Woolwich. From the mixture of marine, brackish, and fresh-water shells, it appears that now the fresh-water and now the salt-water occupied the estuary; and these changes could not have been slow, for the fresh-water mollusks are frequently found in their natural positions, indicating that they were killed where they lived, and have never been since disturbed. As the Woolwich clays are traced inland, they bear more and more evidence of the presence of fresh water, while, following them in the other direction, they show that the waves of the sea beat upon a shore not far off, and the clays contain the fossils of a marine fauna.

The *London clay*, which immediately overlies the last deposit, is of deep-sea origin. It consists of bluish or brown clay, very tenacious, and sometimes containing those *septaria*, of which we have before said *Roman cement* is made, though from its fineness, and the thickness of its bed, it must have been deposited in the quiet depths of the deep sea; yet land must have been in the neighbourhood, for the teeth and bones of crocodiles, the eggs of turtles, and the fruits of palms, have been found in the London clay. The deposit reaches its greatest thickness about the Isle of Sheppey; it gradually thins out to the east, being scarcely represented in Belgium, and not at all in France. The fossils are numerous, and, as may be seen from those which are figured, are nearly approaching to present forms. For instance, *Leda amygdaloides* (Fig. 135), *Nautilus ziczac* (Fig. 136), *Voluta nodosa* (Fig. 137), the *Cryptodon angulatum* (Fig. 138).

The *Bagshot sands* occupy extensive districts in the neighbourhood of Bagshot, Aldershot, and in the New Forest in Hampshire. In the basin of the Thames they are the uppermost members of the Eocene group, all above them having suffered denudation; but in Hampshire, having been tilted up at an angle, they were protected from being exposed by having the superincumbent beds swept off. The Bagshot and Bracklesham beds are of sand, clay, and limestone, usually soft, though now and then sufficiently hard for building material.

Though soft beds have not the power of preserving fossils with great care, yet there are some in these beds of much interest. It is here we first meet the *Nummulite*, a foraminiferous shell, that is, one perforated with holes, from which issued filaments, or roots, which bestowed upon the class the name of Rhizopods, or radiate animals. The word *nummulite* is coined from *nummus*, money, because the shells are small discs, thicker in the centre than at the edges; when the interior is laid open it is found to be spirally chambered (Fig. 139). These creatures are almost peculiar to the Eocene, very few being found in the lower Miocene; and so restricted are their species, that the lower Eocene may be divided into three sections, according to the species of nummulites they contain. The *Nummulites variolaria* characterises the upper beds; *Nummulites lævigata* is found in the middle beds, whilst the lower contain solely the *Nummulites planulata*.

The nummulite life was vast and profuse. The limestone rocks formed by these shells are found stretching in an almost unbroken chain from the west of Europe to India. To quote Lyell, "The nummulitic formation often attains a thickness of many thousand feet, and extends from the Alps to the Carpathians, and is in full force in the north of Africa, as, for example, in Algeria and Morocco. It has also been traced from Egypt, where it was largely quarried of old for the building of the pyramids, into Asia Minor, and across Persia by Bagdad to the mouths of the Indus. It occurs not only in Cutch, but in the mountain-ranges which separate Scinde from Persia, and it has been followed still farther eastward into India, as far as Eastern Bengal and the frontiers of China." This is a remarkable example of uniformity of life, for many of the same species are common to France and Cutch; and the vast accumulation of organic life exhibited in this Eocene deposit is perfectly incalculable.

Of the other fossils contained by these beds we figure some. The *Venericardia planicosta* (Fig. 140), *Pleurotoma attenuata* (Fig. 141), *Turritella multisulcata* (Fig. 142), *Conus deperditus* (Fig. 143). In these beds are found many sharks' teeth; and, not having given any previous drawings of these fossils, we here add some specimens (Figs. 144, 145, 146).

The *Barton clay* and *Upper Bagshot sands* present a thickness of some 500 feet. The former deposit has yielded upwards of 250 marine shells. The *Chama squamosa* is particularly plentiful.

The *Headon series*, which are the centre of the middle Eocene, may be seen at the east and west extremities of the Isle of Wight. As our table indicates, the upper and lower beds are of fresh-water origin, while the sea seems to have made the water brackish during the deposition of the middle strata. The *Planorbis enomphalus* (Fig. 147) characterises the fresh-water deposits, while the *Potamomya plana* and *Cerithium mutabile* are found in the brackish deposits. There is an interesting shell, the *Helix labyrinthica*, found in this deposit, which is now living on the land in the United States. The Headon series occupies some 200 feet.

The *Osborne series*, which are the uppermost members of the middle Eocene, supply the Nettlestone grit, which is used for building-stone at Ryde. They are also of fresh-water and brackish origin, but are not more than seventy feet thick. They contain marked species of *Paludina, Melania*, and *Melanopsis*, and frequently the seeds of the fresh-water plant, the *Chara*.

The *Bembridge series* is the lower member of the upper Eocene. The beds, which are marls, clays, and fresh-water limestones, reach a thickness of 115 feet. In these beds were first discovered the fossil remains of the *Palæotherium*, the extinct mammal which Cuvier completed from a partial skeleton found in the Paris basin. The correctness of the great naturalist's surmise has been proved by many fossil remains of the creature which have been since found. It was about four feet high (Fig. 148). Of the other fossils the beds contain these were the chief:—*Planorbis discus* (Fig. 149), *Bulimus ellipticus* (Fig. 150), *Lymnea longiscata* (Fig. 151), *Chara tuberculata* (Fig. 152).

The *Hempstead beds* are at the top of the Eocene; they used to be classed at the bottom of the Miocene. They take their name from a hill near Yarmouth, Isle of Wight. At their base is the "black band," so called because of its colour, from the presence of carbonaceous matter. It is a marl deposited from a fresh-water estuary. Two other deposits, scarcely so thick, succeed it, each distinguished by its fossils, and the whole is surmounted by the *Corbula beds*, which consist of marine sands and clays, which are characterised by the abundance of the *Corbula pisum* (Fig. 153), which are also found in the Barton beds.

The Paris basin is a depression in the chalk in which the Eocene beds have been deposited. The beds mainly correspond to the English series, but two are peculiarly prominent—the *Calcaire grossier*, which is rough limestone, of which the houses of Paris are built; and the *Gypsum beds* of Montmartre, which are accumulations of sulphate of lime. This, when calcined, produces the well-known *plaster of Paris*. It was in these beds that the mammalian remains were discovered upon which Cuvier founded the science of Comparative Anatomy. He astounded the scientific world by building up the complete skeleton from a few fragments. Subsequent discoveries of other remains proved conclusively that the deductions of the great naturalist were correct, and that it was possible to determine the construction of an animal from the inspection of part of its skeleton. Here was the foundation laid of the science of Comparative Anatomy.

CHARACTERISTIC FOSSILS OF THE EOCENE PERIOD.

Plastic Clay.

Plants.—Many beautiful leaves and some stems from the clays near Reading, etc.

Conchifera.—Avicula arcuata; Ostræa pulchra; Arca depressa; Astarte tenera; Cardium Plumsteadiense; Corbula Arnouldii; Cyprina planata; Cyrena cordata; Leda striata; Modiola simplex; Nucula compressa; Pholadomya virgulosa.

Gasteropoda.—Melania inquinata; Melanopsis buccinoidea; Murex foliaceus; Planorbis hemistoma, lævigatus.

Crustacea.—Cytheræa angulatopora, plicata.

Reptiles.—Chelone, fragments of.

Birds.—First phalangeal bone of a bird's foot.

Mammalia.—Hyracotherium cuniculus; Lophiodon or Coryphodon, fragments of.

London Clay.

Plants.—Callitrites Comptoni, crassus; Cupanoides corrugatus; Leguminosites cordatus, gracilis; Solenostrobus corrugatus.

Foraminifera.—Dentalina acuta, adolphina; Nodosaria affinis; Textularia carinata.

Polyzoa.—Eschara Brongniarti; Flustra crassa.

Brachiopoda.—Lingula tenuis; Terebratulina striatula.

Conchifera.—Pecten duplicatus; Pinna affinis; Astarte rugata; Cardium nitens; Corbula globosa; Modiola depressa; Tellina subrotunda.

Gasteropoda.—Aporrhais Sowerbyi; Cypræa oviformis; Murex coronatus; Natica microstoma; Pleurotoma acuminata; Voluta denudata.

Cephalopoda.—Nautilus centralis, imperialis, regalis.

Echinodermata.—Astropecten armatus, crispatus.

Fish.—Accstrus ornatus; Eurygnathus cavifrons; Goniognathus maxillaris; Loxostomus mancus: Megalops priscus; Myliobatis acutus, striatus; Phyllodus irregularis, planus.

Reptiles.—Chelone breviceps, convexa; Crocodilus champsoides; Trionyx pustulatus.

Birds.—Halcyornis Toliapicus; Lithornis vulturinus.

Mammalia.—Coryphodon eocænus; Hyracotherium leporinum.

Bagshot Series.

The Bracklesham beds contain—

Plants.—Comptonia dryandrifolia; Pinites Dixoni.

Foraminifera.—Nummulites lævigatus, scaber.

Conchifera.—Ostræa elegans, inflata; Pecten corneus, multistriatus; Pinna margaritacea; Cardium alternatum; Chama calcarata, gigas; Corbula rugosa; Cypricardia carinata; Cytheræa lucida, striatula; Leda serrata; Mactra depressa; Modiola lithophaga; Nucula ovata; Tellina lamellosa, reflexa, speciosa.

Gasteropoda.—Actæon sulcatus; Bulla expansa; Cerithium cornucopia, cristata, giganteum, turris; Conus pyriformis, velatus; Fusus incultus, rugosus; Natica conoidea, obovata; Pleurotoma acuminata, dentata; Turbo plicatus; Turritella contracta, marginata, sulcata; Voluta augusta.

Reptiles.—Chelone trigoniceps; Gavialis Dixoni.

Mammalia.—Lophiodon minimus.

Barton Beds.

Zoophyta.—Turbinolia Bowerbankii, firma.

Brachiopoda.—Terebratula bisinuata.

Conchifera.—Lima obliqua; Pecten carinatus; Cardium discors; Chama squamosa; Cyrena obovata; Cytheræa pusilla; Modiola sulcata; Nucula trigona, deltoidea; Pholas conoidea; Solen gracilis.

Gasteropoda.—Ancylus elegans; Bulla conulus, ovulata; Cerithium cinctum; Conus dormitor; Murex contabulatus; Natica mutabilis; Nerita globosa; Turritella brevis; Voluta costata.

Reptiles.—Alligator Hantoniensis; Crocodilus Hastingsiæ; Trionyx marginatus, planus.

Headon Series.

Plants.—Carpolithes ovulum.

Conchifera.—Ostræa flabellula; Corbula cuspidata; Cyrena arenaria; Mya angustata.

Gasteropoda.—Ancillaria subulata; Cerithium acutum, duplex; Limnæa angusta, cincta, costellata; Melania minima; Melanopsis subulata; Murex sexdentatus; Natica similis; Nerita aperta; Planorbis elegans; Pleurotoma innexa.

Fish.—Myliobatis and Squalus teeth.

Mammalia.—Dichodon cuspidatus; Paloplotherium annectens; Spalacodon.

Osborne Series.

Plants.—Chara Lyelli.

Gasteropoda.—Cerithium; Hydrobia; Paludina globuloides; Planorbis discus.

Bembridge Series.

Conchifera.—Cyrena obtusa; Mytilus affinis; Nucula similis.

Gasteropoda.—Helix globosa, tropifera; Melania Forbesii; Paludina orbicularis; Pupa perdentata.

Hempstead Series.

Plants.—Chara helicteres.

Conchifera.—Ostræa callifera; Corbula Vectensis.

Gasteropoda.—Aporrhais; Melania inflata; Neritina tristis.

Reptiles.—Trionyx incrassatus.

Mammalia.—Hyopotamus bovinus.

LESSONS IN GREEK.—XLVII.

VERBS WHICH FOLLOW THE FORMATION OF VERBS IN *μι*.

BESIDES those already mentioned, there are several other verbs which form their tenses according to the analogy of the verbs in *μι*; such are—

1. *διδρασκω*, *I run away from*; aor. (ΔΡΑ), *απεδρᾱν*, *ᾱς*, *ᾱ*, *ᾱμεν*, *ᾱτε*, *ᾱσαν*; subj. *αποδρῶ*, *δρᾷς*, *δρᾷ*, *δρῶμεν*, *δρᾶτε*, *δρῶσι(ν)*; opt. *δραιην*; imp. *αποδραθι*, *ατω*; inf. *αποδρᾶναι*; part. *δρᾶς*, *ᾶσα*, *αν*.
2. *πετομαι*, *I fly*; aor. (ΠΤΑ) *επτην*; imp. *πτῆναι*; pass. *πτας*, act. mid. *επταμην*, imp. *πτασθαι* (by syncope).
3. *σκελλω* or *σκελεω*, *I dry*, *I dry up* (hence our *skeleton*); aor. (ΣΚΛΑ) *εσκλην*, *I am dried up*; inf. *σκλῆναι*; opt. *σκλαιην*.
4. *φθα-νω* (with acc.), *I get before*, *I anticipate*; aor. *εφθην*, *φθω*, *φθαιην*, *φθῆναι*, *φθας*.
5. *καιω*, *I burn* (transit.); aor. (ΚΑΕ) *εκαην*, *I burnt* (intrans.), but 1 aor. *εκαυσα* (transit.), *I set on fire*.
6. *ἁλισκομαι*, *I am taken*, *caught*; aor. (ἉΛΟ) *ἥλων* and *ἑάλων*.
7. *βιοω*, *I live*; aor. *εβιων*; subj. *βιῶ*, *ῷς*, *ῷ*, etc.; opt. *βιῴην* (not *βιοιην*, as *γνοιην*, to distinguish this part from the opt. imperf. *βιοιην*); inf. *βιῶναι*; part. *βιους*, *οῦσα* (the neuter does not occur); the cases, however, are supplied by the 1st aor. *βιωσας* (so, *ανεβιων*, *I lived again*, from *αναβιωσκομαι*). The present and imperfect are little used by the Attics, instead of which they employ *ζῶ* (*ζαω*), which, on the other hand, borrows the remaining tenses from *βιοω*; thus—pres. *ζῶ*, imperf. *εζων*, fut. *βιωσομαι*, aor. *εβιων*, perf. *βεβιωκα*, perf. pass. *βεβιωται*, part. *βεβιωμενος*.
8. *φυω*, *I bring forth*; 2 aor. *εφῡν*, *I arose*, *came into being*; *φῦναι*, *φυς*, subj. *φυω* (no opt. in Attic), 1 aor. *εφῡσα*, *I brought forth*; fut. *φυσω*, *I shall bring forth*. The perfect *πεφῡκα*, *I have come into being*, *I have become*, is also intransitive. The mid. pres. *φυομαι*, fut. *φυσομαι*.

Particular attention must be paid to a verb of frequent occurrence, namely, *οἶδα* (stem ΕΙΔ; *vid-eo* in Latin), *I know*.

PERFECT.

Ind. *Sing.* 1.	*οιδα*.	Subj. *ειδῶ*.	Imperat.	Infinit.
2.	*οισθα*.	*ειδῇς*.	*ισθι*.	*ειδεναι*.
3.	*οιδε(ν)*.	*ειδῇ*.	*ιστω*.	
Dual 2.	*ιστον*.	*ειδῆτον*.	*ιστον*.	Participle.
3.	*ιστον*.	*ειδῆτον*.	*ιστων*.	*ειδως*, *υῖα*, *ος*
Plur. 1.	*ισμεν*.	*ειδῶμεν*.		
2.	*ιστε*.	*ειδῆτε*.	*ιστε*.	
3.	*ισᾶσι(ν)*.	*ειδῶσι*.	*ιστωσαν*.	

PLUPERFECT.

Ind. *Sing.* 1.	*ᾐδειν*. Attic *ᾐδη*.	*Dual.*	*Plur.* *ᾐδειμεν*.
2.	*ᾐδεις* and *ᾐδεισθα* or *ᾐδησθα*.	*ᾐδειτον*.	*ᾐδειτε*.
3.	*ᾐδει* or *ᾐδη*.	*ᾐδειτην*.	*ᾐδεσαν*.
Opt. *Sing.*	*ειδειην*, *ης*, *η*.	*ειδειητον*, *ητην*.	*ειδειημεν*, *ητε*, *ειδειεν*.

Fut. *εισομαι*, *I shall know* or *experience*. (Of *οιδα* there is this compound, *συνοιδα*, *I am conscious*, inf. *συνειδεναι*, imp. *συνισθι*, subj. *συνειδῶ*, etc.).

INVARIABLE WORDS.

The words which we have hitherto studied are susceptible of certain changes. We come next to words which do not undergo change, or undergo change only to a small extent. Many of these have occurred in the course of these lessons. Nevertheless, invariable or uninflected words must be put together and spoken of specifically.

PREPOSITIONS.

The prepositions require careful study, as on them, as well as on other invariable verbs, the sense very much depends, and you will be ignorant of some of the most delicate shades of meaning, and unaware of many an elegance, if you do not familiarise your mind with the import and the usage of the prepositions and the conjunctions particularly.

Prepositions have a relation to place, and denote the direction of an action in regard to place. Thus, I say "you go *from* home," "you go *to* home," "you go *round* the house," "you go *over* the wall." In order, therefore, to your possessing an exact knowledge of the prepositions, of which there are in Greek eighteen, you must study them in their relation to place.

The Prepositions arranged in their Relations to Place.

RELATIONS TO PLACE.	GREEK.	ENGLISH.
1. Place *where* you are.	1. εν,	in.
2. Place *whither* you go	2. εις or ες,	into.
	3. προς,	to.
3. Place *whence* you come	4. εκ or εξ,	out of.
	5. απο,	from.
4. Place *through* which you pass.	6. δια,	through.
	7. ανα,	up.
5. Place *at* which you stop / ,, *down* which you go	8. κατα.	down, at, on.
6. Different relations of position—		
Place by the side of	9. παρα,	along.
,, together with	10. μετα,	with.
,, connected with	11. συν and ξυν,	with.
,, over	12. ὑπερ,	over, above.
,, under	13. ὑπο,	under, by.
,, before	14. προ,	before.
,, on both sides	15. αμφι,	around.
,, around	16. περι,	around.
,, on or upon	17. επι,	on.
7. Opposition, displacement.	18. αντι,	against. instead of.

The following six words may also be considered as prepositions; namely, ατερ, ανευ, *without*; ἑνεκα, *on account of*; αχρι, μεχρι, *up to, until*; πλην, *but, except*.

Prepositions are very frequently used in combination with verbs. Such verbs are then said to be *compounded* with prepositions. Thus, by the addition of the preposition εις, *into*, to the simple verb αγω, *I lead*, we get the compound verb εισαγω, *I lead into*. More than one preposition may combine with a verb; for example—

εξαγω, *I lead out* (an army from its camp).
παρεξαγω, *I lead out* (an army against the enemy).
αντιπαρεξαγω, *I lead out* (an army and march it to assail the enemy).

ADVERBS.

Among the invariable or indeclinable words are adverbs. Adverbs qualify action in regard to—

1. Place.	5. Interrogation.
2. Time.	6. Affirmation.
3. Manner or quality.	7. Negation.
4. Quantity.	8. Doubt.

1. *Adverbs of Place.*

One kind of adverbs of place is derived from the prepositions. The following will serve as examples:—

PREPOSITIONS.	ADVERBS.	MEANING.
1. εν,	ενδον, εντος,	*within.*
2. εις,	εισω,	*within* (with motion).
3. προς,	προσω,	*forwards, in advance.*
4. εξ,	εκτος, εξω,	*outwards, externally.*

These adverbs are often found before a genitive, and so perform the part of prepositions; for example, ποῤῥω τῆς πολεως, *far from the city*; εισω τοῦ χαρακος, *within the entrenchments.*

The following also may have a genitive; and others, which will be learned by practice—as τηλε, *far off*; περα and περαν, *on the other side of* (a river); χωρις, *separately*; πελας, εγγυς, αγχι, *near.*

There is another kind of adverbs which, by means of certain terminations, express the different relations of place:—

PLACE WHERE YOU ARE.	PLACE WHITHER YOU GO.
ποῦ, ποθι, *where?*	ποῖ, ποσε, *whither?*
εκεῖ, εκεῖθι, *there.*	εκεῖσε, *thither.*
οικοι, οικοθι, *at home.*	οικονδε, *home.*
Αθηνησι, *at Athens.*	αλλοσε, *somewhere else.*
	Αθηναζε, *to Athens.*
PLACE WHENCE YOU COME.	**PLACE THROUGH WHICH YOU PASS.**
ποθεν, *whence.*	πῆ, *by what way.*
εκεῖθεν, *thence.*	εκεινῃ, *by that way.*
οικοθεν, *from home.*	
αλλοθεν, *from some other place.*	αλλῃ, *by some other way.*
Αθηνηθεν, *from Athens.*	

From this view you see that the terminations or particles

ον, θι, οι, σι,	denote *the place where you are.*
δε, σε, ζε, and sometimes οι	,, ,, *whither you go.*
θεν	,, ,, *whence you come.*
ῃ	,, ,, *through which you pass.*

Ου is the termination of the genitive; thus, ποῦ represents επι ποῦ τοπου, *in what place?*

Οι is the old form of the dative, so that οικοι is for εν οικῳ.

Αθηνησι is for Αθηναις, the dative of Αθῆναι. This ending applies particularly to the names of cities.

Θεν appears to be an ancient form of the genitive. The poets say σεθεν for σοῦ, *of thee*; thus οικοθεν is equivalent to εξ οικου.

Ηι is the termination of the dative, οδῳ being understood; thus αλλῃ is for αν αλλῃ οδῳ, *by another way.*

2. *Adverbs of Time.*

The principal adverbs of time are the following:—

σημερον, to-day (from ἡμερα, a day).	ετι, yet, still.
αυριον, to-morrow.	αρτι, lately, but now.
χθες, yesterday.	αυτικα, immediately.
προθες, the day before yesterday.	τοτε, then.
πρωι, in the morning.	ποτε, some time.
οψε, in the evening.	θαμα, often.
νῦν, νυνι, now.	αει, always, successively.
παλαι, of old, formerly.	ουποτε, never.
ουπω, not yet.	πριν, previously, before.
ηδη, by this time.	ειτα, next, then.

3. *Adverbs of Quality.*

Adverbs of quality end in ως, and correspond to our adverbs in *ly*:—σοφῶς, *wisely*; πεπαιδευμενως, *learnedly*; ευδαιμονως, *fortunately.*

To this class may be referred οὑτως (before a consonant οὑτω), *thus, in this way*, from οὑτος; εκεινως, *in that way*, from εκεινος, *that person*; and in general all the adverbs ending in ως.

Others have the form of the genitive or dative of the first declension:—

εξῆς (from obsolete nominatives), *forthwith.*
εικῆ, ,, ,, *by chance.*
ἡσυχῆ (from ἡσυχος), *peacefully.*

Usage has suppressed the iota subscript as found in ἡσυχῃ ὁδῳ. Other adverbs of quality have the terminations ει, τι, στι, and consequently resemble datives of the third declension:—

πανδημει, *en masse, the whole people.*
αμαχητι, *without combat.*
ἑλληνιστι, *in the Greek language* or *manner.*

Some have the form of accusatives:—

ματην (nominative obsolete), *in vain.*
δωρεαν ,, ,, *gratuitously.*

Those of this division in δον and δην correspond with the Latin adverbs in *tim*:—

αγεληδον (*gregatim*), *by flocks.* κρυβδην (*furtim*), *secretly.*

LESSONS IN LOGARITHMS.—III.

COMMON SYSTEM OF LOGARITHMS.

34. *To find the Logarithm of any Prime Number.*—Rule 1. Divide the given prime number by the natural number nearest to it in the skeleton tables, but less; divide the quotient by the natural number nearest to it, but less; divide this quotient by the natural number nearest to it, but less; and so on, till the last quotient coincide with some natural number in the tables; then, the last quotient with all the divisors are the tabular factors of which the prime number is composed. Consequently, if the logarithms of all these factors, given in the tables, be added together, their sum will be the logarithm of the given prime number. On this principle the following table, exhibiting the method of calculating the logarithm of the prime number 2, is constructed:—

FIRST CALCULATION OF THE LOGARITHM OF 2.

Dividends.		Divisors.		Quotients.		Logs. of Divisors.
2·00000	÷	1·77828	=	1·12468	. .	·250000
1·12468	÷	1·07461	=	1·04660	. .	·031250
1·04660	÷	1·03663	=	1·00961	. .	·015625
1·00961	÷	1·00904	=	1·00057	. .	·003906
1·00057	÷	1·00056	=	1·00001	. .	·000244
1·00001	÷	1·00001	=	1·00000	. .	·000004
				Logarithm of 2 = Sum		·301029

35. *To find the Logarithm of any Prime Number.*—Rule 2. Look for the tabular number nearest to the given prime number, but greater; divide the former by the latter; divide the quotient by the tabular number nearest it, but less; and so on, as before, till the last quotient coincide with some tabular number; then, the last quotient with all the divisors but the first are the tabular factors of the first quotient. Consequently, if the sum of the logarithms of these factors, which is the logarithm of the first quotient, be subtracted from the logarithm of the first dividend, the remainder will be the logarithm of the given prime number. On this principle, the following table, exhibiting another method of calculating the logarithm of 2, is constructed:—

SECOND CALCULATION OF THE LOGARITHM OF 2.

Dividends.		Divisors.		Quotients.		Logs. of Divisors.
2·15443	÷	2·00000	=	1·07722	. .	·333333
1·07772	÷	1·07461	=	1·00243	. .	·031250
1·00243	÷	1·00225	=	1·00018	. .	·000977
1·00018	÷	1·00014	=	1·00004	. .	·000061
1·00004	÷	1·00004	=	1·00000	. .	·000015
				Sum of the logarithms of the factors		·032303
				Logarithm of 2 = Remainder		·301030

The latter logarithm of 2 is more correct than the former, owing to the difference in the mode of calculation. The logarithm of 2, calculated to ten places of decimals, is ·3010299957.

36. As the prime number 5 is the quotient of 10 divided by 2, its logarithm is found on the principle that if the logarithm of the dividend be subtracted from the logarithm of the divisor, the remainder is the logarithm of the quotient (see Art. 20). Hence the reason of the following calculation is made evident:—

Logarithm of 10 = 1·000000
,, 2 = ·301030
,, 5 = ·698970

37. By the application of either of the preceding methods, or by a judicious combination of both, the logarithms of all the prime numbers to any extent may be found. The following table exhibits the logarithms of some prime numbers, which may be calculated in the manner proposed:—

LOGARITHMS OF PRIME NUMBERS.

Natural Numbers.	Logarithms.	Natural Numbers.	Logarithms.
3 . .	·477121	29 . .	1·462398
7 . .	·845098	31 . .	1·491362
11 . .	1·041393	37 . .	1·568202
13 . .	1·113943	41 . .	1·612784
17 . .	1·230449	101 . .	2·004321
19 . .	1·278754	1013 . .	3·005609
23 . .	1·361728	etc.	etc.

38. The logarithms of the powers of a prime number are found by multiplying its logarithm by the indices of those powers (see Art. 22). On this principle, the following tables are constructed:—

LOGARITHMS OF THE POWERS OF 2.

Log. 4 = 2 × ·301030 = ·602060.	Log. 32 = 5 × ·301030 = 1·505150.
,, 8 = 3 × ·301030 = ·903090.	,, 64 = 6 × ·301030 = 1·806180.
,, 16 = 4 × ·301030 = 1·204120.	etc. etc. etc.

LOGARITHMS OF THE POWERS OF 3.

Log. 9 = 2 × ·477121 = ·954243.	Log. 243 = 5 × ·477121 = 2·385606.
,, 27 = 3 × ·477121 = 1·431364.	,, 729 = 6 × ·477121 = 2·862728
,, 81 = 4 × ·477121 = 1·908485.	etc. etc. etc.

39. The logarithms of the composite numbers are found by the addition of the logarithms of the factors (see Art. 19). On this principle, the following table is constructed:—

LOGARITHMS OF COMPOSITE NUMBERS.

Log. 6 = log. 2 + log. 3 = ·778151.
,, 12 = ,, 2 + ,, 6 = 1·079181.
,, 18 = ,, 3 + ,, 6 = 1·255273, etc.
Log. 14 = log. 2 + log. 7 = 1·146128.
,, 21 = ,, 3 + ,, 7 = 1·322219.
,, 28 = ,, 4 + ,, 7 = 1·447158, etc.
Log. 15 = log. 3 + log. 5 = 1·176091.
,, 20 = ,, 2 + ,, 10 = 1·301030.
,, 25 = ,, 5 + ,, 5 = 1·397940, etc.
Log. 105 = log. 3 + log. 5 + log. 7 = 2·021189.
,, 385 = ,, 5 + ,, 7 + ,, 11 = 2·585461.
,, 1001 = ,, 7 + ,, 11 + ,, 13 = 3·000434, etc.

40. The integer prefixed to the decimal part of a logarithm is called its *index* or *characteristic*. Thus, in the preceding table, the logarithm of 20 is 1·301030, of which 1 is the index or characteristic, and ·301030 is the decimal part or mantissa.

41. From the skeleton tables and the preceding articles, it is evident (1.) that the index of the logarithm of every number between 0 and 10 is 0; the index of the logarithm of every number between 10 and 100 is 1; the index of the logarithm of every number between 100 and 1000 is 2; and so on. Hence, generally, *the index of the logarithm of every integer is a number less by unity than the number of figures which it contains.* The index of the logarithm of a mixed number, being determined solely by its number of figures, is, of course, not affected by the decimal.

42. (2.) The index of the logarithm of every decimal of which the highest place is tenths is -1; the index of the logarithm of every decimal of which the highest place is hundredths is -2; thousandths, -3; and so on. Hence, generally, *the index of the logarithm of every decimal is a number denoting its highest place, with a negative sign attached to it.* The use of this sign, which is usually written *above* the index, is to indicate that when the logarithm of a decimal is added, its index is to be subtracted, and when the logarithm of a decimal is subtracted, its index is to be added.

43. In tables of logarithms, only the decimal parts or mantissæ of the logarithms of the natural numbers are printed; hence, the preceding rules for supplying their indices are indispensably necessary for the purpose of calculation. To facilitate this process, however, the following table is added:—

TABLE OF INDICES OF LOGARITHMS.

Part I.

For Integers.	Indices.	For Integers.	Indices.
Units	0	Tens of Millions . . .	7
Tens	1	Hundreds of Millions . .	8
Hundreds	2	Thousands of Millions . .	9
Thousands	3	Tens of Thousands of Millions	10
Tens of Thousands . .	4	Hundreds of Thousands of Millions	11
Hundreds of Thousands . .	5	etc.	etc.
Millions	6		

Part II.

For Decimals.	Indices.	For Decimals.	Indices.
Tenths	$\bar{1}$	Hundredths of Millionths .	$\bar{8}$
Hundredths	$\bar{2}$	Thousandths of Millionths .	$\bar{9}$
Thousandths	$\bar{3}$	Tenths of Thousandths of Millionths	$\overline{10}$
Tenths of Thousandths .	$\bar{4}$	Hundredths of Thousandths of Millionths. . .	$\overline{11}$
Hundredths of Thousandths.	$\bar{5}$	etc.	etc.
Millionths	$\bar{6}$		
Tenths of Millionths . .	$\bar{7}$		

44. As an additional illustration of the principles on which

the indices of logarithms are supplied, the following table is added; it shows the change that takes place in the index of the logarithm of a number by merely lowering its value in the decimal scale of notation:—

Numbers.	Logarithms.	Numbers.	Logarithms.
100200 . .	5·000868	·1002 . .	$\bar{1}$·000868
10020 . .	4·000868	·01002 . .	$\bar{2}$·000868
1002 . .	3·000868	·001002 . .	$\bar{3}$·000868
100·2 . .	2·000868	·0001002 . .	$\bar{4}$·000868
10·02 . .	1·000868	·00001002. .	$\bar{5}$·000868, etc.
1·002 . .	0·000868		

45. The preceding tables and remarks clearly show the advantages which the common system of logarithms possesses over every other, in consequence of its base being the same as the root of the decimal scale of notation. By merely increasing or diminishing by unity the index of the logarithm of a number, the logarithm of a decimal multiple or sub-multiple of that number is immediately obtained. Hence, the calculation of the logarithm of one number is sufficient for the determination of innumerable others; for, by tabulating the decimal parts of the logarithms of all integers from 1 to 10,000, or from 1 to 100,000, etc., the complete logarithms of such numbers can easily be found, whether they be considered as integers, decimals, or mixed numbers; the proper indices being supplied according to the foregoing rules.

46. A system of logarithms founded on any other base but 10 would want all the advantages above-mentioned. The logarithms of all such numbers as are determined by the mere change of the index in the common system, would require to be separately calculated and tabulated with their indices. The logarithms of all fractions, as well as integers, and the logarithms of all numbers of which the factors were powers of the base, would require the same operation to be performed. For though, in the latter case, the calculation of the logarithms would be as easy as before, yet their tabulation with indices would still be necessary, as the bare inspection of the numbers themselves would not be sufficient to suggest the proper index as in the common system. The disadvantages would be even more strongly felt in the reverse operation of finding from the tables the number corresponding to any given logarithm.

47. In addition to the decimal parts of the logarithms of the common system, which are given in tables of logarithms, the average differences of every five logarithms are usually given in an adjoining column, for the purpose of rendering it easy to obtain the approximate logarithms of numbers greater than those contained in the table. The approximate logarithms of such numbers are obtained on the principle, that the differences of numbers which differ *little* from each other are *nearly* proportional to the differences of their logarithms. Thus in Part I. of the Third Skeleton Table, Art. 32, the successive difference of the numbers 1·00056, 1·00028, and 1·00014, are ·00028 and ·00014; and the differences of their logarithms are ·000122 and ·000061; now, the following proportion is correct, as far as the decimals extend:—

$$\cdot00028 : \cdot00014 :: \cdot000122 : \cdot000061.$$

But were the decimals further extended, this proportion would be found to be only *nearly* correct. The application of the principle thus established, however, is sufficiently correct for all practical purposes.

LESSONS IN FRENCH.—LXXXVII.

§ 144.—Analogy between many English and French Words.

(1.) Most words ending in **al, ce, de, ge, le, ne, ant, ent, ion,** are the same in both languages:—

al	Minéral, général, animal, principal, fatal.
ce	Race, prudence, notice, sacrifice, édifice.
de	Parade, grade, ambuscade, parricide, prélude.
ge	Courage, page, vestige, orange, déluge.
le	Docile, capable, table, possible, fertile, ridicule.
ne	Doctrine, mine, scène, famine, machine, héroïne.
ant	Dormant, vigilant, constant, instant, arrogant.
ent	Présent, content, accident, président, résident.
ion	Question, fraction, légion, pension, religion.

(2.) Most words ending in **ary, ory, gy, ncy, ty, ous, or, our, ine, ive,** become French by changing—

ary	into	**aire**	Nécessaire, militaire.
ory	„	**oire**	Mémoire, gloire, victoire.
gy	„	**gie**	Énergie, géologie, effigie.
ncy	„	**nce**	Clémence, décence, excellence, constance.
ty	„	**té**	Charité, pureté, divinité.
ous	„	**eux**	Industrieux, curieux, fameux.
or, our	„	**eur**	Candeur, ardeur, acteur, docteur.
ine	„	**in**	Masculin, féminin, clandestin.
ive	„	**if**	Actif, passif, massif.

English feminine names ending in **a**, finish in French in **e**: *Sophia*, **Sophie**.

Note.—Students should not assume that because some French words are more or less similar in spelling to some English words, they are also similar in signification. It is far from being always so. See § 147, table of homonyms and paronyms.

§ 145.—Gallicisms or Idiomatic Phrases.

Gallicisms, or idioms peculiar to the language, are very numerous in French. We have already in the first part of these lessons presented a considerable number of such expressions, and will here give a somewhat extended list of those not placed in the examples and exercises. In proverbial sayings, we have endeavoured to give the equivalent English phrase. We would advise the student to analyse carefully the following idiomatic sentences, and particularly those which do not admit of a literal or near translation. Idioms and proverbial phrases give a great insight into the character and customs of a nation, and their analysis is often of great assistance in the acquisition of a language:—

Ce piano n'est pas d'accord.	*This piano is out of tune.*
Arrangez cette affaire à l'amiable.	*Settle that business amicably.*
Nous sommes d'accord sur ce point.	*We agree upon that point.*
Quel âge donneriez-vous à cet homme?	*How old would you take that man to be?*
Cela fera bien mon affaire.	*That will suit me exactly.*
Allons au fait.	*Let us come to the point.*
Vous mettez ma patience à bout.	*You exhaust my patience.*
Ce sont deux têtes dans un bonnet.	*They are both of the same mind.*
Vous avez toujours ces propos à la bouche.	*You always use those expressions.*
Entre nous soit dit, ce n'est pas la mer à boire.	*Between ourselves, the thing is not so very difficult.*
Vous ne savez plus de quel bois faire flèche.	*You are put to your last shift. You are at your wit's end.*
J'avais ce mot sur le bout des lèvres.	*I had that word at my tongue's end.*
C'est son bras droit.	*He is his right hand.*
Il nous a fermé la porte au nez.	*He shut the door in our face.*
Vous allez toujours droit au but.	*You come always to the main point.*
En tout cas, je leur remettrai votre lettre.	*At all events, I will give them your letter.*
Ne voyez-vous pas qu'il rit sous cape?	*Do you not see that he laughs in his sleeve?*
Nous avons piqué des deux.	*We put spurs to our horses.*
Nous en sommes sur ce chapitre.	*We are speaking about this matter.*
Oh! pour le coup, vous avez raison.	*Oh! for this time you are right.*
Cet orateur bat la campagne.	*That speaker wanders from his subject.*
Parlez-moi à cœur ouvert.	*Speak to me without reserve, openly.*
Nous avons couché à la belle étoile.	*We slept in the open air.*
Je n'ai que faire de son argent.	*I do not want his money.*
J'ai fait si bien mon compte, que j'ai obtenu cet argent.	*I managed matters so well, that I obtained that money.*
Cela ne me fait rien du tout.	*That is nothing at all to me.*
Faites-moi grâce de tous ces détails.	*Spare me all those particulars.*
C'en est fait.	*It is all over. All is gone.*
Comme vous voilà fait!	*What a condition you are in!*
Il m'a prié de vous faire ses amitiés.	*He wished me to give his love to you.*
En attendant, faites-lui mes compliments.	*In the mean while, present my compliments to him.*
Chemin faisant, nous le rencontrâmes.	*Going along, we met him.*
Le plus fort est fait.	*The most difficult part is done.*
Ce soldat n'a jamais vu le feu.	*That soldier has never smelt gunpowder.*
Il s'est bien tiré d'affaire.	*He came off very well.*

Nous sommes au fort de l'hiver.	*We are in the depth of winter.*
Qu'allait-il faire dans cette galère ?	*What business had he there?*
C'est un homme comme il faut.	*He is a gentleman.*
Ce drap est hors de prix.	*That cloth is extravagantly dear.*
Il se fit jour à travers les ennemis.	*He forced his way through the enemy.*
Je vois cela dans un autre jour.	*I see that in a different light.*
Dites-moi au juste ce qu'il en est.	*Tell me exactly how the matter stands.*
Il ne laisse pas de dépenser beaucoup.	*He spends a great deal, nevertheless.*
C'est une autre paire de manches.	*That is quite another thing.*
C'est un tour de son métier.	*That is one of his tricks.*
Vous l'avez mis au pied du mur.	*You left him no excuse.*
Voilà qui va le mieux du monde.	*That is going on finely.*
Revenons à nos moutons.	*Let us resume our subject.*
Cela est d'un bon naturel.	*That bespeaks a good disposition.*
Ces arbustes grandissent à vue d'œil.	*Those shrubs grow visibly.*
Je regarde cela d'un autre œil.	*I look upon that in a different light.*
Il a vendu sa montre pour un morceau de pain.	*He sold his watch for a mere song.*
Vous lui avez donné la monnaie de sa pièce.	*You paid him in his own coin.*
Il a trouvé à qui parler.	*He met with his match.*
Vous êtes un homme de parole.	*You are a man of your word.*
Je lui ai coupé la parole.	*I cut him short.*
Vous avez cela sur le cœur.	*You cannot digest that.*
Il se creuse la cervelle.	*He racks his brain.*
Le jeu n'en vaut pas la chandelle.	*The toll is more than the grist.*
Vous avez pris le change.	*You started upon the wrong scent.*
Chansons que tout cela.	*That is all nonsense.*
Les bons comptes font les bons amis.	*Short reckonings make long friends.*
Il met la charrue devant les bœufs.	*He puts the cart before the horse.*
Vous bâtissez des châteaux en Espagne.	*You build castles in the air.*
Je suis au comble de la joie.	*I am overjoyed.*
Ce n'est pas à vous de lui reprocher sa faute.	*It does not become you to reproach him with his fault.*
Il est tombé de Charybde en Scylla.	*He fell from the frying-pan into the fire.*
Cet homme cherche à vous en conter.	*That man is trying to deceive you.*
Nous sommes en pays de connaissance.	*We are here amongst acquaintances.*
La sentinelle nous coucha en joue.	*The sentinel levelled his gun at us.*
Ce malade n'en reviendra pas.	*That sick man will not recover.*
Nous sommes au courant de tout cela.	*We are perfectly acquainted with all that.*
Cela fait dresser les cheveux.	*That makes one's hair stand on end.*
Ils chantent sur une autre note.	*They have changed their tone.*
Ce vers est frappé au bon coin.	*That verse bears the right stamp.*
Je lui ai donné la clef des champs.	*I set him free.*
Il ne sait où donner de la tête.	*He does not know which way to turn.*
Vous vous donnez toujours raison.	*You pretend to be always in the right.*
Il a donné dans le piége.	*He fell into the snare.*
Cela lui donne de l'humeur.	*That puts him out of temper.*
Je n'entre point là dedans.	*That is no business of mine.*
Il entre dans vos intérêts.	*He interests himself for you.*
Je m'embarrasse fort peu de cela.	*I care very little about that.*
Son amitié est à toute épreuve.	*His friendship will stand any test.*
Vos propos m'échauffent les oreilles.	*Your expressions provoke my anger.*
Finissez ce badinage.	*Put an end to this trifling.*
Reposez-vous-en sur moi.	*Trust to me about this matter.*
Cette marchandise n'a point de débit.	*This article has no sale.*
Il est toujours sur le qui vive.	*He is always on the watch.*
Cette maison est à vendre au plus offrant et dernier enchérisseur.	*That house is to be sold to the highest bidder.*
De quelle part ce domestique vient-il ?	*Who sent that servant?*
Doublons le pas ; il se fait tard.	*Let us mend our pace; it is growing late.*
J'y vais de ce pas.	*I am going thither this moment.*
Passe pour ceci.	*Let this pass.*
Il faut en passer par là.	*We must submit to those terms.*
Vous m'avez peint avec de beaux traits.	*You have given a fine account of me.*
Pour moi, je m'y perds.	*As for me, I cannot see into it.*
Peu s'en fallut qu'il ne me frappât.	*He came very near striking me.*
Dites-moi un peu ce que vous en pensez.	*Just tell me what you think of it.*
Il nous jette de la poudre aux yeux.	*He throws dust into our eyes.*
Vous seriez bien embarrassé, si on vous prenait au mot.	*You would be at a great loss, if you were taken at your word.*
Ne vous en prenez pas à moi.	*Do not blame me about this.*
Le malade n'en pouvait plus.	*The patient was quite exhausted.*
Je l'ai envoyé promener.	*I sent him about his business.*
Le bon homme que c'est !	*What a simple man he is!*
Brisons là-dessus.	*No more of this.*
Il en fut quitte pour la peur.	*He got off for his fear.*
Vous en êtes quitte à bon marché.	*You come off cheaply.*
Cela n'est pas de refus.	*That is not to be refused.*
Je l'ai entrevu ce matin.	*I had a glimpse of him this morning.*
Je ne m'en soucie guère.	*I care but little about it.*
Il a des affaires par dessus la tête.	*He is over head and ears in business.*
Qu'à cela ne tienne.	*That shall not make us disagree.*
A la bonne heure.	*Well and good.*
Tout fin qu'il est, il s'est trompé.	*Cunning as he is, he made a mistake.*
Ce n'est pas là un trait d'ami.	*That is not acting like a friend.*
Trève de compliments.	*No more compliments.*
Je vous vois venir, monsieur.	*I see what you are about, sir.*
Voilà comme vous êtes.	*That is the way with you.*
Tout cela va le mieux du monde.	*All goes on as well as possible.*
Vous n'y êtes pas.	*That is not it.*
Vous voilà bien avancé !	*You are much the better for it.*

§ 146.—French Homonyms and Paronyms.

(1.) Homonyms are words which, having a more or less similar spelling, are sounded in the same manner, but have different significations.

(2.) Paronyms are words differing in spelling, but somewhat similar in pronunciation, and having different significations.

Note.—For homonyms of different genders, see § 7.

French Words.	Meaning in English.	French Words.	Meaning in English.
A.		Août, *nm.* (a silent)	*August (month).*
Accord, *nm.*	*accord, agreement, concord,* (mus.) *chord, straine.*	Houe, *nf.*	(agri.) *hoe.*
		Houx, *nm.*	*holly-tree.*
Accore, *nf.*	*prop.*	Ou, *conj.*	*or.*
Accort, *adj.*	*good-humoured.*	Où, *adv.,pron.*	*where; in which.*
Acre, *nm.*	*acre.*	Appas, *nm.*	*charms, attractions; allurement.*
Âcre, *adj.*	*acrid.*		
		Appât, *nm.*	*bait.*
Aine, *nf.*	*groin.*		
Haine, *nf.*	*hatred.*	Après, *prep.*	*after.*
		Apprêt, *nm.*	*preparation; dressing; cooking.*
Air, *nm.*	*air.*		
Aire, *nf.*	*thrashing-floor, superfices; aerie, eyry.*	Archer, *nm.*	*archer, bowman.*
Haire, *nf.*	*sackcloth-shirt.*	Archet, *nm.*	*fiddlestick, bow.*
Hère, *nm.*	*sorry fellow; poor wretch.*		
		Are, *nm.*	*are* = 119.6046 *sq. yds.*
Ère, *nf.*	*era.*		
		Arrhes, *nf. pl.*	*earnest-money.*
Alène, *nf.*	*awl.*		
Haleine, *nf.*	*breath.*	Art, *nm.*	*art.*
		Hart, *nf.*	*withe; rope, halter.*
Aller, *v.*	*to go.*		
Haler, *v.*	*to haul, to heave; to set to (dogs).*	Aulx (*plur. of* ail), *nm.*	*garlic.*
Hâler, *v.*	*to burn, to tan (of the sun).*	Eau, *nf.*	*water;*
		Haut, *adj.nm.*	*high; top.*
Allié, *nm.*	*ally.*	Os, *nm.*	*bone.*
Hallier, *nm.*	*thicket.*		
		Auspice, *nm.*	*auspice, omen, presage.*
Amande, *nf.*	*almond, kernel.*		
Amende, *nf.*	*fine, penalty.*	Hospice, *nm.*	*alms-house; asylum.*
Ami, *nm.*	*friend.*	Autan, *nm.*	*south wind; auster.*
Amict, *nm.*	*amice, amict.*	Autant, *adv.*	*as much; as many.*
Anche, *nf.*	*reed, mouth-piece of a hautboy; pipe of an organ.*	Autel, *nm.*	*altar.*
		Hôtel, *nm.*	*hotel, inn; mansion.*
Hanche, *nf.*	*hip.*	Auteur, *nm.*	*author, writer.*
		Hauteur, *nf.*	*height; haughtiness.*
Ancre, *nf.*	*anchor.*		
Encre, *nf.*	*ink.*	Avant, *prep.*	*before.*
		Avent, *nm.*	*advent.*
Anoblir, *v.*	*to raise to the peerage.*		
Ennoblir, *v.*	*to ennoble.*	Aveuglement, *nm.*	*blindness.*
Antre, *nm.*	*cave, den, cavern.*	Aveuglément, *adv.*	*blindly.*
Entre, *prep.*	*between.*		

RECREATIVE SCIENCE.—XVIII.

THE ASTROMETROSCOPE—THE THAUMATROPE—THE PEDEMASCOPE.

In the last paper the principle of the astrometroscope, an instrument for producing elaborate patterns by the movement of star-like figures, was alluded to and illustrated by Pilkington's simple contrivance. The apparatus called the astrometroscope was devised and constructed by Mr. Pichler, and consists of a metallic plate, in which a number of perforations in the form of stars at equal distances from each other are made, like a wall-paper with stars on it; and when fitted into the lantern and exhibited by the oxy-hydrogen light, white stars are apparent on a black ground, or that part of the disc which is not illuminated. The first effect is produced by quickly moving the perforated star-plate diagonally, when each point of light or star-like figure leaves a track of light, similar to a meteor, and the effect on the disc is that of a number of diagonal lines moving rapidly, every line or track of light being perfectly distinguishable the one from the other. The next change is effected by imparting a general circular motion, and if the star figures were subjected only to this movement they would merge one into the other, there would appear so many circles of light and dark bands, and no other result could be obtained.

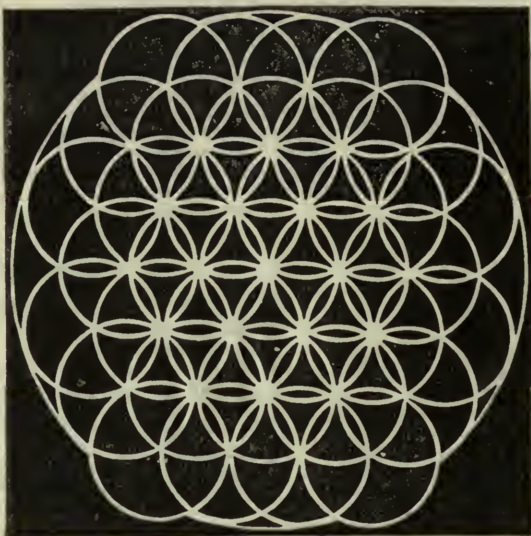


Fig. 1.

In this apparatus the movements are different, and the operator can at pleasure impart either a diagonal, circular, perpendicular, or horizontal motion, or a combination of them all. Thus a multiplication of well-known forms can be projected on the disc, such as straight lines, then the same lines thrown into waves, next into parabolic curves, circles with star-like figures in the central portions (shown in Fig. 1), elliptical figures, or oblate spheroids.

Just as the kaleidoscope, with constant movement, may produce by reflection an endless variety of figures, so the astrometroscope, on a different principle—viz., by the formation of tracks of light left upon the vision after a variety of complicated movements of points of light—forms an endless series of line patterns. The observer is reminded of those beautiful geometrical figures obtainable by the slide-rest and overhead motion attached to the most expensive lathes.

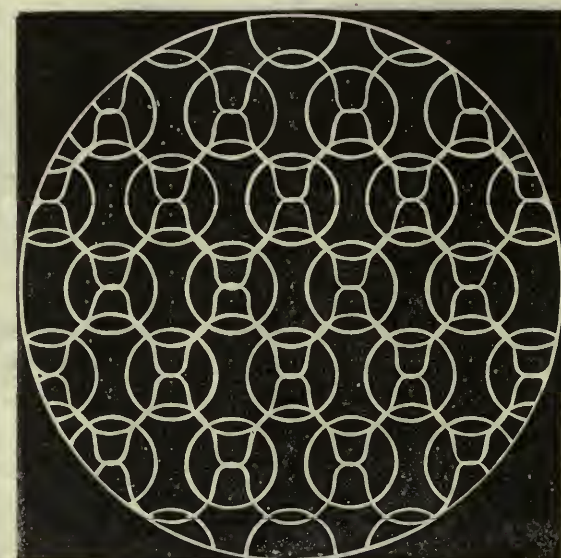


Fig. 2.

A large book might be devoted to the illustration of the various designs obtainable from the astrometroscope; space alone must limit the drawings of these figures to one more example (Fig. 2). This pattern looks like a piece of crochet-work, the crossed loops in the circles and portions of circles in the oval figures being very curious, and only equalled by other effects, in which the lines appear like shelves or thin boards, one above the other, each shelf having so many circles upon it, and moving half round horizontally and returning again to its former position, as if the shelves were on pivots; or the lines become perpendicular, and perform the same curious motion at right angles to the former ones. In fact, it takes a quarter of an hour to show all the figures obtainable, even when the operator makes the changes as rapidly as possible, consistent with the separate exhibition of each pattern. Indeed, we might say with Pope, in showing how cleverly art, in the astrometroscope, may imitate Nature's meteors—

> "All Nature is but art unknown to thee;
> All chance, direction which thou canst not see;
> All discord, harmony not understood;
> All partial evil, universal good."

A learned physician, Dr. Paris, appears to have been the first who specially directed attention to those more amusing effects in which we seem to be able to look through an opaque substance and see both sides of a piece of board or card upon which different designs are painted. He wrote a little book on "popular science," to which he gave the happy title of "Philosophy in Sport made Science in Earnest." It is written in the dialogue style, and is somewhat pedantic, for the worthy doctor will trot out his classics, as much as to say, "Don't think I wish to put the learning of science before the acquisition of Latin and Greek." At page 376, he thus introduces what he calls his new invention, forgetting that from time immemorial children had twirled round coins and seen both sides at the same time. But let Dr. Paris speak for himself. His preface runs thus:—"A new Optical Toy, invented by the Author, and termed the Thaumatrope—Explanation of its Principle — Retentive Power of Retina":—

Tom's holidays were now drawing to a close, and the children were summoned into the library to receive their last lesson in philosophy.

"You have lately witnessed an experiment," said Mr. Seymour, "which must have convinced you how liable the ear is to be deluded with respect to the nature and direction of sound; I shall now show you that the eye has also its sources of fallacy."

"If you proceed in this manner you will make us Cartesians,"* exclaimed the Vicar.

"I shall illustrate my subject by means of a toy which *I have lately invented*," said Mr. Seymour; "and, unless I am much mistaken, it will afford as much amusement to the elder as to the younger members of our party, although the Vicar may perhaps regard it as a more hostile instrument than even that of the wooden horse which filled unhappy Troy with an armed enemy. It is a small machine," continued Mr. Seymour, "which is well calculated to furnish us with some capital puns and well-pointed epigrams."

"With puns!" exclaimed the horrified Vicar, who no sooner heard this appalling declaration than, like another Laocoon, he deprecated the introduction of the *donum exitiale* (hurtful gift) within the walls of Overton Lodge. But his hostility was soon disarmed, not by the

* The Cartesians maintained that the senses were the great sources of deception; that everything with which they present us ought to be suspected as false, or at least dubious, until our reason has confirmed the report.

circumvolutions of a snake round the body of the enraged orator, but by the embraces of little Rosa, who threw her arms around the neck of the Vicar with such supplicating grace that at length he exclaimed, "Well, well; if it be the decree of the Fates I must submit."

During this altercation, Mr. Seymour had procured the "wooden engine" from his study.

"I will first," said he, "exhibit the toy in its original state, and then show you the improvements which have been effected in it."

"Let us hear the account of its operation," said the Major, "which I perceive is enclosed within the box."

"True," replied Mr. Seymour; "and I think you will agree that I have given a very plausible explanation of its effects."

"Plausible," muttered the Vicar —"plausible enough, no doubt; oh, the Sinon!" (*Illusive* is the synonym of *plausible*.)

Mr. Seymour then proceeded: "This toy is termed the Thaumatrope."

"Of Grecian origin!" observed the Vicar. "'*Timeo Danaos et dona ferentes*,' as Virgil has it."

"What is the meaning of the term?" asked Louisa.

The Vicar explained to her that it was compounded of the Greek words θαῦμα and τρεπω, the former of which signified *wonder*, and the latter *to turn*.

"Exactly," replied Mr. Seymour, "*a wonder-turner*, or a toy which performs wonders by turning round. But let me proceed in the explanation." He then continued to read as follows: "This philosophic toy is founded upon the well-known optical principle that an impression made on the retina of the eye lasts for a short interval after the object which produced it has been withdrawn. During the rapid twirling of the card, the figures on each side are presented with such quick transition that they both appear at the same instant, and thus occasion a very striking and magical effect. On each of these cards a device is introduced, with an appropriate motto or epigram, the point of which is announced or explained by the change which the figure assumes during the rapid whirling of the card."

"It may be very clever," said the Vicar, "but I do not understand it."

"But you shortly will. Look at one end of the card." Mr. Seymour then displayed a pasteboard circle, on one side of which was figured a rat, and on the other a cage. Two strings were fastened in its axis, by which the card could easily be made to revolve by means of the thumb and finger. . . . No sooner had Mr. Seymour put the card in motion than the Vicar, in the tone of the greatest surprise, exclaimed, "Magic! magic! I declare the rat is in the cage!"

Dr. Paris's description of his toy and the effect obtained will be endorsed by all those who have tried the experiment, and it is usually found that plain black objects on a white ground show better than any coloured devices.

The original thaumatrope was subsequently modified and improved by the inventor, so that not only were two figures made apparent as if painted on one side of the card, but motion was seemingly imparted to them.

The improvements consisted in attaching *two* strings, one being elastic, in one or both sides of the circular cardboard, which, being united at a distance of an inch or two from the latter, would afford when twirled and pulled a variety of motions in consequence of the axis upon which the card turns being constantly changed. Thus, a card with a jockey on one side and a horse on the other, on spinning round, presented the combined figure; on tightening the elastic string in the manner described, the card changed its axis without the slightest halt or hesitation in its rotation, and the rider was in an instant canted over the head of his charger; in a moment, however, he appeared remounted; after which, by pulling the elastic string with different degrees of force, he was made to stand on the saddle, and to exhibit a number of different movements.

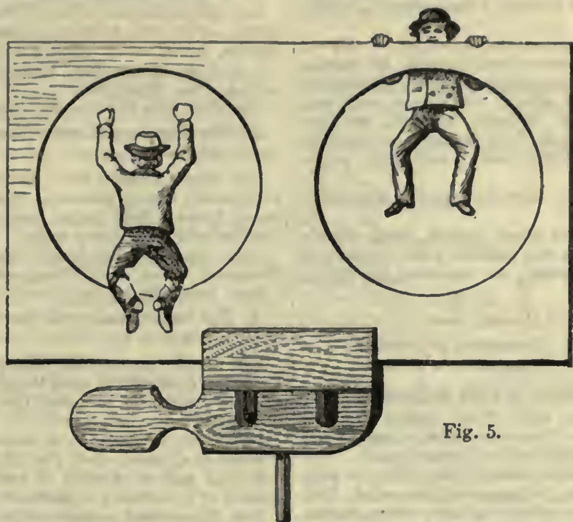


Fig. 5.

The Rev. Richard Pilkington registered some years ago a very excellent and simple modification of the thaumatrope, which he called the *Pedemascope*, from the Greek πηδημα (pe-de'-ma), *a spring* or *bound*, and σκοπεω (skop'-e-o), *I view*, which is capable of seven distinct applications of figures and devices —viz., engraved, embossed, relievo, stamped out or stencil, duplicate, swinging, and transparent devices. The stencil or transparent figures may be used in the magic lantern, and are so constructed as to change their position apparently on being reversed, and by a semi-rotation only apparent movements are obtained.

The little toy consists of a piece of mahogany, like half a hair-brush (A B, Fig. 3), in which two hollow spaces, C, C", are cut out, and between them a hole is bored to take the brass pin, P, carrying the upper slip of mahogany, D D, grooved to receive the various pictures; and in order to prevent D D from turning quite round, a bit of iron is inserted, as seen in the hollow C". In this design the card has the same picture painted in two different positions (Figs. 3 and 4) on both sides, and when the brass pin, B, is twirled with one hand, the handle, A, being held in the other, the motions of the cobbler, as shown in Figs. 3 and 4, are very distinctly seen.

Fig. 4.

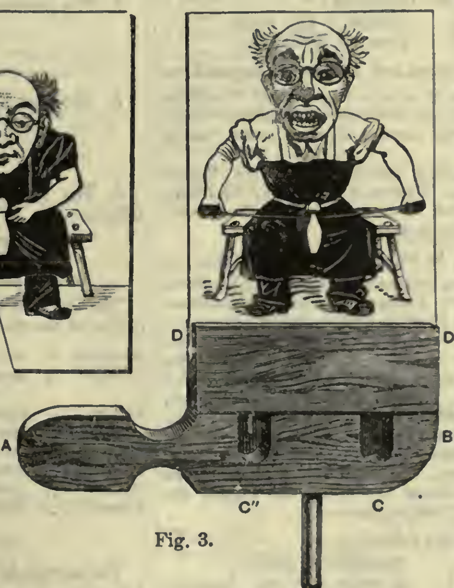


Fig. 3.

In the cut-out or stencil designs, the pedemascopic or springing motion is very well shown, the two boys delineated in Fig. 5 appearing to jump up and down and across the cut-out or open circular aperture with great precision when the brass pin is twirled half round.

Besides the contrivances that have been described and illustrated in this page, there are numerous other optical toys that owe the pleasing illusions they convey to the optic nerve to the principle of persistence of vision, or the retention of the image of the object on the retina after the object itself has passed beyond or out of the field of vision. The Zoetrope, or Wheel of Life, is one of the toys that can be explained upon this principle. Its construction may be thus briefly described. A long strip of paper, on which an object is represented in different positions, is placed within a cylinder having long narrow slits at intervals in the upper part of it. The cylinder is made to rotate rapidly, and the eye of the beholder is directed to the interior through the slits. As the cylinder revolves, each variation of the figure is imprinted on the retina in turn, and in this way an impression is produced on the mind of the spectator that *all* the figures in the cylinder are in active and rapid motion.

LESSONS IN ITALIAN.—XXXVIII.

IRREGULAR VERBS OF THE THIRD CONJUGATION (*continued*).

8. The irregular verb *seguíre*, to follow, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Seguíre, *to follow.—Pres. Gerund.* Seguéndo, *following.—Past Part.* Seguíto, *followed.——Compound Tenses.—Past.* Avére seguíto, *to have followed.—Past Gerund.* Avéndo seguíto, *having followed.*

IND. *Pres.* Séguo *or* siéguo, ségui *or* siégui, ségue *or* siégue; seguiámo, seguíte, séguono *or* siéguono.—*Imp.* Seguíva *or* seguía, seguívi, seguíva or seguía; seguivámo, seguiváte, seguívano *or* seguíano. —*Ind. Pret.* Seguíi; seguísti; seguì *or* seguío. Seguímmo; séguíste; seguírono, seguíro, *or* seguír.—*Fut.* Seguirò, seguirái, seguirà; seguirémo, seguiréte, seguiránno.—*Cond. Pres.* Seguiréi *or* seguiría; seguirésti; seguirébbe *or* seguiría. Seguirémmo; seguiréste; seguirébbero, seguiríano, *or* seguiríeno.

IMP. Ségui *or* siégui, ségua *or* siégua; seguiámo, seguíte, séguano *or* siéguano.

SUB. *Pres.* Che ségua *or* siégua; che ségua, siégua, ségui, siégui; che ségua *or* siégua. Che seguiámo; che seguiáte; che séguano *or* siéguano.—*Imp.* Che seguíssi, che seguíssi, che seguísse; che seguíssimo, che seguíste, che seguíssero.

After this example conjugate the following:—

Conseguire, *to obtain.*	Perseguire, *to persecute.*
Inseguire, *to run after*	Proseguire, *to prosecute.*

9. The irregular verb *udíre*, to hear, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Udíre, *to hear.—Pres. Gerund.* Udéndo, *hearing.—Past Part.* Udíto, *heard.——Compound Tenses.—Past.* Avére udíto, *to have heard.—Past Gerund.* Avéndo udíto, *having heard.*

IND. *Pres.* Ódo, ódi, óde; udiámo, udíte, ódono.—*Imp.* Udíva *or* udía, udívi, udíva *or* udía; udivámo, udiváte, udívano *or* udiáno.—*Ind. Pret.* Udíi; udísti; udì *or* udío. Udímmo; udíste; udírono, udíro, *or* udír. —*Fut.* Udirò *or* udrò, udirái *or* udrái, udirà *or* udrà; udirémo *or* udrémo, udiréte *or* udréte, udiránno *or* udránno.—*Cond. Pres.* Udiréi *or* udréi, udirésti, udirébbe *or* udiría; udirémmo, udiréste, udirébbero.

IMP. Ódi, óda; udiámo, udíte, ódano.

SUB. *Pres.* Che óda, che óda, che óda; che udiámo, che udiáte, che ódano.—*Imp.* Che udíssi, che udíssi, che udísse; che udíssimo, che udíste, che udíssero.

After this example conjugate the following:—

Disudire, *to feign not to hear.*	Riudire, *to hear again.*
Fraudire, *to overhear.*	Traudire, *to overhear.*

10. The irregular verb *uscíre*, to go out, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Uscíre, *to go out.—Pres. Gerund.* Uscéndo, *going out.—Past Part.* Uscíto, *gone out.——Compound Tenses.—Past.* Éssere uscíto, *to have gone out.—Past Gerund.* Esséndo uscíto, *having gone out.*

IND. *Pres.* Ésco, ésci, ésce; usciámo, uscíte, éscono.—*Imp.* Uscíva *or* uscía; uscívi; uscíva *or* uscía. Uscivámo; usciváte; uscívano, uscíano, *or* usciéno.—*Ind. Pret.* Uscíi *or* uscì; uscísti; uscì *or* uscío. Uscímmo; uscíste; uscírono, uscíro, *or* uscír.

11. The irregular verb *veníre*, to come, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Veníre, *to come.—Pres. Gerund.* Venéndo, *coming.—Past Part.* Venúto, *come.——Compound Tenses.—Past.* Éssere venúto, *to have come.—Past Gerund.* Esséndo venúto, *having come.*

IND. *Pres.* Véngo *or* végno, viéni, viéne; veniámo *or* vegnámo, veníte, véngono *or* végnono.—*Imp.* Veníva *or* venía; venívi; veníva or venía. Venivámo; veniváte; venívano, veníeno, *or* veníano.—*Ind. Pret.* Vénni, venísti, vénne; venímmo, veníste, vénnero *or* veníro.—*Fut.* Verrò, verrái, verrà; verrémo, verréte, verránno.—*Cond. Pres.* Verréi *or* verría, verrésti, verrébbe or verría; verrémmo, verréste, verrébbero.

IMP. Viéni, vénga; veniámo, veníte, véngano.

SUB. *Pres.* Che vénga, che vénga, che vénga; che veniámo, che veniáte, che véngano.—*Imp.* Che veníssi *or* venéssi, che veníssi, che venísse; che veníssimo, che veníste, che veníssero.

After this example conjugate the following:—

Avvenire, *to happen.*	Pervenire, *to attain.*
Convenire, *to agree.*	Rivenire, *to return.*
Divenire, *to become.*	Sopravvenire, *to come unexpectedly.*
Invenire, *to find.*	Svenire, *to faint away.*

IMPERSONAL VERBS.

Impersonal verbs are those which have only the third person singular, and whose subject is unknown and cannot be supplied by a noun.

The following are impersonal:—

Baléna, *it lightens.*	Dilúvia, *it rains very hard.*	Névica, *it snows.*
Bisógna, *it is necessary.*	Ghiáccia, *it freezes.*	Pióve, *it rains.*
Dighiáccia, *it thaws.*	Grándina, *it hails.*	Tuóna, *it thunders.*

Several other verbs become impersonal. They are as follow:—

Appartiéne, *it belongs.*	Impórta, *it concerns.*
Avviéne, *it happens.*	Léce, *it is permitted.*
Conviéne, *it becomes.*	Páre, *it seems.*
Básta, *it suffices.*	C' ò *or* v' è, *there is.*

CONJUGATION OF THE IMPERSONAL VERBS.

1. The impersonal verb *pióvere*, to rain, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Pióvere, *to rain.—Pres. Gerund.* Piovéndo, *raining.—Past Part.* Piovúto, *rained.——Compound Tenses.—Past.* Avére piovúto, *to have rained.—Past Gerund.* Avéndo piovúto, *having rained.*

IND. *Pres.* Pióve.—*Imp.* Piovéva.—*Ind. Pret.* Piovè.—*Fut.* Pioverà. —*Cond. Pres.* Pioverébbe.

SUB. *Pres.* Che pióva.—*Imp.* Che piovésse.

2. The impersonal verb *bisognáre*, to be necessary, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Bisognáre, *to be necessary.—Pres. Gerund.* Bisognándo, *it being necessary.—Past Part.* Bisognáto, *needed.——Compound Tenses.—Past.* Avére bisognáto, *to have needed.—Past Gerund.* Avéndo bisognáto, *having needed.*

IND. *Pres.* Bisógna.—*Imp.* Bisognáva.—*Ind. Pret.* Bisognò.—*Fut.* Bisognerà.—*Cond. Pres.* Bisognerébbe.

SUB. *Pres.* Che bisógni.—*Imp.* Che bisognásse.

3. The impersonal verb *ésserci* or *esservi*, to be there, is thus conjugated:—

INF. *Simple Tenses.—Pres.* Ésserci *or* ésservi, *to be there.—Pres. Gerund.* Esséndoci *or* esséndovi, *being there.——Compound Tenses.—Past.* Ésserci *or* ésservi státo, *to have been there.—Past Gerund.* Esséndoci *or* esséndovi státo, *having been there.*

IND. *Pres.* C' è *or* v' è; ci sóno *or* vi sóno.—*Imp.* C' éra *or* v' éra; c' érano *or* v' érano.—*Ind. Pret.* Ci fù *or* vi fù; ci fúrono *or* vi fúrono. —*Fut.* Ci sarà *or* vi sarà; ci saránno *or* vi saránno.—*Cond. Pres.* Ci sarébbe *or* vi sarébbe; ci sarébbero *or* vi sarébbero.

IMP. Ci *or* vi sía, *or* síaci *or* síavi; ci *or* vi síano, *or* síanci *or* síanvi.

SUB. *Pres.* Che ci sía *or* vi sía; che si síano *or* vi síano.—*Imp.* Che ci fósse *or* vi fósse; che ci fóssero *or* vi fóssero.

THE PARTICIPLE.

The participle is a word which possesses the qualities both of the verb and the adjective.

Participles are of three kinds: present, past, and future.

1. The present participle terminates in *ándo* or *éndo*; as:—

Amándo, *loving.*
Credéndo, *believing.*
Servéndo, *serving.*

2. The past participle ends as follows in the regular verbs:—

Amáto, -a, amáti, -e, *loved.*
Credúto, -a, credúti, -e, *believed.*
Servíto, -a, servíti, -e, *served.*

3. The participle future is not so often used. It is as follows:—

Avére ad amáre, éssere per amáre, *being about to love.*
Avére a crédere, éssere per crédere, *being about to believe.*
Avére a servíre, éssere per servíre, *being about to serve.*

The Italians are accustomed to syncopate several past participles of the first conjugation; as—

Accóncio	for	acconciáto,	*fitted.*	Mácero	for	maceráto,	*soaked.*
Avvézzo	,,	avvezzáto,	*accustomed.*	Nétto	,,	mettáto,	*wiped.*
				Págo,	,,	pagáto,	*paid.*
Cárico	,,	caricáto,	*laden.*	Prívo	,,	priváto,	*deprived.*
Créspo	,,	crespáto,	*curled.*	Sálvo	,,	salváto,	*saved.*
Désto	,,	destáto,	*awaken.*	Sázio	,,	saziáto,	*satiated.*
Férmo	,,	fermáto,	*stopped.*	Tócco	,,	toccáto,	*tended.*
Gónfio	,,	gonfiáto,	*swelled.*	Vólto	,,	voltáto,	*turned.*
Lácero	,,	laceráto,	*torn.*	Vuóto	,,	vuotáto,	*emptied.*

THE ADVERB.

The adverb is a word generally joined to a verb, participle, or adjective, to express some circumstance, quality, degree, or manner of its signification.

FORMATION OF ADVERBS.

Italian adverbs are formed from adjectives in three ways, viz.:—

1. By uniting the substantive *mente* to the feminine of the adjectives ending in *a*; as—

Dótto or dótta, *learned*; Dottaménte, *learnedly.*

2. By adding the substantive *mente* to the adjectives ending in *e* not preceded by *l*; as—

Diligénte, *diligent*; Diligenteménte, *diligently.*

3. By joining the substantive *mente* to the adjectives ending in *le* and *re*, which lose their *e*; as—

Fácile, *easy*; Facilménte, *easily*.
Particoláre, *particular*; Particolarménte, *particularly*.

Exception.—Mále, *bad*, makes malaménte, *badly*.

VARIOUS KINDS OF ADVERBS.

Adverbs are of different kinds, as in the following list:—

TIME PRESENT.

In quésto instánte, in questo púnto, in témpo, *this moment.*
In quésto méntre, *just now.*
Óggi, *to-day.*
Óra, adesso, al presénte, *at present.*
Or óra, *directly.*
Presenteménte, *presently.*
Présto, *quick.*
Quésta máne, quésta mattína, sta máne, sta mattína, *this morning.*
Quésta nótte, sta nótte, *to-night.*
Quésta séra, sta séra, *this evening.*
Súbito, *immediately.*

TIME PAST.

Anticaménte, príma, *anciently.*
Di frésco, *recently.*
È grand pézzo, è lúnga pézza, è mólto, è un pezzo, *it is a long time.*
Fra póco, in bréve, *shortly.*
Ier l' áltro or avántieri, *the day before yesterday.*
Ier mattína, *yesterday morning.*
Ier séra, *yesterday evening.*
Il mése passáto, *last month.*
Innánzi, *before.*
L' áltro iéri, *the day before yesterday.*
L' ánno passáto or scórso, *last year.*
Néi témpi andáti, áltre vólte, *formerly.*
Non è guári, non ha guári, *it is not long ago.*
Póco fa, *a little while ago.*
Ultimaménte, da póco in quà, *lately.*

TIME TO COME.

A dománi dúnque, *to-morrow then.*
All' avveníre, *in future.*
Da quì a dúe mési, *in two months' time.*
Dománi a ótto, *to-morrow week.*
Dománi a quíndici, *to-morrow fortnight.*
Dománi mattína, domattína, *to-morrow morning.*
Domán l' áltro, *the day after to-morrow.*
D' óra innánzi, *henceforward.*
Il giórno seguénte, *the next day.*
Il mése ventúro, *next month.*
L' ánno próssimo, *next year.*
La settimána próssima, *next week.*
Óggi a ventidúe, *three weeks hence.*
Posdománi, *the day after to-morrow.*
Quánto prima, *as soon as possible.*

TIME INDEFINITE.

Álle vólte, *sometimes.*
Al più présto, *at the soonest.*
Di bel nuóvo, *again.*
Di bótto, *suddenly.*
Di buon' óra, *early.*
Di contínuo, *continually.*
Di dì in dì, di giórno in giórno, *from day to day*
Di già, *already.*
Di giórno, *by day.*
Di nuóvo or ancóra, *again.*
Di quándo in quándo, di témpo in témpo, trátto, trátto, *from time to time.*
Di rádo, *seldom.*
Fin adésso, fin a quést' óra, fin óra, *hitherto.*
Fra póco, *in a short time.*
Giornalménte, *daily.*
Il più sovénte, *oftener.*
In bréve, in bréve tempo, *shortly.*
In quel méntre, *in the meantime.*
In tempo, *seasonably.*
In un áttimo, *all at once.*
In un bátter d' òcchio, *all of a sudden.*
Mái, *never.*
Méntre, *whilst.*
Non ancóra, *not yet.*
Ógni giórno, *every day.*
Per sémpre, *for ever.*
Per témpo, *early.*
Quálche vólta, *sometimes.*
Quándo, *when.*
Sémpre, *always.*
Spésso, *often.*
Tárdi, *late.*
Tósto or présto, *soon.*

PLACE.

Accánto or a cánto, *by the side.*
A déstra, *on the right.*
Al di là, óltre, *beyond.*
Altróve, *somewhere else.*
A sinístra, *on the left.*
Da ógni dóve, da ógni párte, *on all sides.*
Dappertútto, in ógni párte, *every way.*
Déntro, *in.*
Di diétro, *from behind.*
Di dóve, *whence.*
Di lì, là, *from thence.*
D' intórno, *all around.*
Di quà, *on this side.*
Di quì, quà, *from hence.*
Di sótto, abbásso or giù, *under or below stairs.*
Dónde, *from whence.*
Dóve, *where.*
Fin a quándo, *till when.*
Fin dóve, *till where.*
Fin là, *till there.*
Fin quì, *till here.*
Fuóri, *out.*
Indiétro, *behind.*
In dispárte, a párte, da párte, da bánda, *aside.*
In gíro, *round about.*
In giù, *down.*
Innánzi or avánti, *before.*
In sù, *above.*
Lì, là, colà, *there.*
Lúngi or lontáno, *far.*
Quà e là, *here and there.*
Quì or quà, *here.*
Qui vicíno, *near here.*
Rimpétto, *opposite.*
Sin dóve, *how far.*
Sópra, *upon.*
Sù in álto, di sópra, *above or upstairs.*
Vérso, *towards.*
Vicíno or apprésso, *near.*

ORDER.

A dúe a dúe, *two by two.*
Álla rinfúsa, sossópra, *topsyturvy.*
A úno a úno, *one by one.*
A vicénda, *alternately.*
Dállo fondaménto, *from the foundation.*
Dipói, *then.*
In fíla, *in a row.*
Infíne, álla fíne, *at last.*
In gíro, álla vólta, *by turns.*
In séguito, di séguito, *afterwards.*
Insiéme, *together.*
Príma or primieraménto, *first.*
Sopratútto, *above all.*
Un dópo l' áltro, álla fíla, *one after another.*

QUANTITY AND NUMBER.

Abbastánza, *enough.*
Abbondantémente, *abundantly.*
Alméno, *at least.*
Círca, *about.*
Davvantággio, di vantággio, di più, *some more.*
Dúe vólte, *twice.*
Intieraménte, *quite.*
Méno, *less.*
Mólte vólte, *several times.*
Mólto, *much.*
Niénte, *nothing.*
Niénte affátto, *not at all.*
Non mólto, *not much.*
Per metà, *by half.*
Più, *more.*
Présso a póco, *near abouts.*
Quánte vólte, *how many times.*
Quánto, *how much.*
Quási, *almost.*
Tánte vólte, *so many times.*
Totalménte, del tutto, *entirely.*
Tróppo, *too much.*
Una vólta, *once.*
Un pochettíno, *a little, very little.*
Un póco di méno, *a little less.*
Un póco di più, *a little more.*
Un po' tróppo, *a little too much.*
Un tantíno, *a little piece.*

QUALITY AND MANNER.

A bríglia sciólta, *at full speed.*
A cáso, *by chance.*
A cáso pensáto, *wilfully.*
A cavalcióni, *astraddle.*
A cavállo, *on horseback.*
Accortaménte, sagaceménte, *cunningly.*
A dirótte lágrime, *bitterly.*
Agevolménte, *easily.*
Álla stordíta, *at random.*
All' improvvíso, *unawares.*
All' indiétro, *backward.*
A ménte, *by heart.*
Amichevolménte, *amicably.*
A piédi, *on foot.*
A póco a póco, *little by little.*
A próva, *in emulation.*
A spron battúto, *full speed.*
A tentóne, *groping along.*
A vísta, *in sight.*
Bel béllo, adágio, *softly, gently.*
Béne, *well.*
Carpóne, *upon all fours.*
Cólle buóne, con tútto il cuóre, a búon grádo, per amóre, *willingly.*
Con árte, *artfully.*
Con frétta, *hastily.*
Con ragióne, *rightly.*
Da párte a párte, da bánda a bánda, *through.*
Da sénno, da dovvéro, daddovvéro, *in good earnest.*
Di mála vóglia, *unwillingly.*
Fuór di luógo, *unseasonably.*
Giustaménte, *justly.*
In dúbbio, *in doubt.*
Inginocchióni, *upon one's knees.*
In sospéso, *in suspense.*
Mále, *badly.*
Malgrádo mío, *in spite of me.*
Mirabilmente, a maraviglia, *admirably.*
Per fórza, mal volentiéri, cólle cattiva, *against one's will.*
Per il dritto, *the right way.*
Per il rovéscio, *the wrong side outward.*
Sénza la sapúta, *unknowingly.*
Smisurataménte, *beyond measure.*
Supíno, *on one's back.*
Tacitaménte, *silently.*
Temerariaménte, *rashly.*

AFFIRMATION.

Affè, *in faith.*
Certaménte, di cérto, per cérto, *certainly.*
Davvéro, veraménte, *truly.*
Di sicúro, sicuraménte, *surely.*
In cosciénza, *on my conscience.*
In verità, *in truth.*
Non v' è dúbbio, non v' ha dubbio, *there is no doubt.*
Sì, *yes.*
Sì in verità, *yes, indeed.*
Sénza dúbbio, *without doubt.*
Sénza fállo, *without fail.*

NEGATION.

Affátto, assolutaménte no, *by no means.*
Non del tútto, *not at all.*
Mai, *never.*
Niénte affatto, *not at all.*
Nò, *no or not.*

DOUBT.

Fórse, *perhaps.*
Potrebbe dársi, *it might be.*
Può dársi, può éssere, *it may be.*

COMPARISON.

A guisa, a módo, *like.*
Cóme, *as or like.*
Così, *so or thus.*
Méno, *less.*
Più, *more.*
Più tósto, piuttósto, *rather.*
Siccóme, *as.*
Via più, viappiù, vie più, vieppiù, assái più, *still more.*
Via méno, vie méno, assái méno, *much less.*

INTERROGATION.

Chè, *what.*
Cóme, *how.*
Dóve, *where.*
Perchè, *why.*
Perchè no, *why not.*
Quándo, *when.*
Quánto, *how much.*

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XI.—GREECE.

GREECE presents in its history many contrasts to the other commercial states of antiquity, owing chiefly to its physical conditions. We have seen wealth flow along many converging routes into Babylon and Alexandria, raising those cities to a height of prosperity beyond the reach of rivalry. Geographical position favoured them as commercial centres of exchange. Greece proper, in ancient times, occupied about the same area as the modern kingdom. Washed on three sides by the Mediterranean, and its coast deeply indented, every part of the country is within easy reach of the sea, and, though united to the mainland, its character is insnlar. Off the western coast there is a range of large islands, stretching from Corcyra (Corfu) to Cythera (Cerigo), and on the east lie the Cyclades. The diversity of feature and prodnce which marked this classic soil was reflected in the Greek character and institutions. We possess no anthentic record of the founding of Greece. In its natural characteristics it was eminently original—a land to which the world is indebted for new thoughts, for departure from Oriental monotony. Jnst as passive repose was the ruling principle in Egypt, so restless energy distinguished Greece. It was composed of a number of states, differing in dialect, laws, and industry; but all inspired with the love of freedom and enterprise. Such a people, thus situated, became of necessity colonisers and merchants. No single city of Greece ever contained in itself the wealth of Carthage or Tyre; but the Republic of Athens in its best days attained a prosperity never reached even by Babylon.

There are many allnsions to the early intimate relations between the Greeks and Phœnicians; and monuments have been found in Athens itself, with Phœnician inscriptions, commemorating sojourners from Tyre, Sidon, and Citium, one of which may be seen in the British Museum. Phœnicians opened the Greek mines, and worked them. They supplied the Greeks with tin, which came into extensive use; from the Greeks they obtained polished iron, unwrought iron being procured from Carthage. The Greeks, however, soon assumed the control of their own commerce, shook off their dependence on the Phœnicians, and became their keenest rivals.

Corinth, Elis, Argos, Messenia, and Attica were the leading commercial states, from which colonists spread over the neighbouring archipelago, and multiplied the marts of trade. Colonisation was a distinctive feature of Greek enterprise and policy. Æolian, Doric, and Ionian settlements were founded in Asia Minor, where numerous towns arose, of which Miletns, Ephesus, Smyrna, and Phocea especially, disputed with the Phœnicians the profit of the eastern and western traffic. The famous royal caravan track between Sardis and Susa competed with the maritime route for the treasures of Persia, and all the above cities shared in the proceeds. "Smyrna was the lovely crown of Ionia, the ornament of Asia; and Ephesus was celebrated for its riches and splendour. Miletus was scarcely second to Tyre in luxury and wealth. From it colonists went forth who settled ronnd the Euxine, opening up the traffic of another Mediterranean, and who founded the first Greek station in Egypt. Naucratis on the Nile was established by Milesian traders; Cyrene, in Africa, was likewise founded by the Greeks. Marseilles was a settlement of the Phoceans, the inhabitants still fancifully designating themselves by the ancient name. Tarentum, Sybaris, and Croton were the principal towns that sprang up in Magna Grecia; Syracuse and Agrigentnm the chief in Sicily.

Patriotism cansed the Greeks to extend to their colonies the name of the mother country, and to call the colonists by the common appellation of Hellenes.

The Greeks, like sea-rovers generally, were first indnced to bnild ships for the sake of plunder, rather than of commerce. Thucydides graphically pictures the inhabitants of the shores or the isles as people who, once having risked the jonrney across from one coast to another, grew thievish, and wandering abroad in quest of booty, would fall upon any straggling town, rifle it of everything worth carrying off, and regard the act as glorions. Bred a race of hardy sailors, and afterwards better engaged in colonisation and peaceful commerce, there arose, distinct from the nobility, a wealthy class, holding property, not in lands bnt in portable goods. They congregated in cities, instituted governments for the protection of life and wealth, and continued trading and accumulating riches. When the necessaries of life had been supplied, a taste for comfort and luxury soon arose. Architecture and sculpture, pottery, and work in the precious metals, attained a perfection since emulated in vain. They devoted themselves also to study and contemplation; and Greek philosophers have ever since influenced human thought.

Athens and Corinth were the chief seats of commerce in Greece proper. Athens possessed three harbours, of which the Piræus was the most important. A wall, sixty feet high, and wide enongh for two chariots to run abreast, encircled the port, which was also united to the city by another double wall, five miles long.

Attica did not yield more than half the grain consnmed by the Athenians, and corn was, consequently, the most important commodity imported. It came from Egypt, Palestine, and Sicily; bnt the great granary of Greece was then, as it is now for Enrope, the Crimea and the Ukraine. Thrace and Macedonia sent timber; from Africa came ivory and gold; from Egypt, linen and paper; while the universal custom of selling into bondage the prisoners taken in war provided endless consignments of black and white slaves from the outlying parts of Europe and Africa. A trade in fnrs was carried on with the Scythians north of the Sea of Azov; and from the same people, probably, were procnred gold, horses, and skins.

Athens monopolised Greek commerce for more than 150 years. The chief export trade consisted of wine, oil, figs, wax, and honey, the finest in the world, from Mount Hymettus; and representatives from every mart then known were to be found in the warehonses of the Piræus. The entire freedom of trade permitted by the Athenians attracted to their harbour all the choicest prodnctions of the known world, from the snow-clad regions of the north to the glowing sands of the south. In return, the exquisite creations of Athenian looms, forges, and chisels went forth to ennoble and refine the manners of mankind. The Athenians lavished their magnificence chiefly on temples and pnblic buildings. Their dwellings were comparatively small and nnornamented. The interiors, however, were sumptuonsly furnished and decorated. Babylonian tapestries, Thracian pictnres and chairs, Carthaginian pillows, Corinthian cushions, and specimens of Athenian art, enriched the apartments. The baths were constrncted of marble from Monnt Hymettus; and the dressing-rooms displayed costly fabrics and perfumed reqnisites for the toilet. A levy was laid upon Nature for every delicacy of food and wines, with which to spread the table. Chaste jewellery, of the rarest value, adorned the ladies. The afflnence of the state was only snbdued in its display by that artistic or poetic perception of harmony which the Greeks evinced from their infancy. As many as 10,000 houses and 100,000 citizens, with fonr times that number of slaves, were enumerated when Athens was in its pride.

The city of Corinth had the reputation of being the most luxurious in Greece. Its name has come down to us as indicative of profusion. Its position on the isthmus, uniting the peninsula now called the Morea to the mainland, gave it two harbours, and thus enabled it to command the sea, both towards Italy and Asia Minor. Corinth did not attain its eminence so soon as Athens, but kept it longer. It was a powerful city, as remarkable for its manufactures as its trade, being especially celebrated for metal-work and porcelain. The order of architecture named from the city shows that Corinthian art had reached great perfection. The Romans described the place as containing more statues than any city they had ever taken; and there is a story that during the conflagration which followed its capture, streams of silver and other metals became commingled in the streets to such an extent as to originate a new commercial product, afterwards called Corinthian metal (brass).

Byzantium, the modern Constantinople, was so matchlessly situated that from the day of its colonisation it has never ceased to be an emporium of trade, notwithstanding its many vicissitudes. Salt fish, honey, wax, grain, fat cattle, and slaves, reached it from the Euxine settlements; and it sent, in return, its own produce of oil and wine. Byzantium was important as the terminus of the grand caravan system, to the chief line of which, between Sardis and Snsa, we have already adverted. This traffic placed Byzantium in communication with the Ganges and China, and filled its bazaars with Indian wares and silk fabrics, as well as with pearls and gems, spices and balsams, ivory and gold, and goods of cotton and linen. The commodities sent in exchange consisted of red coral and amber, dredged from the Mediterranean coasts, glass and metal work, and numberless industrial products valued in the East. The island of Crete, for a considerable period, possessed an extensive commerce, and is reported to have contained a hundred cities; but it declined, and fell into decay. The common proverb declared that the "Cretans were always liars," a character inconsistent with sound commercial success.

The island of Rhodes was more celebrated. Its climate was very fine, and its soil produced excellent wines. A statue of Apollo, called the Colossus of Rhodes, is said to have bestridden the mouth of the harbour. Its outstretched hand bore a beacon light, to guide vessels at night. There were 320 tons of brass used in its construction, which took twelve years to complete; it stood 70 cubits or 105 feet high. The Colossus was shattered by an earthquake, B.C. 224, after standing fifty-six years. Fragments of it remained where it fell for nearly a thousand years, when they were removed, on 900 camels, by a Jew, who bought them of one of the generals of Caliph Othman. Rhodes rose from its ruins, and, till the Romans destroyed its freedom, continued to be the chief carrier of the Levant. Miletus, queen of Asiatic Greece, standing near the mouth of the river Meander, boasted of eighty colonies. Its mariners, in order to extend its commerce, ventured beyond the Pillars of Hercules; but its chief settlements were in the Black Sea. It possessed immense flocks, and was noted for its woollen fabrics. It was the emporium for Lydia and Phrygia, and from it the products of these districts were distributed abroad. The city, after offering a vain resistance, was left in ruins by Alexander the Great.

Colonists from Corinth founded Syracuse, which eventually became the capital of Sicily. It was one of the most famous Greek colonies, and its wealth and grandenr were based, as in the parent state, upon commerce. When most prosperons it had a circuit of twenty-two miles, and the splendour of its edifices, built of stone quarried in the neighbourhood, was not snrpassed even by that of Carthage. The Athenians and Carthaginians in turn besieged the city, but each met with a disastrous repulse. Syracuse is celebrated as having been the abode of Archimedes, who for more than two years, by his mechanical devices, aided his fellow-citizens in withstanding the Romans. After its capture by Marcellus, in 212 B.C., Syracnse became the chief town of the Roman province of Sicily.

We are now in a position to consider the benefits which were conferred on the world at large by the commerce and refinements of the Greeks. In this investigation our interest centres in Athens. Spartan pride and roughness must be passed by. The contempt for industry, and the want of sound economy, exhibited in the arbitrary laws of Lycurgus might make a state feared, bnt could not make it truly great or lasting.

Baron Liebig says:—"The source of wealth, trade, and power of the Grecian states, when the latter were in their prime, was a highly-developed and widely-spread industry. Corinth produced what would correspond to Birmingham and Sheffield wares; Athens was the centre of the manufactures which we now find divided between Leeds, Staffordshire, and London, snch as woollen cloths, dyes, pottery, gold and silver utensils, and ships. The citizens were manufacturers on the largest scale—shipowners and merchants, who had their offices and factories along the whole coasts of the Black Sea and the Mediterranean. The men of science were the sons of the citizens, and thus became familiar with trade, mannfacture, and commerce. Thales was a trader in oil, Socrates was a stonemason, Aristotle an apothecary; Plato and Solon were not strangers to trade. In ancient Greece the learned man spoke the same language as the tradesman. The mind of the latter had been as highly cultivated as that of the philosopher, the difference between them consisting only in the direction of their knowledge. Democratic institutions frequently bronght them into personal intercourse. In fact, the thirty-eight chapters of 'Problems' appear to be no other than a series of questions from tradesmen, artists, mnsicians, architects, and engineers, which Aristotle endeavoured to solve, as far as his knowledge enabled him to do. Until the time of Pericles, no other country of the ancient world nnited the necessary conditions for the rise of science as they were found in Greece, owing to its social state and to the intimate relationship that existed between the productive and intellectual classes. *But Greece was a slave state, and in slavery lay the ban which contracted its civilisation within fixed limits that could not be extended.*"

We owe to Greece the invention of coinage. Iron tokens, to which an artificial valne was affixed, were used in Sparta; brass coins were used in other states. Athens from the first issued gold and silver coins, the standard of value being so carefully maintained that they passed current without question in every state.

Licences to follow certain trades originated in Athens, and laws were made to discourage usury. Debtors were severely dealt with. Deliberate fraud was punished with death, and bankrupts were sold and kept in bondage, till they had saved enough to redeem themselves. Plato was in danger of being thus enslaved for debt, but his friends ransomed him. A public register of debts was kept. We must not forget, however, that our own laws not long ago punished forgery and even more venial crimes with death, and caused debtors to be imprisoned for life, without giving them the chance of labouring for their redemption. To Corinth we owe the appointment of consnls at mercantile ports. The consuls were merchants who knew the manners and customs of the people with whom their countrymen had commercial dealings, and who conld be relied on to arbitrate justly when disputes or misnnderstandings arose.

Alexander the Great combined with his love of conqnest a desire to make Greek trade nniversal. He planned the conqnest of the East and Carthage, of Italy and Western Europe, a group of states of which his native land would be the centre, and Babylon the great Asiatic emporium. His career, though cut short at an early age, nevertheless contribnted partially to bring abont this result; inasmuch as the Greek garrisons settling in the places where they were stationed, the language of Greece became widely diffused, and a strong desire arose for commercial intercourse. While their principles retained their pristine vigour, the Athenians and the states they represented remained invincible.

LESSONS IN GERMAN.—LXVIII.

§ 84.—PASSIVE VERBS.

(1.) The passive voice is formed by adding to the auxiliary werden, *to become*, through all its moods and tenses, the perfect participle of the main verb, thus:—

	INDIC. ACTIVE.	INDIC. PASSIVE.
Pres.	Ich lobe, I praise.	Ich werde gelobt, I am praised.
Imp.	Ich lobte, I praised.	Ich wurde gelobt, I was praised.
Perf.	Ich habe gelobt, I have praised.	Ich bin gelobt worden, I have been praised.
Plup.	Ich hatte gelobt, I had praised.	Ich war gelobt worden, I had been praised.
1. *Fut.*	Ich werde loben, I shall praise.	Ich werde gelobt werden, I shall be praised.
2. *Fut.*	Ich werde gelobt haben, I shall have praised.	Ich werde gelobt worden sein, I shall have been praised, etc.

(2.) It will be noted, that wherever the perfect participle of the main verb (as gelobt above) is joined with the participle of the auxiliary, the latter is written worden, not geworden, whereby an offensive repetition (of the syllable ge) is avoided. Sometimes worden is altogether omitted in the past tenses.

(3.) The German, by confining werden with the past participle to the expression of *passivity*, and nsing sein, when the participle is to be taken as a mere *adjective*, has a manifest advantage over the English passive. Thus, if we wish to say in German, *he is feared*, it will be, er wird gefürchtet; if the intention, however, be merely to mark the state or character of the person as one who is feared, that is, whose character or condnct inspires fear generally, the German will be, er ist gefürchtet, he is (a) feared (man). The form of expression in English, it will be observed, is the same for *both* ideas: "he *is* feared."

(4.) The Germans, however, employ the passive form far less freqnently than the English. They prefer other methods; thns, man sagt, one says, *i.e.*, *it is said;* der Schlüssel hat sich gefunden, the key has been fonnd.

§ 85.—PARADIGM OF A PASSIVE VERB.

Gelobt werden, *to be praised.*

IND. *Pres.* Ich werde gelobt, du wirst gelobt, er wird gelobt; wir werden gelobt, ihr werdet gelobt, sie werden gelobt.—*Imp.* Ich wurde gelobt, du wurdest gelobt, er wurde gelobt; wir wurden gelobt, ihr wurdet gelobt, sie wurden gelobt.—*Perf.* Ich bin gelobt worden, du bist gelobt worden, er ist gelobt worden; wir sind gelobt worden, ihr seid gelobt worden, sie sind gelobt worden.—*Plup.* Ich war gelobt worden, du warst gelobt worden, er war gelobt worden; wir waren gelobt worden, ihr waret gelobt worden, sie waren gelobt worden.—*First Fut.* Ich werde gelobt werden, du wirst gelobt werden, er wird gelobt werden; wir werden gelobt werden, ihr werdet gelobt werden, sie werden gelobt werden.—*Second Fut.* Ich werde gelobt worden sein, du wirst gelobt worden sein, er wird gelobt worden sein; wir werden gelobt worden sein, ihr werdet gelobt worden sein, sie werden gelobt worden sein.

Sub. *Pres.* Ich werde gelobt, du werdest gelobt, er werde gelobt; wir werden gelobt, ihr werdet gelobt, sie werden gelobt.—*Imp.* Ich würde gelobt, du würdest gelobt, er würde gelobt; wir würden gelobt, ihr würdet gelobt, sie würden gelobt.—*Perf.* Ich sei gelobt worden, du seiest gelobt worden, er sei gelobt worden; wir seien gelobt worden, ihr seiet gelobt worden, sie seien gelobt worden.—*Plup.* Ich wäre gelobt worden, du wärest gelobt worden, er wäre gelobt worden; wir wären gelobt worden, ihr wäret gelobt worden, sie wären gelobt worden.—*First Fut.* Ich werde gelobt werden, du werdest gelobt werden, er werde gelobt werden; wir werden gelobt werden, ihr werdet gelobt werden, sie werden gelobt werden.—*Second Fut.* Ich werde gelobt worden sein, du werdest gelobt worden sein, er werde gelobt worden sein; wir werden gelobt worden sein, ihr werdet gelobt worden sein, sie werden gelobt worden sein.

Cond. *First Fut.* Ich würde gelobt werden, du würdest gelobt werden, er würde gelobt werden; wir würden gelobt werden, ihr würdet gelobt werden, sie würden gelobt werden.—*Second Fut.* Ich würde gelobt worden sein, du würdest gelobt worden sein, er würde gelobt worden sein; wir würden gelobt worden sein, ihr würdet gelobt worden sein, sie würden gelobt worden sein.

Imp. *Pres.* Werde (du) gelobt, werde er gelobt; werden wir gelobt, werdet (ihr) gelobt, werden sie gelobt.

Inf. *Pres.* Gelobt werden, to be praised.—*Perf.* Gelobt worden sein, to have been praised.—*Fut.* Werden gelobt werden, to be about to be praised.

Part. *Perf.* Gelobt, praised.

§ 86.—REFLECTIVE VERBS.

(1.) A verb is said to be *reflective* when it represents the subject as acting upon itself. We have several such in English; he *deports* himself well; he *bethought* himself; they *betook* themselves to the woods; where the subject and the object, in each case, being identical, the verb is made reflective. It is manifest that any active transitive verb may thus become a reflective verb.

(2.) Strictly speaking, however, those only are accounted reflectives that cannot otherwise be used. The number of these, in German, is much larger than in English. Some of them require the reciprocal pronoun to be in the dative, but most of them govern the accusative; thus (with the dative), ich bilde mir nicht ein, I do not imagine; (with the accusative), ich schäme mich, I am ashamed. Further examples are the following :—

WITH THE DATIVE.	WITH THE ACCUSATIVE.
Sich anmaßen, to presume, usurp.	Sich anschicken, to prepare.
Sich ausbedingen, to make a condition.	Sich äußern, to intimate.
Sich einbilden, to imagine.	Sich bedanken, to thank.
Sich getrauen, to dare.	Sich bedenken, to pause, to think.
Sich schmeicheln, to flatter one's self.	Sich begeben, to repair to, to happen.
Sich vornehmen, to propose to one's self.	Sich behelfen, to put up with, to make do.
Sich vorstellen, to represent to one's self.	Sich freuen, to rejoice.
Sich widersprechen, to contradict [one's self.	Sich widersetzen, to resist.

(3.) Since the action of these verbs is confined to the agent, they are rightly regarded as *intransitives;* for the verb and the pronoun under its government are to be taken *together* as a single expression for intransitive action; thus, ich freue mich, I rejoice *myself*, that is, I *rejoice*, or *delight in*.

(4.) In like manner, reflectives often become the equivalents of *passives;* as, der Schlüssel hat sich gefunden, the key has *found itself*, that is, the key *is found*, or *has been found*, etc.

(5.) In some instances a verb is found to have, both in the simple and in the reflective form, the same signification; as, irren and sich irren, to err; to be mistaken.

(6.) It is worthy of remark, also, that some transitives, upon passing into the reflective form, undergo some change of signification; thus, from berufen, to call, comes sich berufen, *to appeal to*. It is generally easy, however, in these cases, to account for such changes. The following are additional examples :—

Bedenken, to think upon;	sich bedenken, to pause, to think.
Bescheiden, to assign;	sich bescheiden, to be contented with.
Finden, to find;	sich finden (in etwas), to accommodate one's self to a thing.
Fürchten, to fear;	sich fürchten, to be afraid of.
Hüten, to guard;	sich hüten, to beware.
Machen, to make;	sich machen (an etwas), to set about a thing.
Stellen, to place;	sich stellen, to feign, pretend.
Verantworten, to answer for;	sich verantworten, to defend one's self.
Vergehen, to pass away;	sich vergehen, to commit a fault.
Verlassen, to leave;	sich verlassen, to rely upon.

§ 87.—PARADIGM OF A REFLECTIVE VERB.

Sich freuen, to rejoice.

Ind. *Pres.* Ich freue mich, du freust dich, er freut sich; wir freuen uns, ihr freut euch, sie freuen sich.—*Imp.* Ich freute mich, du freutest dich, er freute sich; wir freuten uns, ihr freutet euch, sie freuten sich.—*Perf.* Ich habe mich gefreut, du hast dich gefreut, er hat sich gefreut; wir haben uns gefreut, ihr habt euch gefreut, sie haben sich gefreut.—*Plup.* Ich hatte mich gefreut, du hattest dich gefreut, er hatte sich gefreut; wir hatten uns gefreut, ihr hattet euch gefreut, sie hatten sich gefreut.—*First Fut.* Ich werde mich freuen, du wirst dich freuen, er wird sich freuen; wir werden uns freuen, ihr werdet euch freuen, sie werden sich freuen.—*Second Fut.* Ich werde mich gefreut haben, du wirst dich gefreut haben, er wird sich gefreut haben; wir werden uns gefreut haben, ihr werdet euch gefreut haben, sie werden sich gefreut haben.

Sub. *Pres.* Ich freue mich, du freuest dich, er freue sich; wir freuen uns, ihr freuet euch, sie freuen sich.—*Imp.* Ich freute mich, du freutest dich, er freute sich; wir freuten uns, ihr freutet euch, sie freuten sich.—*Perf.* Ich habe mich gefreut, du habest dich gefreut, er habe sich gefreut; wir haben uns gefreut, ihr habet euch gefreut, sie haben sich gefreut.—*Plup.* Ich hätte mich gefreut, du hättest dich gefreut, er hätte sich gefreut; wir hätten uns gefreut, ihr hättet euch gefreut, sie hätten sich gefreut.—*First Fut.* Ich werde mich freuen, du werdest dich freuen, er werde sich freuen; wir werden uns freuen, ihr werdet euch freuen, sie werden sich freuen.—*Second Fut.* Ich werde mich gefreut haben, du werdest dich gefreut haben, er werde sich gefreut haben; wir werden uns gefreut haben, ihr werdet euch gefreut haben, sie werden sich gefreut haben.

Cond. *First Fut.* Ich würde mich freuen, du würdest dich freuen, er würde sich freuen; wir würden uns freuen, ihr würdet euch freuen, sie würden sich freuen.—*Second Fut.* Ich würde mich gefreut haben, du würdest dich gefreut haben, er würde sich gefreut haben; wir würden uns gefreut haben, ihr würdet euch gefreut haben, sie würden sich gefreut haben.

Imp. *Pres.* Freue (du) dich, freue (er) sich; freuen wir uns, freuet (ihr) euch, freuen sie sich.

Inf. *Pres.* Sich freuen, to rejoice.—*Perf.* Sich gefreut haben, to have rejoiced.

Part. *Pres.* Sich freuend, rejoicing.

§ 88.—IMPERSONAL VERBS.

(1.) The impersonal verb, properly so called, is one destitute of the first and *second* persons; being confined to the third person singular, and having for its grammatical subject the pronoun es, without definite reference to any antecedent; as :—

Es regnet, it rains.	Es donnert, it thunders.	Es friert, it freezes.
Es schneit, it snows.	Es blitzt, it lightens.	Es thaut, it thaws.
Es hagelt, it hails.		Es tagt, it dawns.

(2.) It must immediately appear, that a verb may be impersonal, and yet belong to any of the classes of verbs described in preceding sections. Thus some are *transitive*, some are *intransitive*, some are *passive*, some are *reflective*, etc.

Examples.

Es ärgert mich, it *vexes me, i.e.*, I am vexed.
Es friert ihn, it *chills him, i.e.*, he is chilled or frozen.
Es hungert mich, it *hungers me, i.e.*, I am hungry.
Es reift, there is a hoar frost.
Es heißt, it is said.
Es wird viel davon geredet, it is much talked about.

Es versteht sich, *it understands itself*, *i.e.*, it is understood, etc.
Es fragt sich, it *asks itself*, *i.e.*, it is asked, it is the question.
Es giebt Menschen, it *gives* or *yields men*, *i.e.*, there are men.

§ 89.—COMPOUND VERBS.

(1.) Various derivative verbs in German are produced by the union of simple words with prefixes. Under the name of *prefixes* are here comprehended all those invariable words (as adverbs and prepositions) which are combined with other words to vary or modify their signification. They are, also, often called *particles.* The simple words with which they are united are generally verbs; but often nouns and adjectives are, by prefixes, converted into verbs. Most of the prefixes are *separable*, that is, may stand apart from the radicals; some, however, are found to be *inseparable;* some are either separable or inseparable, according to circumstances.

(2.) The prefixes are themselves, also, either simple or compound; as, herkommen, to come *here* or *hither;* herüberkommen, to come *over here*, or *hither*. In most instances the prefixes may be translated severally as above; but often they are found to be merely intensive or euphonic. This is, likewise, often the case in English; thus, *ex* (which, literally, signifies *out* or *out of*) has, in some words, the signification *very*, *exceedingly*, or the like; as, *exasperate*, to make *very* angry; so *a*, in the word *ameliorate*, is merely euphonic—the derivative form (ameliorate) meaning nothing more than the simple one, *meliorate*.

§ 90.—SIMPLE PREFIXES SEPARABLE.

Ab,	from, off, down;	Absetzen, to set or put down; to depose.
An,	to, at, in, on, towards;	Anfangen, to catch at, *i.e.*, to begin.
Auf,	on, upon, up;	Aufgehen, to go up; to rise.
Aus,	out, out of, from;	Ausnehmen, to take out; to except.
Bei,	by, near, with;	Beistehen, to stand by, assist.
Da,	there, at;	Dableiben, to remain there, or at; to stay.
Dar,	there, at;	Darreichen, to reach there, *i.e.*, to offer.
Ein,	in, into;	Einkaufen. to buy in; to purchase.
Empor,	up, upward, on high;	Emporheben, to lift up.
Fort,	onward, away, forward;	Fortfahren, to drive away; to continue.
Gegen,	towards, against;	Gegenhalten, to hold against; to compare.
Heim,	home, at home;	Heimkehren, to turn homewards; to return.
Her,	hither, here;	Herbringen, to bring hither, or along.
Hin,	thither, there, away;	Hingehen, to go thither, or away.
Mit,	with;	Mitnehmen, to take with, or along.
Nach,	after;	Nachfolgen, to follow after; to succeed.
Nieder,	down, downwards, under;	Niederreißen, to pull down.
Ob,	on, over, on account of;	Obliegen, to lie on, *i.e.*, to apply one's self to; to be incumbent on.
Vor,	for, before;	Vorgehen, to go before; to precede.
Weg,	away, off;	Wegbleiben, to stay away.
Zu,	to, towards;	Zugeben, to give to; to grant.

§ 91.—COMPOUND PREFIXES SEPARABLE.

Anheim	(an+heim, to-home);	Anheimstellen, to put home to, *i.e.*, to refer to.
Dabei	(da+bei, there-by);	Dabeistehen, to stand close by.
Dahin	(da+hin, there-thither);	Dahineilen, to hasten away.
Daran	(dar+an, there-to);	Daransetzen, to put or lay thereto, *i.e.*, to risk, to stake.
Darein	(dar+ein, there-in);	Dareinreden, to talk there-in, *i.e.*, to interrupt.
Davon	(da+von, there-from);	Davonlaufen. to run off, or away.
Dazu	(da+zu, there-to);	Dazuthun, to do (in addition) thereto; to add.
Dazwischen	(da+zwischen, there-between);	Dazwischenreden, to speak there in the midst.
Einher	(ein+her, into-hither);	Einherziehen, to draw along.
Entgegen	(ent+gegen, apart-towards);	Entgegengehen, to go towards; to go to meet.
Entzwei	(ent+zwei, apart-two);	Entzweibrechen, to break or burst asunder.
Herab	(her+ab, hither-down);	Herabsetzen, to put down; to lower.
Heraus	(her+aus, hither-out);	Herausfahren, to drive out.
Herbei	(her+bei, hither-along);	Herbeirufen, to call by or towards.
Hernieder	(her+nieder, hither-down);	Herniederblicken, to look down.
Herüber	(her+über, hither-over);	Herüberkommen, to come over.
Herum	(her+um, hither-around);	Herumgeben, to give or hand around.
Herunter	(her+unter, hither-under);	Herunterfahren, to drive down.
Hervor	(her+vor, hither-forward);	Hervortreten, to step forward.
Hinauf	(hin+auf, hither-on or up);	Hinaufziehen, to pull up.
Hinaus	(hin+aus, thither-out);	Hinauswerfen, to throw out.
Hinein	(hin+ein, thither-into);	Hineingießen, to pour into.
Hintan	(hint(en)+an, behind-to);	Hintansetzen, to put behind; to undervalue.
Hinüber	(hin+über, thither-over);	Hinübertragen, to carry over.
Hinunter	(hin+unter, thither-under);	Hinunterspringen, to leap down.
Hinweg	(hin+weg, thither-away);	Hinwegnehmen, to take away.
Hinzu	(hin+zu, thither-towards);	Hinzueilen, to hasten towards.
Ueberein	(über+ein, over-into);	Uebereinkommen, to come over into, *i.e.*, to agree.
Umher	(um+her, around-hither);	Umherschauen, to gaze around.
Umhin	(um+hin, around-thither);	Umhinkönnen, to be able thereabout; to forbear.
Voran	(vor+an, before-to);	Voranstellen, to place before.
Voraus	(vor+aus, before-out);	Voraussehen, to see or spy out beforehand; to anticipate.
Vorbei	(vor+bei, before-by);	Vorbeireiten, to ride along before; to ride past.
Vorher	(vor+her, before-hither);	Vorhersehen, to foresee.
Vorüber	(vor+über, before-over);	Vorüberfahren, to drive along past in a coach.
Zuvor	(zu+vor, before-to);	Zuvorthun, to do before; to excel.
Zurück	(zu+rück, back-to);	Zurückkehren, to return.
Zusammen	(zu+sammen, to-gether);	Zusammensetzen, to put together.

KEY TO EXERCISES IN LESSONS IN GERMAN.

EXERCISE 179 (Vol. III., page 378).

1. Erst werde ich lesen, dann werde ich schreiben. 2. Ich kehrte von meiner Reise erst gestern zurück. 3. Ich werde ihn erst morgen sehen. 4. Ich habe erst die Hälfte meiner Bücher erhalten. 5. Erst sollten wir vermeiden Böses zu thun, und dann Gutes thun. 6. Ich werde wahrscheinlich nächsten Frühling einige Tage auf das Land gehen. 7. Sind Sie hinreichend mit den Ursachen seiner augenblicklichen Abreise bekannt? 8. Dieser Auftrag wurde pünktlich von diesem Manne besorgt. 9. Diese arme Frau hat fünf Kinder zu versorgen. 10. Ich versehe ihn zuweilen mit einem lehrreichen Buche. 11. Nächstes Mal werde ich vorsichtiger sein.

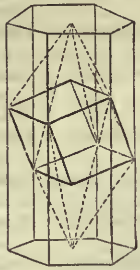
MINERALOGY.—III.

CRYSTALLOGRAPHY (*concluded*).

IN our last lesson on this subject we explained to the reader that crystals are divided into six classes or systems by the arrangement of their axes of symmetry, and gave some account of the different forms which are classified under the Monometric, Regular, Tessular, or Cubic system. We now proceed to a consideration of the various forms of crystals that are included in one or other of the remaining five systems.

2. The *Dimetric, Right Square; Prismatic.* or *Pyramidal System* has also three axes, all at right angles to each other, but one axis is longer than the other two. This will be seen

in the four principal figures of the system (Figs. 15, 16, 17, and 18). The two prisms and the two octahedra are formed in the usual manner. In one case the axis terminates in the centre of the faces, in the other in the angles. The way in which these octahedra and right-square prisms blend with each other is shown in Figs. 19 and 20. *Tinstone, ferrocyanide of potassium, cyanide of mercury, rutile, anatase,* and *idocrase* crystallise in this system.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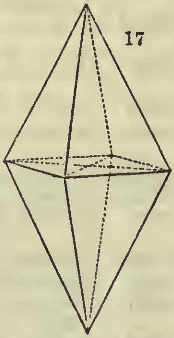
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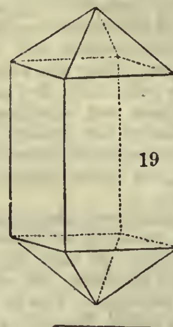
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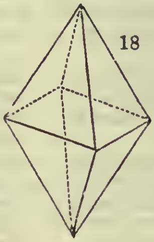
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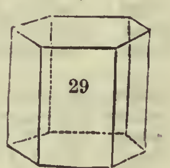
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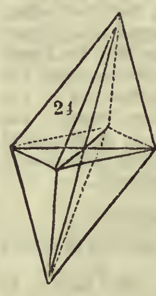
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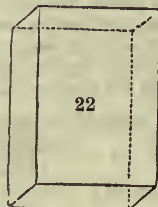
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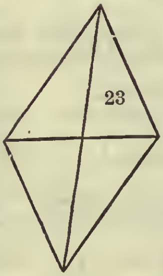
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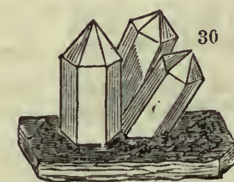
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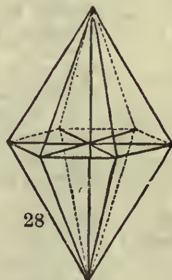
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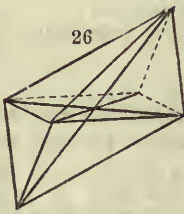
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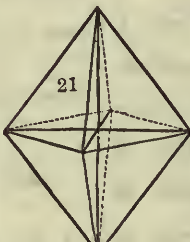
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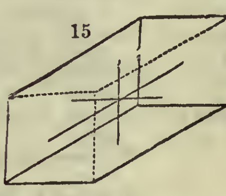
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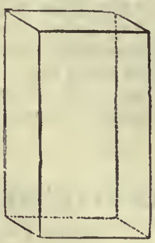
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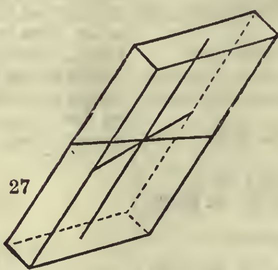
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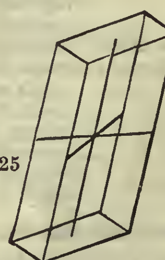
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3. *The Trimetric, Right Rectangular, or Prismatic System.*—This system has three axes, all right angles, but all unequal. The effect of the lateral axes being unequal makes the bases of the prism and octahedron rectangles but not squares (Figs. 21 and 22), and if the axes terminate in the angles, then the bases will be rhombs, that is, parallelograms with equal sides. The accompanying figures will indicate this. *Nitre, aragonite, topaz, sulphate of baryta, sulphur,* and *stilbite* belong to this system.

4. *The Monoclinic or Oblique System.*—The axes of this system are unequal in length, like the last, but two of them cut each other not at right angles. The effect of this is, that the base of the prism or octahedron is a parallelogram, but not having equal sides. Figs. 23, 24, and 25 will give the idea of this system. *Green vitriol, sulphate of soda, phosphate of soda, sulphur* crystallised from its melted state, and *borax* crystallises in this system.

5. The *Triclinic, Doubly Oblique,* or *Anorthic System* has also three unequal axes, but none of them intersect at right angles. The octahedron and the prism of the system are Figs. 26 and 27. But few minerals appear in this system; the most common are *blue vitriol* (sulphate of copper), *labradorite, anorthite,* and *axinite.*

6. The *Hexagonal* or *Rhombohedral System* has four axes, three of them in the same plane and intersecting at angles of 60°, and all equal; the fourth perpendicular to these, and varying in length. By joining the extremities of the three axes a hexagon is formed, which is the base of the prism (therefore six-sided) and of the hexagonal dodecahedron. These primary forms are shown in Figs. 28 and 29. They appear in *snow crystals, beryl, tourmaline,* and *nitrate of soda;* and the very common crystals of *quartz* are generally six-sided prisms terminated by six-sided pyramids, as in Fig. 30. This system is also called the *rhombohedral,* from the fact that the *rhomb,* so admirably shown in *calc-spar,* is the hemihedral form of the hexagonal dodecahedron; that is, if the alternate faces of Fig. 28 be produced, there being six of them, they will form a six-sided solid, whose relation to the prism is best described by Fig. 31. It will be seen that the edges of the rhomb intersect the faces of the prism in six slanting lines. If the points where these lines meet the edges of the prism be joined to the extremities of the longer axis, then the *scalenohedron* will be formed, a crystal which is found in a form of carbonate of lime, called *dog-tooth spar.*

This glance at Crystallography will be sufficient to enable the student to comprchend the allusions to the subject in the following lessons in Mineralogy.

It may be useful to give the reader a brief explanation of some of the terms that have been used in this and the preceding lesson in the names of the various systems under which crystals are classified.

Monometric means having one measurement or equal measurement, from the Greek μονος (mon′-os), *one,* and μετρεω (met′-re-o), *I measure;* the monometric system being distinguished by equality of axes. *Dimetric* means having two measurements, from the Greek δις (dis), *twice,* etc.; crystals in this system having one longer axis and two shorter ones, which are of the same length. *Trimetric* means having three measurements, from the Greek τρεις (trice), *three,* etc.; the crystals in this system having three axes, all of which differ in length. *Monoclinic* means having one sloping axis, from μονος, *one,* and κλινω (kli′-no), *I incline or bend;* crystals of this system having one axis which is not rectangular to the other two. The meaning of *Triclinic* is having three axes at oblique angles to one another. Its derivation is obvious. *Hexagonal* means six-sided or six-angled, from the Greek ἑξ (hex), *six,* and γωνια (go′-ni-a), an angle; and *Rhombohedral,* having its sides in the form of a rhombns, from ῥομβος (rhom′-bos), a figure whose four sides are equal, but its angles are not right angles, and εδρα (ed-ra), *a side.*

VOLTAIC ELECTRICITY.—XIV.

THE ELECTRIC LIGHT—THE ARC SYSTEM—THE JABLOCHKOFF CANDLE—THE INCANDESCENT SYSTEM—DOMESTIC ILLUMINATION BY ELECTRICITY.

HAVING already traced the history and gradual development of the dynamo-electric machine, we shall now be in a position to consider the general question of electric illumination, which is just now of so much interest. The newspapers have for the last few years so teemed with advertisements of electric-lighting companies, and with accounts of new methods of electric illumination, that the ordinary reader is altogether puzzled to know how so many different plans of arriving at the same end can be possible. But without any difficulty it is possible to sort all the forms of electric lamps now before the public into two great divisions—namely, arc lights and incandescent lights. In outward appearance these two forms of light differ very considerably. The arc light with its blue-white painful glare is generally used for our streets, or to illuminate very large areas, such as the reading-room at the British Museum, which is lit by four large hanging lamps of that nature. The incandescent lamp, on the other hand, gives a soft, steady, yellow radiance of from five candle to twenty-five candle power, which is well adapted for the illumination of private houses. Let us at once endeavour to make clear the method by which such different results are achieved.

The first arc light was produced quite at the beginning of this century by Sir Humphry Davy. Noticing that the wires from a powerful electric battery gave sparks, and that the two extremities of the wires became hot when brought together, he tried the experiment of furnishing each wire, or electrode, with a short pencil of charcoal. The result was that the charcoal points when brought together became red hot, and if separated from one another by a short distance, a brilliant

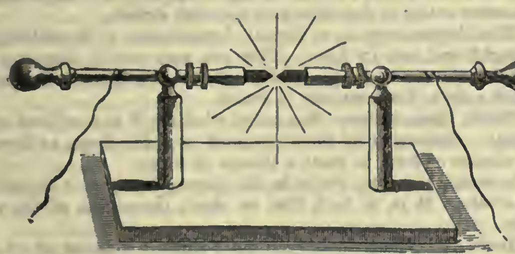


Fig. 83.

light played between them, as shown in Fig. 83. The immense battery used by Davy allowed this distance to amount to four inches, and the luminous atmosphere between them, owing probably to the heated air, took the form of an arch, hence the term arc, or arc-light. Exactly the same effect is of course produced if instead of a battery current that from a dynamo machine is employed.

Foucault substituted gas retort carbon, or coke sawn into pencils, for the charcoal which Davy employed. This material is so hard that it wastes away slowly, and has been used for electric lamps ever since. But of late years a more homogeneous carbon has been produced by manufacture, and these are now almost exclusively employed. The arc-light requires a regulator, which acts the same part as a candlestick does to a candle. But there are certain points to be observed which require this regulator to fulfil particular conditions. In the first place, the arc is not produced at all unless the carbon points first touch and are then separated, and if from any cause the light should be extinguished, the pencils must be again brought into contact before the arc can be re-established. The general form of arc-lamp is shown at Fig. 84. The two carbon rods are placed vertically one above the other, and held in sockets. Their points touch until the connection is made with the source of electricity. Directly this occurs, and the current flows from one pencil to the other, they are seen to grow white hot, and by the action of an electro-magnet they are separated, and the arc is established between them. As they gradually waste away they are caused to approach one another by suitable mechanism until they are consumed. Regulators have been devised by Foucault, Duboscq, Serrin—and, more lately, by Siemens, Brush, and others—all containing self-adjusting mechanism to fulfil the conditions stated.

Fig. 84.

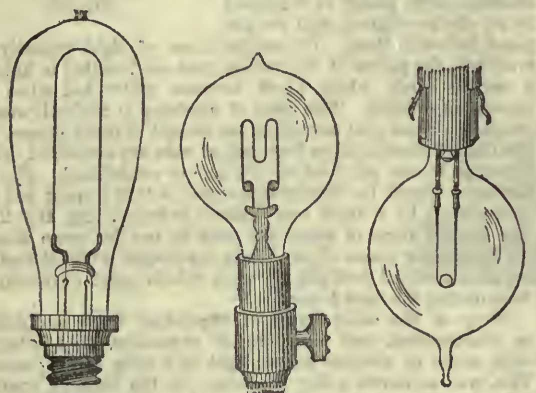
Although, as we have seen, the carbon rods of the arc form of electric light are generally placed vertically one above the other, as shown in Fig. 84, many other positions for them have been adopted by different inventors; indeed, it would be somewhat difficult to devise a new one for them. In Werderman's electric regulator one carbon takes a bun-like shape, the other being a very thin carbon rod which, by means of a counterweight, is kept constantly pressed against it. In the Wallace-Farmer regulator, the carbons are in the form of two plates, about seven inches long and three broad. The distance between these plates is regulated by an electro-magnet, and the arc plays between them. In another form of light recently introduced, the points of the carbon rods are inserted in holes in a marble block, which block becomes white hot when the current is applied. This form of arc-lamp is perfectly steady, which is a great deal more than can be said of many others. In the Rapieff electric lamp four carbon rods are employed, which converge to one point where the arc is established. The advantage claimed for this arrangement is that a spent rod can be replaced by a fresh one without extinguishing the light. The Rapieff form of lamp has been in use for some time in the composing rooms of the *Times* newspaper, where it usefully supplies artificial daylight for work which must obviously be done during the dark hours.

Many of the older forms of regulators were so intricate in construction, and therefore so expensive, that attempts were made to produce an arc-light in a more simple manner. This was achieved a few years ago by the Russian engineer Jablochkoff, and the introduction of the so-called "Electric Candle" invented by him had more to do with the revival of electric illumination as a near possibility than anything else, not excepting even the Gramme machine. The Jablochkoff candle is entirely free from mechanism, for the provision for the maintenance of the carbons in their respective positions is contained in the carbons themselves. These, instead of being one above the other as in the old lamps, are placed side by side, but separated by a thin layer of plaster of Paris. Each "candle" is bridged over at the top by a conducting link of graphite, so that when the current is applied to the base of the twin carbon rods, this graphite is quickly fused, and the arc is established between the carbons. As they waste away, the plaster partition is fused with them, and the compound rod burns down just as a candle would.

Under ordinary circumstances the consumption of the positive carbon is in a given time double that of the negative carbon, and in the older forms of regulator this was provided for by the one rod being fed towards the arc at double the rate of the other. But this only holds good where a battery current or that from a direct current machine is employed. It is obvious that if a Jablochkoff candle were dependent upon such a machine or battery it would soon be extinguished, for one side would waste at double the rate of the other. This has been obviated by making the positive rod twice the substance of the other, but the general plan is to employ an alternate current machine. When the Jablochkoff candle was first publicly shown in this country, an old-fashioned alliance machine was put to work for the purpose, but latterly Gramme and others have produced modified machines which give alternate currents. Such machines are now in use on the Thames Embankment, and in other situations where the Jablochkoff candle is regularly used. A formidable objection to this system of lighting is the circumstance that if one candle from any ineqnality of manufacture or momentary interrnption of the onrrent becomes extingnished, all the lights on the same circuit will go out, until once more the carbons are bridged over with a connecting link. Mr. Wilde, of Manchester, has remedied this in his form of candle. He dispenses altogether with the plaster partition, the carbons being merely separated by a film of air. Normally, they fall towards one another, so that their points touch, but the same current which canses them to glow passes through an electro-magnet, which draws them apart. Shonld they fail for an instant, they once more fall together, and the light is renewed.

In the incandescent system of electric lighting we have quite a different thing to deal with. Supposing that we have at hand a few cells of Grove or Bunsen, and fasten wires to their terminals in the usnal way. If we bridge over the ends of these electrodes with a few inches of fine iron wire, the resistance which that wire exerts towards the cnrrent is shown by its getting white hot and melting into globules. A fine platinum wire will hold out longer, and will continue to give a brilliant light for some time. If snch a wire be arranged in a glass globe exhausted of air, its lasting power will be mnch increased, but the danger remains of its fnsing if the current be stronger than it can bear.

Edison, Swan, Maxim, whose lamps are shown at Fig. 85, and many others, have remedied this by employing very fine



Edison. Maxim. Swan.

Fig. 85.

filaments of carbon. The first named uses bamboo fibre for the purpose, but Swan employs carbonised thread. In the form of a horse-shoe loop this carbon filament is placed in a glass bnlb, which is then carefnlly exhausted of air, and a lamp so prepared will last for many months. Supposing that we passed the current through snch a conductor without exhansting the globe, the carbon would unite with the oxygen of the air, and ordinary combnstion would ensue. Several years ago this method of electric illumination was tried, but it failed, not because of anything intrinsically wrong in the method of procedure, but because at that time no thoronghly efficient air-pump existed. The Sprengel and other forms of modern air-pumps have enabled Edison and others to snceeed where the pioneers of the system failed. There are in the patent office nnmerous old specifications giving details of lamps which do not differ materially from the modern incandescent arrangements, except that the carbon or platinum employed is very much more substantial than a mere thread, snch as is nsed now.

Although, as must be apparent, the incandescent method of electric lighting is more especially suitable for domestic purposes, it has also been employed for the illumination of large buildings. At the Fisheries Exhibition immense halls have been lighted by this means, many hundred lamps being employed for each. In New York, where Mr. Edison has adopted this system, a whole colony of houses are fed with the electric current from a central source. Again, in London we have the same system shown in certain thoroughfares, not only in the adjacent shops, bnt also in the street lamps. In one of the London theatres, too, the plan has been tried of lighting both anditorium and stage with these electric globes, and with marked success.

In order to show the adaptability of the light for domestic use, we will give an account of the means employed at Mr. Swan's honse at Bromley, which is wholly illnminated from cellars to attics by incandescent lamps. From a recently pnblished description we condense the following remarks:—The lamps in each room are controlled by little switches placed outside the door, so that a person entering or leaving has merely to tonch the switch in order to lighten or darken the apartment, as may be required. A light at a reading-desk, a toilet table, or even above the pillow of a bed can instantly be had by the tonch of a button. The lamps are placed in ornamental chandeliers and brackets, except in the lower part of the house, where they are naked. On the dining table stand lamps which are connected when reqnired by wires passing through the table-cloth into the table. By a simple form of electro-motor, the current can be directed to a sewing-machine, a coffee mill, or anything requiring motion. Altogether there are about 70 lights employed in and abont the house. They are fed by two small Siemens' dynamo machines, each driven by an Otto gas engine of half-horse power nominal, bnt capable of developing two-horse power. These engines consume 75 cubic feet of gas per honr, which amonnt, if expended in gas lighting, would feed 30 gas jets, each of 15 candle power. The incandescent lamps give more light than this, besides which the light given is of far pnrer quality—there are no unhealthy fumes given off, and no oonseqnent injury to goods and chattels.

LESSONS IN ENGLISH.—LIII.

SYNTAX: DEPENDENCE.

Dependence or Government.—There is another relation which it is necessary to understand. I mean the relation of independence. When I say, *The man drinks* WATER, I state a proposition in which a noun, or object, appears in a state of dependence; the noun *water* is dependent on the verb *drinks*.

This dependence is a logical dependence, a dependence in thought and not in form. This you may see if, changing the form of the sentence, you make *water* the subject of the proposition; thus, THE WATER *is drunk*.

Water, then, remains the same, whether it is a snbject or an object. Consequently the agreement is not in form, as there is no change of form to meet a change in sense.

In sense, however, *water* in the former sentence is dependent on *drinks*. It is, in fact, that on which the action of the verb falls.

Hence it is the thought yon must consult to know whether a noun is or is not an object. This remark is necessary, becanse, for want of inflections, ambiguity may arise, as in cases when the subject may become the object, and the object the subject; for instance,

Subject.		*Object.*	*Subject.*		*Object.*
The man	strikes	the boy.	The boy	strikes	the man.

These two statements are the reverse of each other, and observe that the reversal is made by a mere change of position; *man*, which in the first sentence is the subject, becomes in the second sentence the object, by being pnt after the verb. You thus learn how important a part position plays in English grammar.

In the instances here considered, the dependence is that of a noun on a verb. There is another kind of dependence; that of a noun on a preposition, as seen in the following sentence, *The water is drunk* BY THE MAN. Here *the man* is in sense dependent on the preposition *by*.

Not only nouns but verbs also are dependent on prepositions; thus, *The physician* ORDERS *the man* TO *drink water;* where in sense, or logically, *drink* depends on *to*.

The sentence presents a third case of dependence, for you see that the verb *drink* is in sense dependent on the verb *orders*.

Position here, too, is of consequence, for the dependent verb *drink* comes after *orders*, and after *to;* in no way could *drink* precede *to*, and scarcely could *orders* follow *drink*. Instances of dependence may also be considered as instances of government.

One word is said to be governed by another when the former is dependent on the latter; as, *The man* DRINKS *the water*, where *water* is governed by *drinks*, because *water* is *dependent* on *drinks*.

Under the heads of AGREEMENT and DEPENDENCE (or government) may all the facts and laws of grammar be arranged. You see the two set forth as they appear in this sentence :—

Agreement. Agreement. Dependence.
The man drinks water.

But here is an instance of agreement of which I have not spoken, namely, that between the article and the noun *the man*; *the* and *man*, referring to the same object, agree in sense. I subjoin then

Instances of Agreement.	*Instances of Government.*
The article and the noun.	The object and its verb.
The adjective and the noun.	The noun and the preposition.
The verb and the noun.	A verb and a preposition.
	A verb and a verb.

Verbs of different kinds.—The government of a noun by a verb takes place only when the verb is transitive. A transitive verb is a verb the action of which passes from the subject to the object; thus, in the sentence, *The man drinks water*, the act denoted by the word *drinking* passes directly from *man* to *water*. Verbs that have an object directly dependent on them are called *transitive*, that is, passing over (from Lat. *trans*, "over," and *eo*, "I go").

Transitive verbs have for their opposite verbs *in*transitive, that is, verbs the action denoted by which does not extend to an object, but remains confined to the subject. *Sleeps*, in the sentence, *The man sleeps*, is an intransitive verb.

Intransitive verbs may appear either with a personal subject, as in the last sentence, or without a personal subject, as in *It rains*.

Transitive verbs may exist in two forms as—1. ACTIVE. *The man drinks water;* 2. PASSIVE. *The water is drunk by the man.*

These two forms are commonly called *voices*. In the first the verb is said to be in the *active voice;* in the second the verb is said to be in the *passive voice*. A transitive verb is in the active voice when it has a subject and an object. A transitive verb is in the passive voice when it has only a subject. In the passive voice the object of the active verb has become the subject. Only transitive verbs can exist in the passive form.

I have endeavoured to show you that the form "man drinks" is the simplest sentence that can be constructed. A sentence equally simple can, however, exist in another shape; as, *The man is good.*

In the analysis of this sentence, I have to introduce and explain a new term or two.

You already know that *the man* is the subject of the verb *is*, but what is *good?* The word *good* is an adjective, or it may be called an attributive, because it assigns the attribute or quality of the noun *man*. This attribute is connected with the subject *man* by means of the verb *is*. A verb so connecting an attribute with a subject is called a *copula*, or link; and that copula in union with the attribute is termed the *predicate*. This name is given to the united copula and attribute, because when so united the predicate and copula predicate or declare something of the subject. These facts may be exhibited thus :—

SUBJECT.	PREDICATE.		SUBJECT.	PREDICATE.	
	Copula.	*Attribute.*		*Verb.*	*Object.*
1. The man	is	good.	2. The man	drinks	water.

In the second sentence you see *drinks water*, that is, a verb and its object—is the predicate, for it is they which there predicate or declare something of the subject.

In the case of intransitive verbs, the predicate has no attribute, as exhibited in this sentence :—

SUBJECT.	PREDICATE.
The boy	runs.

A yet more abstract form of a simple sentence is found in this example :—

SUBJECT.	PREDICATE.
The man	is,

where *is* is the predicate to the subject *the man*. Here, however, observe that the word *is* is employed in the sense of *exists*, and so is seen to belong to the general class of intransitive verbs.

It may be added that the verb *to be* is sometimes called *a substantive verb*, because it denotes existence in its most abstract form.

Before going further, I may remark here that intransitive verbs are also denominated *neuter* (*neither*) *verbs*, because they are properly *neither* active *nor* passive.

SYNTAX OF THE SUBJECT.

I now proceed to the grammatical analysis of simple sentences considered in their several elements, taking, as the thread of my discourse, the oft-repeated model in its fullest form—

The sick man copiously drinks pure water at the well.

I shall consider what modifications the several parts may undergo, and what instances of agreement or government they involve.

I shall first take the subject, *the sick man*, and then the predicate, *copiously drinks pure water at the well.*

THE ARTICLE.

The subject consists simply of three words. Of these words the first, *the*, may become *a*, as *a sick man*. As the sentence stood originally, some particular sick man was designated. Now this determinativeness is lost, and instead we have the statement that a sick man, whoever he may be, drinks, etc.

This want of determinativeness may be increased by substituting the indefinite pronoun *some* for the definite article *the*. Or it may be wholly removed, and an exact determination may be substituted, by putting *this* into the place of *a* or *the*, as *this* (or *that*) *sick man drinks.*

A gives an intimation of unity, but *one* declares unity explicitly. *One*, then, is also a determinative.

Of these determinatives some are singular, others plural, and they may be arranged thus :—

DETERMINATIVES.

Singular.	A,	one,	some,	this,	that.
Plural.	—	—	some,	these,	those.

These determinatives are adjectival, that is, they qualify nouns, as *a man*. Of these adjectival determinatives *one* and *some* may be used with a substantival force, as—

SUBSTANTIVAL DETERMINATIVES.

"I love boys." "*All* boys?" "No, good ones."
Here are many books, *some* in Greek, *some* in Latin.

These determinatives all agree with their nouns. Thus *a* agrees with *man; some* also agrees with *books*, for *some* and *books* are symbols of the same objects.

The definite article is prefixed to adjectives and adverbs to assist in the expression of comparisons; as—

Adjectives.—*The longer* the noviciate *the greater* the progress.
Adverb.—I choose the book *the rather* because, etc.

The definite article is also prefixed to adjectives in the superlative degree, in order to denote the highest possible amount, being thus used intensively; as—

The most strenuous exertions will be made.

The indefinite article gives to plurals the force of totality or unity; as—

"Let the damsel abide *a few days*." (Gen. xxiv. 55.)

When *a few* is the subject of a proposition, it has a plural verb; as—

"When a few years *are* come, then I shall go." (Job xvi. 22.)

The repetition of the article with adjectives of dissimilar import requires the verb to be in the plural; as—

The metaphorical and *the* literal meaning *are* improperly mixed.

Here two meanings are intended. But in this example,

The original and present signification *is* retained,

only one signification is meant. We may also say—

The north and south *poles are* wide asunder.

THE ADJECTIVE.

The next word in the subject is the adjective *sick*, which qualifies the noun *man*. As qualification is the attribute of the adjective, it may be called the qualifier, and whatever word qualifies a noun performs the part of an adjective.

Adjectives may pass into adverbs; that is, adjectives may qualify verbs instead of nouns. When I say "the house is near," *near* is an adjective. But when I say "he stood near," I use *near* in an adverbial sense.

Near has also the appearance of a preposition, as "they live near each other;" but here it is really an adverb, the preposition *to* being understood.

Participles frequently stand as adjectives, as the *broken* wheel, the *mourning* city.

Adjectives sometimes appear as nouns. The word *square* is, according to its application, either a noun or an adjective; as appears in these examples :—

Noun.—The general ordered the troops to form a *square*.
Adjective.—A *square* room fails in due proportion.

Adjectives may be made into nouns by means of the definite article, as *the cowardly :* for example—

The cowardly flee when there is no danger.

It is only when an adjective has acquired a fixed substantival force that it can be preceded by the indefinite article; as—

An *imbecile* should be restricted from doing evil.

It also deserves remark that an adjective converted into a noun by the definite article is used in the plural; thus we say—

The sick *are* well tended;

but if we want to employ the singular, we must say, not "*the sick* drinks," but "the sick *man* drinks pure water."

Adjectives are generally placed before the nouns which they qualify; as—

"*Miserable* comforters are ye all." (Job xvi. 2.)

But when an adjective is an attribute, and so forms part of the predicate, it stands after its noun; as—

"No hand is wholly *innocent* in war."

The qualified noun is sometimes understood—that is, it has to be supplied from either the sense or the context; as—

"To whom they all gave heed, from *the least* to *the greatest*." (Acts viii. 10.)

In every case the adjective agrees with the particular noun with which it stands connected. When, then, the noun is of the singular number, the adjective is to be accounted of the singular number; when the noun is of the plural number, the adjective is to be accounted of the plural number. Also the gender of the noun determines the gender of the adjective.

There are pronouns which possess an adjectival force, as *this* and *that*. *This* and *that* have plural forms; consequently *this* and *that* undergo a change when they come before plural nouns; for example :—

This horse, *these* horses; *that* book, *those* books.

The word *whole*, denoting one object, a unit, cannot, like *all*, be used distributively, and consequently ought not to stand before a plural noun.

As a singular noun requires a singular adjective, so, *vice versâ*, a singular adjective requires a singular noun. Hence we must condemn as ungrammatical the union of adjectives of number (except *one*) with nouns in the singular; as—

INCORRECT.	CORRECT.
Twenty *foot* long.	Twenty *feet* long.
Six *pound* ten *shilling*.	Six *pounds* ten *shillings*.

Adjectives in the comparative degree take *than* after them; as in the following example :—

He is wiser than you.

The sentence is obviously elliptical; if you fill it up, it will stand thus—

He is wiser than you *are*.

Here *you* bears to *are* the same relation that *he* bears to *is*—I mean they are severally subjects to the verbs. Hence arises the ordinary rule that *conjunctions* (*than* is a conjunction) *have the same case after as before them*. In the following—

I believe him to be wiser than you,

you may be either the subject or the object, according to the construction intended. I will fill up the ellipsis in two ways, and you will see the difference :—

Subject.—I believe him to be wiser than you (are).
Object.—I believe him to be wiser than (I believe) you (to be).

The proper way, then, to ascertain the relation which a noun or pronoun holds after a comparative, is to fill up the ellipsis or supply the words necessary to complete the sense.

Some adjectives, from the nature of their import, do not admit of comparison. If a thing is universal, it cannot be more than universal, consequently *universal* has no comparative and no superlative. Equally is *perfect* incapable of comparison. The same may be said of *absolute, infinite, interminable, boundless*. Accordingly, it is incorrect to say—

He is *more perfect* than you.

Instead of which you may say—

He is *less imperfect* than you; or,
He is *nearer perfection* than you.

Double comparisons are to be avoided; for example—

INCORRECT.	CORRECT.
Less *nobler* plunder.	Less *noble* plunder.
The *most straitest* sect.	The *straitest* sect.

HUMAN PHYSIOLOGY.—IX.

CIRCULATION (*concluded*)—EXCRETORY ORGANS.

When speaking of the structure of the arteries, it was said that they had three coats, one of which was elastic, another muscular, and the third mucous. The purpose of the first coat is to enable the vessel to expand when the blood is forced into it by the ventricle, and so save the artery from giving way under the sudden pressure to which it is subjected; this elastic property also serves another purpose, by reducing what without it would be an intermittent and jerking flow of the blood to a continuous stream; it is also of great importance in enabling the vessels to enlarge when from any cause a sudden increase in the supply of blood to any part of the body takes place. The muscular property of arteries, though it does not probably directly aid in propelling the blood, is important, as regulating the quantity of blood sent to any particular tissue, according to its requirements at any special moment; it is also essential when an artery is wounded, enabling the vessel to contract, closing the orifice, and so preventing bleeding. The jerking motion of the blood, which it is the purpose of the elastic properties of the arteries to control, but which is not entirely subdued until the blood reaches the capillaries, causes that pulsation which is felt at the wrist or at any other spot where the artery is sufficiently superficial, and which is commonly known as the pulse. The pulse is, of course, a measure of the frequency of the heart's action, as its beats correspond with the contraction of the ventricles; the pulse varies according to age, and is affected by many circumstances—the average in an adult is from 70 to 75 per minute; in an infant at birth, 140; whilst in old age it gradually declines from the adult standard; in persons of an excitable or sanguine temperament it is quicker than in the phlegmatic, and it is also more rapid in women than in men. After a meal the pulse is quicker than while fasting, and any exertion not carried sufficiently far to produce exhaustion increases its rapidity in proportion to the severity of the exercise taken. In the morning it is more rapid than at night, when the body is fatigued. Position also influences it; it is slowest in the recumbent posture; sitting or standing increases it, the latter more so, as requiring more muscular action.

When the blood reaches the capillary network, it begins to move at a much slower rate; and when it is examined by a microscope, as can be easily done in the web of a frog's foot, it is seen that the red corpuscles occupy the centre of the stream, and move most rapidly, whilst the white creep along the walls of the vessel at a very sluggish pace, and even sometimes seem to adhere to them for a time. The greater slowness of the circulation in the capillaries is caused partly by the much larger area in the aggregate of these vessels, and also, as a consequence of this, the large increase of the friction caused by the walls of the vessels. The purpose of this retardation will be seen when we come to speak, as we shall do directly, of the process of nutrition. In the veins the blood moves as in the capillaries, without any jerking motion, but at a greater pace, though not so fast as in the arteries: here the valves which are placed in most of the larger veins play an important part, in preventing a backward flow of the blood, and thus compensating in a measure for the diminished influence of the heart's action.

Such, then, is the circulation of the blood; and we must now shortly inquire how it fulfils its purpose of maintaining and nourishing the body. When the blood is circulating slowly through the capillaries, it is brought into most intimate relations with the various tissues which it has to supply; whilst the walls of these vessels are of such a degree of fineness as to offer the least possible resistance to the process of absorption that is constantly going on through them. Each tissue has the power of appropriating that element which is suitable to itself from the common current, and letting the unsuitable elements pass on. This selective power of the tissues is not confined to the nutrient materials which are necessary for their building up and maintenance, but is found also to exist with regard to foreign substances introduced into the blood, whether accidentally as poisons or intentionally as curative agents; as, for instance, the presence of arsenic in the blood is followed by an irritation of the mucous membranes throughout the body, whilst lead is taken up in some way so that the extensor muscles of the fore-arm are affected, and that peculiar kind of paralysis known as lead palsy is produced. In the same way, certain organs or tissues have the power of appropriating medicinal substances introduced into the general circulation. This process of absorption, which is the first step of the more complex one of nutrition, may sometimes be observed: particles are seen to pass from the circulation into the tissues, and, in return, other particles pass back from the tissues into the circulation. But here we are simply upon the threshold of the subject; our knowledge extends no further; we know not, nor can we observe how it is, that from the same blood such a variety of textures are formed, nor the many modifications the crude elements of the blood must pass through before they are converted into bone, flesh, or skin.

Performing, as is supposed, some office in connection with the manufacture of the blood or its circulation, are two glandular bodies, the spleen and the thyroid body; these are known as ductless glands, as no duct has hitherto been discovered in connection with them. The spleen, which is a bluish-red-looking mass, of a brittle consistence, in the adult weighs about seven ounces, but is sometimes enormously increased in size by disease, especially after intermittent fever, when it receives the common name of ague cake. It is situated in the abdomen, on the left side, embracing the larger end of the stomach, and in contact with the tail of the pancreas. The thyroid body is a gland composed of three lobes, of a brownish-red colour, weighing from two to three ounces; it is situated in the lower part of the throat, resting upon the windpipe; when diseased, it becomes enormously enlarged, and constitutes the disease known as goitre or Derbyshire neck. As to the function of either of these bodies, little is certainly known, though the subject has received the attention of many of the most eminent of physiologists. With regard to the spleen, it has been observed that towards the end of the digestive process it is considerably enlarged; and, consequently, it has been thought that in some way it influenced the albuminous elements of the food, elaborating them so as to fit them for reception into the blood. Another opinion is, that the spleen is a destructive organ, that in it the worn-out corpuscles of the blood are disintegrated and broken up. Still less is known of the function of the thyroid body; but the purposes either of them serve are apparently not absolutely essential to life; as the spleen has been removed entire from dogs, and in some cases from men, without any apparent ill results following; and the structure of the thyroid gland is also occasionally destroyed by disease, without any great disturbance of the health of the individual.

The blood, in addition to supplying the nutritive material from which all the structures of the body are formed, acts as a vehicle to carry out of the body the decaying matter from the worn-out tissues, the retention of which in the system would be prejudicial to the health, or even destructive of life.

There are three chief agencies by which this process of purification is effected—the lungs, the skin, and the kidneys. Of the first two we shall speak when we come to the subject of respiration. The kidneys are probably the most purely excretory organs of the body. They do not form any substance for future use in the system; their office is simply to separate from the blood certain matters which would be injurious to the health if not removed. Some traces of these organs are found in even very low types of animal life, and the higher the animal is placed in the scale of creation the greater development and importance do these organs assume. In the human subject they are two in number, and are placed deeply in the abdomen, one on each side of the vertebral column, extending from the eleventh rib to the superior margin of the os innominatum; their shape is well known, somewhat resembling the bean which has been named after them; they are usually inclosed in the centre of a mass of fat, and are held in their position by the vessels which pass to and from them. Each is about four inches in length, two inches in breadth, and about one inch in thickness; their weight varies from four and a half to six ounces each. They are glandular bodies, composed of an immense number of minute tubes, which are lined with secreting cells; these tubes converge and empty themselves into one canal or duct, called the ureter. Ramifying amongst these tubes are the ultimate branches and capillary network of the renal artery, which brings to the kidney the blood loaded with effete material. This artery breaks up and submits the blood to the action of the secreting cells of the kidney, much in the same way as the portal circulation is submitted to the bile-secreting cells of the liver. The tubes, the branches of the artery, and veins are bound together by connective tissue, and the whole organ is inclosed in a capsule of the same material. At the centre of the kidney, where there is a kind of notch, the artery enters, and the vein and the duct leave the kidney. The ducts called the ureters are membranous tubes, of the size of a goose-quill, about sixteen or eighteen inches long, which convey the secreted urine into the bladder. Owing to the large size of the renal arteries and veins, the transit of the blood through the kidneys is so rapid, that it is probable that the whole of the blood in its turn is purified by them. Some of the elements found in the urine exist as such in the blood, but other elements are formed by the chemical agency of the secreting cells of the kidneys.

Healthy urine is a clear limpid fluid, of a pale-yellow colour, generally acid in reaction in man and all carnivorous animals, but alkaline and turbid in the herbivorous; its average specific gravity is from 1015 to 1025; the average quantity secreted during the twenty-four hours is from thirty to forty ounces; but this, as well as the specific gravity, depends very much upon the quantity of fluid taken, and also upon the activity of the skin.

Chemically, the urine consists of water holding in solution certain animal and saline matters; it contains about 33 per cent. of solid matter; but its constitution is best shown by the following table, which exhibits the quantities contained in 1,000 parts of urine:—

Water			967
Urea			14·230
Uric Acid			·468
Colouring Matter Mucous and Animal Extractive Matter			10·167
Salts	Sulphates	Soda Potash Lime	8·135
	Phosphates	Soda Magnesia Ammonia	
	Chlorides	Sodium Potassium	
	Hippurate of Soda		
	Fluoride of Potassium		
Silica			traces.
			1000·000

The quantity of water varies according to the amount of fluid drunk and exercise taken, and is strongly influenced by some mental emotions; in some diseases it is diminished, and in others enormously increased.

The largest and most important solid constituent of the urine is urea; this forms nearly half of the whole solid matter, and is the most important, as it is the chief substance by which the nitrogen of the used-up tissues and unutilised food is removed from the body; and also because the failure to remove it, from whatever cause it may arise, is followed by the most disastrous consequences to the health of the sufferer; every function of the body suffering, but the nervous system chiefly. Some of the most common results of the presence of urea in the blood—of uræmic poisoning, as it is called—are convulsions, loss of consciousness, and eventually paralysis of all nerve power, and death, resulting from the stoppage of the respiratory movements. In any disease, such as scarlet fever, in which the excretory function of the skin is for a time in abeyance, a greater amount of work is required to be done by the kidney; and it is this fact which renders any chill under such circumstances so dangerous; as in that case the work is increased still more, and is often greater than the kidney is able to perform; so the waste products and superfluous fluid accumulate in the circulation, and dropsy often supervenes.

Uric acid is another nitrogenous compound, and is derived from the same sources as the urea, and serves, in a minor degree, the same purpose. The salts of the urine form a fourth of the solid ingredients: the sulphates are probably derived from the decomposing nitrogenous tissues; the phosphates are partly derived from bone destruction, but principally from the wear and tear of nerve substance, as they are always increased after any undue mental exertion, or any other circumstance producing nervous exhaustion. The chlorides are probably derived directly from the food taken. All these elements vary much in amount, but are all of subordinate importance to the excretion of urea.

Having now traced the blood from its origin, in the products of digestion, through the various tissues of the body, and having described one of the methods by which the worn-out materials are removed from it, we shall in the next article consider the subject of respiration, which relieves the blood of the remaining impurities, and refits it to continue its unceasing work of rebuilding and maintaining the different tissues of the body.

LESSONS IN FRENCH.—LXXXVIII.

§ 146.—French Homonyms and Paronyms (*continued*).

French Words.	Meaning in English.
B.	
Badine (*fem. of* badin), *adj.*	*waggish, roguish.*
Badine, *nf.*	*switch.*
Bai, e, *adj.*	*bay (of horses).*
Baie, *nf.*	*bay; gulf; berry; trick.*
Bey, *nm.*	*bey.*
Bâilleur, *nm.*	*yawner, gaper.*
Bailleur, *nm.*	*lessor.*
Baiser, *v.*	*to kiss.*
Baisser, *v.*	*to stoop, to lower.*
Biaiser, *v.*	*to slope, to slant; to use shifts; evasions.*
Bal, *nm.*	*ball, dancing-party.*
Balle, *nf.*	*ball; bullet; husk of rice; bale.*
Balai, *nm.*	*broom.*
Ballet, *nm.*	*ballet.*
Ban, *nm.*	*ban; public proclamation; banishment.*
Banc, *nm.*	*bench, form.*
Bas, *adj., nm.*	*low; stocking.*
Bat, *nm.*	*tail of a fish.*
Bât, *nm.*	*pack-saddle.*
Base, *nf.*	*basis, base.*
Basse (*fem. of* bas), *adj.*	*low.*
Basse, *nf.*	(mus.) *bass, bass-string.*
Basse, *nf.*	*shallow.*
Bau, *nm.*	(nav.) *beam.*
Baux (*pl. of* bail), *nm.*	*leases.*
Beau, *adj.*	*handsome, beautiful.*
Bot, *adj.*	*club-footed; club-foot.*
Bière, *nf.*	*beer.*
Bière, *nf.*	*coffin.*
Bis, *adj.*	(*of bread, etc.*) *brown.*
Bis, *adv.*	*encore.*
Bise (*fem. of* bis), *adj.*	*brown.*
Bise, *nf.*	*north wind.*
Bon, *adj., interj.*	*good;* (excl.), *well! good!*
Bon, *nm.*	*what is good; voucher, check.*
Bond, *nm.*	*bound, leap, jump.*
Bonne (*fem. of* bon), *adj.*	*good.*
Bonne, *nf.*	*maid-servant.*
Bouilli, *nm.*	*boiled beef.*
Bouillie, *nf.*	*pap.*
Bourdon, *nm.*	*pilgrim's staff;* (ent.) *drone.*
Bourdon, *nm.*	*great bell.*
Bourg, *nm.*	*country-town; market-town.*
Bourre, *nf.*	(*of wool*) *flock; wad; trash.*
Boue, *nf.*	*mud.*
Bout, *nm.*	*end, extremity.*
Brick, *nm.*	(nav.) *brig.*
Brique, *nf.*	*brick.*
Brocard, *nm.*	*taunt; joke; scoff.*
Brocart, *nm.*	*brocade.*
Broquart, *nm.*	(hunt.) *brocket.*
Brut, *nm.*	*rough; raw; unpolished;* (com.) *gross.*
Brute, *nf.*	*brute; beast; brutal person.*
C.	
Ça (*abb. of* cela), *pron.*	*that; that thing.*
Çà, *interj.*	*now, then.*
Sa, *adj.*	*her, his, its.*
Sas, *nm.*	*sieve, bolting-sieve; chamber (of weirs, locks).*
Cahot, *nm.*	*jerk; jolt.*
Chaos, *nm.*	*chaos; confusion.*
Cal, *nm.*	*callosity.*
Cale, *nf.*	(nav.) *hold (of ships); wedge; prop; block.*
Camp, *nm.*	*camp.*
Quand, *adv.*	*when.*
Quant à, *adv.*	*as to, as for.*
Campagne, *nf.*	*country-fields; country-seat.*
Campagne, *nf.*	(milit.) *campaign;* (nav.) *cruise, voyage.*
Cane, *nf.*	*duck.*
Canne, *nf.*	*cane, stick.*
Canaux (*pl. of* canal), *nm.*	*canals.*
Canot, *nm.*	*ship's-boat; cutter; yawl.*
Cap, *nm.*	*headland, cape;* (nav.) *head.*
Cape, *nf.*	*cloak with a hood;* (nav.) *try-sail.*

French Words.	Meaning in English.
Capital, *adj.*	*capital; chief; leading; main.*
Capital, *nm.*	*capital (money); stock.*
Capitale (*fem. of* capital), *adj.*	*capital; chief; leading; main.*
Capitale, *nf.*	*chief city.*
Capon, *nm.*	*sneak, mean fellow, hypocrite.*
Capon, *nm.*	(nav.) *cat-tackle.*
Car, *conj.*	*for, as.*
Carre, *nf.*	*breadth (of shoulders); crown (of a hat).*
Quart, *nm.*	*quarter; fourth; point (of the compass);* (nav.) *watch.*
Carrière, *nf.*	*race-ground; race; career; course.*
Carrière, *nf.*	*quarry (of stone, marble, etc.).*
Carte, *nf.*	*paste-board; card; ticket; bill of fare; account; map, chart.*
Quarte (*fem. of* quart), *adj.*	*fourth;* (med.) *quartan.*
Quarte, *nf.*	(mus.) *fourth;* (fenc.) *quarte;* (piquet) *quarte;* (ant.) *half a gallon.*
Cartier, *nm.*	*playing-card maker.*
Quartier, *nm.*	*quarter, fourth part; quarter (of a town, of the moon).*
Case, *nf.*	*division, pigeon-hole, compartment; hut; square (at chess, draughts); point (backgammon).*
Casse, *nf.*	(bot.) *cassia.*
Casse, *nf.*	*breakage;* (milit.) *cashiering.*
Casse, *nf.*	(print.) *case.*
Causer, *v.*	*to cause.*
Causer, *v.*	*to chat, to converse familiarly.*
Ce, *pron.*	*this, that, it.*
Se, *pron.*	*one's self.*
Céans, *adv.*	*here.*
Séant, *pp.*	*sitting.*
Séant, *nm.*	*sitting posture.*
Séant, *adj.*	*becoming, decent.*
Ceint, *pp.*	*girt.*
Cinq, *adj.*	*five.*
Sain, *adj.*	*healthy, sound.*
Saint, *adj.*	*sainted, saint.*
Sein, *nm.*	*breast, bosom.*
Seing, *nm.*	*signature.*
Celle, *pron.*	*this one, that one.*
Sel, *nm.*	*salt.*
Selle, *nf.*	*saddle.*
Cellier, *nm.*	*cellar.*
Sellier, *nm.*	*saddler.*
Cène, *nf.*	*Our Lord's Supper.*
Scène, *nf.*	*scene;* (theat.) *stage.*
Seine, *nf.*	*Seine (river); seine (fish-net).*
Saine (*fem. of* sain), *adj.*	*healthy, sound.*
Cens, *nm.*	*census.*
Sens, *nm.*	*sense.*
Censé, *adj.*	*supposed.*
Sensé, *adj.*	*sensible, wise.*
Sensible, *adj.*	*sensitive.*
Cent, *adj.*	*hundred.*
Sang, *nm.*	*blood.*
Sans, *prep.*	*without.*
Cerf, *nm.*	*stag.*
Serf, *nm.*	*serf.*
Serre, *nf.*	*hot-house, green-house, conservatory.*
Cession, *nf.*	*transfer (of property).*
Session, *nf.*	*session; sitting; term (of law-courts).*
Chaîne, *nf.*	*chain.*
Chêne, *nm.*	*oak-tree.*
Chair, *nf.*	*flesh; meat; skin (of persons).*
Chaire, *nf.*	*pulpit; professorship; desk (church).*
Cher, *adj.*	*dear.*
Chère (*fem. of* cher), *adj., nf.*	*dear; cheer; fare; living; entertainment.*
Champ, *nm.*	*field; scope.*
Chant, *nm.*	*singing; chant.*
Chas, *nm.*	*eye (of needle).*
Chat, *nm.*	*cat.*
Schah, *nm.*	*shah.*
Chasse, *nf.*	*chase; hunt; shooting.*
Châsse, *nf.*	*shrine, reliquary; frame; handle (of lancets); cheek (of a balance).*
Chaud, *adj., nm.*	*hot, warm; heat, warmth.*
Chaux, *nf.*	*lime.*
Chenil, *nm.*	*kennel.*
Chenille, *nf.*	*caterpillar.*
Chœur, *nm.*	*chorus; choir.*
Cœur, *nm.*	*heart.*
Coi, *adj.*	*quiet, still; snug.*
Quoi, *pron.*	*what.*
Chrême, *nm.*	*chrism, holy oil.*
Crème, *nf.*	*cream.*
Chronique, *adj.*	(med.) *chronic.*
Chronique, *nf.*	*chronicle.*
Ci (*abb. of* ici)	*here.*
Scie, *nf.*	*saw.*
Si, *conj.*	*if, whether.*
Six, *adj.*	*six.*
Cire, *nf.*	*wax.*
Sire, *nm.*	*Sire.*
Clause, *nf.*	*condition; agreement.*
Close (*fem. of* clos), *adj.*	*closed; shut.*
Coin, *nm.*	*corner.*
Coing, *nm.*	*quince.*
Coke, *nm.*	*coke.*
Coq, *nm.*	*cock.*
Coque, *nf.*	*shell (of eggs, nuts, snails); pearl-shell;* (nav.) *hull; cockle.*
Col, *nm.*	*neck; collar.*
Colle, *nf.*	*glue, paste, size.*
Colon, *nm.*	(anat.) *colon.*
Colon, *nm.*	*colonist.*

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French Words.	Meaning in English.
Commandant, nm.	(milit.) *major.*
Commandeur, nm.	*commander (in orders of knighthood).*
Commande, nf.	*order for goods.*
Commandement, nm.	*command; word of command; commandment; precept; law.*
Commode, adj.	*convenient; commodious.*
Commode, nf.	*chest of drawers.*
Compte, nm.	*account.*
Comte, nm.	*count, earl.*
Conte, nm.	*tale.*
Confiance, nf.	*confidence, trust.*
Confidence nf.	*the confiding of a secret.*
Confiant, adj.	*trusting; sanguine.*
Confident, nm.	*confidant, confidante, bosom friend.*
Cor, nm.	*corn (on the feet); horn, French hunting horn.*
Corps, nm.	*body, corps; corpse.*
Cors, nm. pl.	(hunt.) *horns; antlers.*
Cote, nf.	*quota; quotation; share; number, letter, figure (to indicate order).*
Côte, nf.	*rib; coast.*
Côté, nm.	*side.*
Cotte, nf.	*petticoat; coat (of arms, of mail);* (ich.) *bullhead.*
Cou, nm.	*neck.*
Coup, nm.	*blow.*
Coût, nm.	*cost, costs.*
Coupe, nf.	*cut, style (of clothes); cutting.*
Coupe, nf.	*cup; chalice; quaffing-bowl.*
Cour, nf.	*court-yard; Court (of Kings, etc.); Court (of justice).*
Cours, n.m.	*course, lectnre.*
Court, adj.	*short.*
Couvert, nm.	*cover (spoon, fork, etc.); cover, thicket, shelter.*
Couvert, pp.	*covered, hid.*
Cri, nm.	*shriek, cry.*
Cric, nm.	*handscrew; lifting-jack.*
Croup, nm.	(med.) *croup.*
Croupe, nf.	*crupper, rump (of horses).*
Cru, adj.	*raw, uncooked; crude.*
Cru, nm.	*growth; invention; making.*
Crue, nf.	*rise, swelling (of rivers); growth.*
Crue (*fem. of* Cru), adj.	*raw, uncooked; crude.*
Cure, nf.	(med.) *cure.*
Cure, nf.	*living; parsonage, vicarage.*
Curé, nm.	*parson.*
Cygne, nm.	*swan.*
Signe, nm.	*sign.*
D.	
Dais, nm.	*canopy, dais.*
Des, art.	*of the, from the; some, any.*
Dès, prep.	*as soon.*
Dés, nm.	*thimbles, dice.*
Dam, nm.	*hurt, injury; deprivation of the sight of God.*
Dans, prep.	*in, into.*
Dent, nf.	*tooth, notch.*
Danse, nf.	*dance, dancing.*
Dense, adj.	*dense.*
Date, nf.	*date (of the month, etc.).*
Datte, nf.	(bot.) *date.*
De, prep.	*of, from.*
Dé, nm.	*thimble; die.*
Déceler, v.	*to reveal, to disclose, to betray.*
Desceller, v.	*to unseal;* (masonry) *to unbed.*
Desseller, v.	*to unsaddle, to take off the saddle.*
Décente, adj.	*decent.*
Descente, nf.	*coming down; declivity; descent.*
Déférer, v.	*to confer, to bestow; to tender; to accuse, impeach, prosecute.*
Déferrer, v.	*to unshoe (a horse); to nonplus; to confound.*
Dégoûter, v.	*to disgust.*
Dégoutter, v.	*to drop, to trickle, to drip, to dribble.*
Délacer, v.	*to unlace.*
Délasser, v.	*to refresh, to relax, to divert.*
Dénier, v.	*to deny.*
Denier, nm.	(antiq.) *denarius; denier; money; an obsolete French coin worth ¼ of a farthing.*
Dès, des, dés	*see* Dais.
Désert, adj., nm.	*deserted; a desert.*
Dessert, nm.	*dessert.*
Desserte, nf.	*leavings (of the table).*
Dessein, nm.	*design, intention, scheme.*
Dessin, nm.	*drawing, sketch.*
Détacher, v.	*to take out stains.*
Détacher, v.	*to detach; to unfasten;* (milit.) *to detail, to tell off.*
Différend, nm.	*quarrel, difference, dispute.*
Différent, adj.	*dissimilar, various, different.*
Diligence, nf.	*diligence, stage-coach.*
Diligence, nf.	*diligence, activity.*
Dom, don, nm.	*dom, don; lord; (Spanish and Portuguese title).*
Don, nm.	*gift.*
Donc, conj.	*then, therefore.*
Dont, pron.	*of which, whose.*
Droit, adj.	*straight.*
Droit, nm.	*right; law.*
Drôle, adj.	*droll; amusing.*
Drôle, nm.	*scamp, mean, sorry fellow.*
E.	
Eau, nf.	*see* Aulx.
Écho, nm.	*echo.*
Écot, nm.	*reckoning, share, score.*
Effort, nm.	*effort.*
Éphore, nm.	(antiq.) *Ephor.*
Élan, nm.	*start, spring; dash; outburst.*
Élan, nm.	*elk, moose-deer.*
Embrasement, nm.	*conflagration, burning.*
Embrassement, nm.	*embrace, kissing.*
Embraser, v.	*to kindle; to rouse; to burn.*
Embrasser, v.	*to embrace; to kiss.*
Encre, nf.	*see* Ancre.
Ennoblir, v.	*see* Anoblir.
Entre, prep.	*see* Antre.
Environ, adv.	*nearly, about.*
Environs, nm.	*surroundings; environs, outskirts, suburbs.*
Équivoque, adj.	*equivocal, ambiguous, doubtful.*
Équivoque, nf.	*equivocation, ambiguity.*
Ère, nf.	*see* Air.
Être, v., nm.	*to be; being; trunk (of a tree).*
Êtres, nm., pl.	*beings; parts, ins and outs (of a house).*
Hêtre, nm.	*beech-tree.*
Exaucer, v.	*to hear favourably, to grant.*
Exhausser, v.	*to raise up; to make higher.*
Exemplaire, nm.	*model, pattern; copy (of books), etc.*
Exemplaire, adj.	*exemplary.*
Exprès, adj., nm.	*positive, express, clear, plain; a messenger.*
Exprès, adv.	*expressly, purposely.*
Express, nm.	*express train.*
F.	
Faim, nf.	*hunger.*
Feint, pp.	*sham, shammed, feigned.*
Fin, nf.	*end.*
Fin, adj.	*clever, cunning; thin, fine.*
Fait, pp., nm.	*done, made; fact.*
Faix, nm.	*burden, load.*
Faîte, nm.	*summit, top.*
Fête, nf.	*feast; birthday; treat; fête.*
Fard, nm.	*rouge; paint, varnish; disguise.*
Phare, nm.	*lighthouse.*
Faste, nm.	*pomp, display, ostentation.*
Fastes, nm., plur.	*fasti, annals.*
Fausse (*fem. of* Faux), adj.	*false, untrue.*
Fosse, nf.	*grave, tomb.*
Fausset, nm.	*faucet, vent-peg;* (mus.) *falsetto.*
Fossé, nm.	*ditch, moat.*
Faux, nf.	*scythe.*
Faux, adj., nm.	*false; what is false; forgery.*
Feinte, ppf.	*sham, shammed, feigned.*
Feinte, nf.	*feint.*
Fendeur, nm.	*cleaver, splitter (man).*
Fendoir, nm.	*cleaver (tool).*
Fente, nf.	*chink.*
Fonte, nf.	*casting, melting.*
Ferme, adj.	*firm.*
Ferme, nf.	*farm, farmstead.*
Fétu, nm.	*straw.*
Fœtus, nm.	*fœtus.*
Feu, nm.	*fire.*
Feu, adj.	*deceased.*
Fil, nm.	*thread; clue.*
Fils, nm. (pl. of Fil).	*threads; clues.*
Fils, nm.	*son.*
Filtre, nm.	*filter; love potion, philter.*
Philtre, nm.	*love potion, philter.*
Flamand, nm. and adj.	*Fleming, Flemish.*
Flamant, nm.	*flamingo.*
Flan, nm.	*custard, cake.*
Flanc, nm.	*side; flank.*
Foi, nf.	*faith.*
Foie, nm.	*liver* (anat.).
Fois, nf.	*time;* trois fois, *three times.*
Fond, nm.	*bottom.*
Fonds, nm.	*land; landed property; funds, stock, stock in trade.*
Fonts, nm.	*font.*
Fondeur, nm.	*founder, melter, smelter; letter-founder.*
Fondoir, nm.	*melting-house (fat, tallow).*
For, nm.	*tribunal* (ant.).
Fors, prep.	*except.*
Fort, adj., nm.	*strong; stronghold, fort.*
Frai, nm.	*spawn, spawning; fry; roe, hard roe.*
Frais, adj.	*fresh.*
Frais, nm.	*costs, expense.*
Franc, nm.	*franc* = 10d., *nearly.*
Franc, adj.	*straightforward; frank.*
Franc, nm., adj.	*Frank, Frankish.*
G.	
Gai, adj.	*cheerful, merry.*
Gué, nm.	*ford.*
Guet, nm.	*watch, look-out.*
Gale, nf.	*itch, scab, mange.*
Galle, nf.	*oak-apple, gall.*
Gare, interj.	*look-out! mind! beware!*
Gare, nf.	*wet-dock; railway terminus.*
Gars, nm.	*lad, youth, boy.*
Gaz, nm.	*gas.*
Gaze, nf.	*gauze.*
Geai, nm.	*jay* (ornit.).
Jais, nm.	*jet.*
Jet, nm.	*spout, jet of water; casting; throw; tiller.*

METEOROLOGY.—III.

SNOW—SLEET—HAIL—WHIRLWINDS—WATERSPOUTS—LIGHTNING AND THUNDER.

WHENEVER the temperature of the air is so much diminished that the vapour can no longer be suspended in it, it falls in the form of rain. Various causes may lead to this, but the most common one is the ascent of warm moist air into higher and cooler regions. Sometimes, too, a cold wind suddenly coming on will produce a condensation of vapour. On a few occasions rain has been known to fall with a cloudless sky; this is, however, rare.

The climate of any place is a good deal affected by the amount of rain that falls there. Instruments for measuring this are called *pluviometers*, or rain-gauges, and many different forms of them have been constructed. The simplest and best consist essentially of a tin funnel, the aperture of whose mouth is accurately known. The water is collected by this, and allowed to flow into a graduated measure, by which its exact amount is ascertained. The object of the funnel is to prevent evaporation.

Fig. 9 represents a good form of instrument. The area of the fnnnel is exactly known, and as the graduated measure is smaller than this, an inch of rain will fill several inches in it, and thus the readings are rendered more accurate. The rain is often collected in a metal vessel, and then ponred into the measure, as the glass is liable to be broken by a frost.

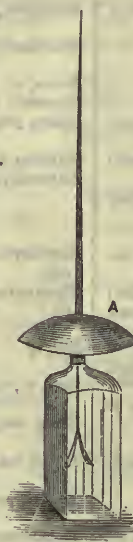


Fig. 10.

One remarkable fact in the use of these instruments, is that the height above the ground at which they are placed makes a very great difference in the reading. When on an elevated position, as, for instance, the top of a house, the reading will be found to be much less than when it is on the ground. In one instance, the amount shown by a gauge at an elevation of forty-four feet was 19·85 inches, while a precisely similar gauge on the surface of the ground recorded 25·71 inches. On this account great care is necessary in comparing measures of the rain-fall made by different observers. The best plan is to let the top of the funnel be just twelve inches above the ground; if all are placed thus, results can easily be compared. The reason of the discrepancy is by no means clear. Many explanations have been proposed, but none of them appear altogether satisfactory. It is, probably, to be attributed mainly to eddies or currents in the air, which play round the instrument when it is at an elevation, and thus blow away some of the finer drops.

There is a very great difference in the amount of rain-fall at different places on the earth's surface. In two or three districts it is hardly ever known to fall; these are known as the rainless districts of the world. In the Old World, they are the Sahara, part of Arabia, and the Desert of Gobi; and in the New, the Coast of Peru and a portion of Mexico. On the other hand, there are isolated stations where the rain-fall is very great. In the Khasia Hills, north-west of Calcutta, 600 inches fall in the year, and as mnch as 30 inches has been known to fall on each of five successive days. This is the largest rain-fall known.

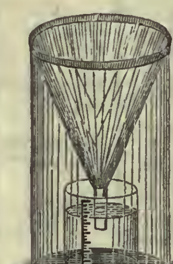


Fig. 9.

Such heavy showers as these are never known in more northern latitudes; bnt in places in Cumberland and Scotland as much as six or seven inches has been recorded in the day on more than one occasion.

The rain-fall, as a general rule, diminishes in amount as we recede from the tropics to the equator; the number of rainy days, however, increases. The reason of this apparently strange fact is that in the tropics the showers are usually much more heavy and continuous, but are almost confined to the wet season. During the dry season, months often pass during which scarcely a single drop of rain falls. In the northern hemisphere, from 12° to 43° latitude, the average number of rainy days is 78; from 43° to 46° it is 103; from 46° to 50° it is 134; and thence to 60°, 161. In this statement a fall of $\frac{1}{100}$ of an inch is taken to constitute a rainy day, this standard being now very generally adopted.

At London the mean rain-fall is about 23½ inches; the average for Great Britain is a little above this; while in some of the hilly districts it ranges as high as from 80 to 150 inches. The proximity of hills, however, always greatly increases the amount of rain, by condensing the vapour of the air in the manner already explained. Other local causes likewise exert a powerful influence.

When the temperature of the air is down to the freezing point, the minute vesicles of vapour, as they condense, are frozen into particles of ice, which unite together, and fall to the earth in the form of snow. When collected on a cool black surface, and viewed through a microscope or a powerful lens, the snow-flakes are found to consist of a great number of beautiful crystals. The shapes which they assume are very varied indeed, bnt nearly all have somewhat the form of six-rayed stars. Fig. 2 in "Mineralogy," page 49, represents a few of the more common forms, but more than a thousand varieties have been observed, many of which have been sketched. The exquisite symmetry and beauty of some of them cannot be described; they must be observed, and will repay the tronble taken in the examination.

The flakes fall but slowly, owing to the broad surface they present as compared with their weight. When the temperature is a little above 32° they often unite, and form larger ones, which sometimes attain the diameter of an inch. During any one fall of snow there will be found to be a strong general similarity in the forms of the crystals; they vary, however, greatly in different storms, though the hexagonal structure is found to prevail almost universally.

Snow but rarely falls in Europe at a lower latitnde than 30° N.; over the sea this limit is considerably higher, and on the west coast of America it attains the latitude of 45° N. The line indicating this limit very nearly coincides with the winter isothermal of 52°.

In the polar regions the surface of the ground is constantly covered with snow, and in all latitudes the snow lies permanently on the tops of the highest mountains. The line marking the limit above which the snow lies on the ground all the year round is called the snow-line. The elevation of this under the equator is about 16,000 feet above the sea-level; from this it declines, till, about latitnde 78°, it is level with the ground. Its elevation does not, however, decrease very regularly, being considerably affected by local causes, the principal of which are the sitnation of the mountain with respect to the rain-bringing winds, the slope of its sides, and the general humidity of the locality. On that side of a range from which the moist winds usually blow the amount of snow which falls will be much greater, and therefore it will lie at a lower level during the summer, as there is not time for it to melt.

The most remarkable irregularity of this kind occurs in the Himalayas, where the snow-line is nearly 4,000 feet higher on the north than it is on the south side. This is principally to be accounted for by the greater dryness of Thibet, which affects it in several ways. It diminishes greatly the amount of snow which falls on that side, as compared with the southern slope; it causes that which does fall to evaporate much more rapidly, since the air is not nearly saturated with moisture; and, further, the dryness of the air allows more of the solar heat to pass and warm the earth, since air when charged with vapour acts as a screen, and keeps off the heat.

The white colour of snow arises from the combination of the various rays which are given off by the crystals of which it is composed; when viewed separately, they reflect all the various primatic colours, but seen collectively, these blend and form the pure white.

Red snow and *green* snow are occasionally met with in Arctic regions; it is also met with during the winter in parts of the Alps. These appearances are caused by the presence of very minute plants which flourish in the snow, and impart to it their own tinge.

As the snow falls very loosely, it entangles a large amount of air between its particles, and thus becomes a very bad conductor of heat. It serves in this way a very important purpose in the economy of Nature, by protecting the surface of the ground from the extreme cold of winter. In very cold seasons the temperature of the ground under the snow is often many degrees higher than that of the air around; the importance of this to the young plants can easily be understood.

Sleet seems to be caused by snow-flakes becoming partially melted in their fall. The snow is sometimes produced in the higher regions of the atmosphere, being caused by a current of air at a very low temperature. The air below is, however, several degrees warmer, and hence the flakes are partially melted in falling, and as they come in contact with one another, unite, and thus produce the larger flakes so frequently noticed.

Sometimes the moisture of the air falls to the ground in the shape of small pieces of ice, known as hail. There is some difficulty in accounting fully for this, especially as it is most common in tropical regions and during the heat of summer. It usually falls, too, at the hottest part of the day.

Its formation is probably to be explained by a very cold current of air suddenly rushing into one at a much higher temperature, and nearly saturated. The rain thus formed is at once congealed into small lumps of ice. This theory is supported by the greater frequency of hail-storms in mountainous regions, where these cold blasts are produced by the proximity of fields of snow and ice.

Hailstones are usually of a globular form, and regular in shape. If they be cut through, their internal structure is likewise found to be regular, as if composed of crystals radiating from a centre. They vary in size from about a tenth of an inch upwards to several inches in diameter. Many well-authenticated instances are on record in which they have attained the size of pigeons' eggs, and they have been known much larger.

In many places much damage is done to the crops by hailstorms, the tender plants being beaten down and destroyed. In the south of France the annual damage to the vines from this cause is very great and serious. Sometimes birds, and even larger animals, have been killed by the hail, and great injury has been caused to windows and roofs of houses.

The fall of snow or hail is not indicated by a rain-gauge, and hence the reading of this does not represent the full amount of water that falls upon the ground. Usually snow is found to occupy some ten or twelve times the bulk of an equal weight of water; but when the temperature is high it lies closer than this. Some observers merely measure the depth of the snow in a place where it is not affected by drifts, and then take one-tenth of this to represent the equivalent rain-fall. This is not, however, a very accurate plan; the better way is to plunge an open tin vessel down into the snow till it touches the ground. Then take it up with the snow in it, and, setting it in a warm place, let it stand till the snow is melted. The depth of water can then be measured, and this amount should be added to the rainfall of the day, as shown by the gauge.

Waterspouts and whirlwinds constitute another very remarkable class of meteoric phenomena, which we will notice here, though they seem to belong partly to aërial and partly to aqueous meteors.

When two currents of air are impelled obliquely against one another, a whirlwind or eddy is produced. These may constantly be seen on a small scale during summer, when the gusts of wind will catch up small particles of straw, dust, or loose materials, and whirl them round in a spiral, sometimes carrying them a little way up in the air.

In sandy deserts this is witnessed on a much grander scale. The sand is caught up by the wind, and formed into tall, stout columns, which rotate on their axes, and move about, sometimes with a slow, stately motion, at other times travelling very rapidly, and in irregular directions. The appearance presented by a large number of these sand-columns has been described by various travellers, and is, indeed, very remarkable.

Fig. 11.—DISCHARGES OF ELECTRICITY DURING A VOLCANIC ERUPTION.

The *dust whirlwinds* of India are similar phenomena. Their presence is first indicated by a dark cloud seen in the horizon; this rapidly spreads, and bursts upon the observer. The air is quite thick with the dust which is carried up by the wind, and sometimes the storm may be seen advancing, and presenting the appearance of a number of spiral clouds hurrying rapidly onwards. The air is highly electrical, this being probably produced by friction of the particles of dust in the air.

Sometimes the agitation of the air becomes even more violent, and then we have the tropical whirlwinds, which uproot trees, overturn buildings, and seem to carry everything before them.

When these whirlwinds occur over large bodies of water, they often give rise to waterspouts. A dark cloud appears, and is whirled round by the wind so as to produce a conical mass of vapour, reaching nearly to the surface of the water, which is likewise so violently agitated that frequently it appears to be connected with the lower end of the vapoury column. Many have supposed that the water is actually sucked up from the sea by the spiral motion, but this is now known to be a fallacy, as water that falls from the spout on the surface of vessels is found to be fresh, and not salt, as it would be were this theory true.

A great quantity of rain is often produced as these waterspouts break. Sometimes they travel on to the land, and the mass of water suddenly liberated from them has often power enough to hollow out a large excavation. Their origin is not fully understood. There is no doubt but that they are in many respects closely allied to whirlwinds, but the electrical condition of the air seems likewise to have much to do with their formation, as they are frequently accompanied by flashes of lightning. The chief danger to ships in the neighbourhood of them arises from the violence of the gusts of wind, and the sudden way in which they shift about to different points of the compass.

We will now turn our attention to the remaining meteors, most of which may be classed as the *luminous* or *optical* phenomena of the atmosphere. The most important of these are the electrical, such as the lightning and the aurora borealis.

The identity of lightning and electricity was conclusively proved more than a century ago, by the celebrated kite experiment of Franklin, in which he succeeded in drawing sparks from a key attached to the string of his kite. The string became moistened by the rain, and thus was converted into a conductor, down which the electric fluid passed in a continuous stream.

This experiment was performed just before a thunder-storm; the air is, however, always charged more or less with electricity, the presence of which may be made manifest by a delicate electroscope. In the instrument commonly employed, and represented in Fig. 10, the disc of the ordinary gold-leaf electroscope is replaced by a slender rod, terminating in a metal point or ball.

The metal screen, A, serves to protect the glass bottle from the rain, and thus improves the insulation. Two strips of gold leaf are fastened to the inner end of the rod, and by their divergence they show the quantity of electricity present in the air. The apparatus should be placed in a somewhat elevated position.

Sometimes insulated conducting wires are fixed to lofty poles, and the electricity of the air examined in this way. When this is done, a large metal ball connected with the earth should be placed at a few inches from the wire, in case the lightning should pass along it, and produce disastrous effects. Fatal accidents have, indeed, arisen from want of due precaution, and experiments of this kind should only be repeated with great care.

From long-continued series of observations, it is found that the air is almost always charged with positive electricity, the intensity of which increases with the elevation. The few occasions on which negative electricity has been observed were for the most part during heavy rain.

The amount of electricity present in the air is at its maximum in mid-winter; it is subject also to a daily fluctuation, attaining a maximum twice each day—the first time in the morning, and then again a little after sunset.

There has been much inquiry as to the origin of this electricity. The following appear to be its principal sonrces:—When *pure* water is evaporated, no electricity is evolved; but if any salt or impurity be present in the water, electricity at once appears. Now sea, river, and lake water all contain impurities, and as the amount of evaporation that goes on is, as we have seen, very great indeed, much of the atmospheric electricity may probably be set down to this canse.

Friction is another cause of electricity. The wind strikes against terrestrial objects; it is also frequently charged with dust and particles of watery vapour, which rub against each other, and thus add to the friction, and in this way electricity is set free.

Vegetation and combustion seem also to increase the amount of free electricity. To the latter of these causes must be attributed the brilliant flashes of lightning which accompany volcanic eruptions (Fig. 11).

TERMS USED IN COMMERCE.—VI.

NOTING OF A BILL.—A note taken of its presentation for acceptance or payment, customarily effected on a second presentation by a notary, as proof of the claim having been duly made.

NULL AND VOID.—Of no effect.

ON DIT (*People say*).—Placed at the beginning of a sentence to denote that what fellows is a flying rumour.

OPEN ACCOUNT.—An account in Dr. and Cr. form, exhibiting all open transactions between two parties, setting down the amonnts of those transactions that are determined but not matured, and estimating the ont-turn of those still pending, so that the balance shows a close estimate of the respective position of the parties concerned in the account.

OPEN POLICY.—In marine insurance, where a certain sum is insured, leaving the declaration of the goods and their valnes to be subsequently made.

OPTIONS.—Speculative transactions on the Stock Exchange, where persons give so much per cent. for the *option* of buying or selling so much stock at a fixed price on a certain fixed day.

OVERCHARGE.—An excessive charge or price.

PANIC.—A sudden fright, especially when without cause. Used commercially to denote a general distrust with regard to money matters.

PAR.—Exact corresponding value, neither enhanced by prêmium nor depreciated by discount.

LESSONS IN SPANISH.—XIX.

THE PRONOUN.

PERSONAL PRONOUNS.

THE personal pronouns of the nominative case, when used, may come either before or after the verb, except the latter be in the imperative mood, or the sentence be interrogative, in which cases the nominative generally follows the verb; as, viva ella, *may she live*; ¿ ha hablado él? *has he spoken?*

As the verb-ending generally indicates of itself the person and number that its nominative must be, the nominative personal pronouns are seldom expressed in Spanish, unless when necessary to distinguish the persons or genders, or to be emphatic, or when a relative pronoun is to follow; as—

El que tiene dinero, tiene cuidados, *he who has money has cares.*
El y ella son prudentes, *he and she are prudent.*
Nosotros seramos castigados, y no vosotros, *we shall be punished, and not you.*

The pronoun se, *oneself*, is sometimes used with a reflective or reciprocal verb, and then it is to be rendered in English by *himself, herself, itself, themselves*, or *one another*, as the sense may require; as in the following example:—

Ellas se aman, *They love themselves* (or, *they love one another*).

The first objective case of all the personal pronouns is also employed with reflective or reciprocal verbs; as—

Nosotros nos aman, *we love ourselves* (or *each other*).
Yo me alabo, *I praise myself.*
Yo no quero alabarme, *I wish not to praise myself.*

The pronoun *se* is also frequently used with the verb in the active voice, of the third person singular or plural, to express the passive voice; as in this example:—

La casa se quemó, *The house was burned* (*the house burnt itself*).

The first objective case of all the personal pronouns is sometimes used with a reflective verb in a passive sense; as—

Yo me admiro, *I am surprised* (*I surprise myself*).
Vosotros os alegrais, *you are rejoiced* (*you rejoice yourselves*).

Strictly speaking, *se* cannot be used in the nominative case, and should therefore always be considered as governed by a verb. Thus, in such sentences as *se dice, se cree, se piensa*, the literal rendering is, *it says itself, it believes itself, it thinks itself*, or *it is said, it is believed, it is thought*. Still, in translating, it is often more convenient to imagine *se* as an indefinite pronoun of the nominative case, nsed in the sense of *they*; as, se dice, *they say*, that is, *people say*; se piensa, *they think.*

Se and other pronouns of the first objective case are often used in Spanish with neuter and active intransitive verbs reflectively, and in such cases seem redundant in English; as—

De allí se pasó á la ciudad, *thence he passed* (*himself*) *to the city.*
Yo me arrepiento, *I repent* (*myself*).
Se arrepiente, *he repents* (*himself*).

Se is sometimes used in the sense of *to him, to her, to them, to you* (i.e., *to your worship*). This use of *se* takes place only when another personal pronoun of the objective case and of the third person immediately follows it; as—

Tengo una cuchara; se la daré,* *I have a spoon; I will give it to him.*

* We cannot say, *le la daré*, I will give it to him, but *se la daré.*

When, in cases coming under the above rule, the pronoun *se* does not denote with clearness the number or gender of the noun for which it is employed, the second objective is also used; as—

Se lo daré á ella, á ellos, á vmd., *I will give it to her, to them, to you.*	Se la mandó dar á ellos, *he commanded it to be given to them.*

The first objective case of the Spanish personal pronouns is very often to be rendered in English by the preposition *to*, and the pronoun; as, *to me, to you, to him, to her, to them*, etc., and it is then equivalent to the second objective, *á mí, á vosotros, á él, á ella, á ellos*, etc.; and in some cases some other preposition than *to* is used in rendering the first objective into English; as—

Juan me dijo, *John said to me.* Te lo pido, *I ask it of thee* (or, *from thee*).	Se lo agradezco, *I thank him for it.* Nos lo suplica, *he beseeches us for it.*

The second objective with the preposition *á* is not used, except when the same verb governs two or more pronouns in the objective case, or when it is designed to be distinct or particularly emphatic; as—

Juan vive, dijeron ellos á ella, *John lives, said they to her.* Yo ví á vosotros y á ellos, *I saw you and them.*	Juan dió dinero á él, á ella, y á tí, *John gave money to him, to her, and to thee.*

To add more clearness or strength to a sentence, both objective cases of pronouns are often employed; the second objective case then being placed either before the first objective or else after the verb, except the first objective case comes after the verb (as in the case of infinitives, gerunds, and imperatives), when the second objective must come after the first; as—

Á mí me dijeron, or me dijeron á mí, *they told me.* Decirme á mí, *to tell me.*	Diciendole á ella, *telling her.* Díme á mí, *tell me.*

When the sentence may contain a noun in the objective case governed by the preposition *á*, a pronoun of the second objective case is often used in Spanish, and is not to be translated in English; as—

Á Dios nádie le vió jamas,	*God no man saw* (*him*) *ever;* i.e., *no one ever saw God.*

Mismo, meaning *same* or *self*, is often used with the nominative personal pronouns; thus, yo mismo, *I myself;* nosotros mismos, *we ourselves*, etc.; and also with the second objective; and must always agree in gender and number with the noun to which the pronoun refers; as—

¿ Qué dices de tí mismo? *what sayest thou of thyself?*	La muger hablará por se misma, *the woman will speak for herself.*

Mismo is often used with nouns also; as, la misma María, *Mary herself;* los mismos soldados, *the very soldiers* or *the soldiers themselves.*

When by the pronoun *it* is meant anything to which we cannot apply a gender, *ello* is used. Its first objective *lo* is employed by the same rule. Thus if it be said, "he has been told to love his enemies, and he does *it*," the pronoun *it* refers to the clause of the sentence, "to love his enemies," and of course has no gender. In such a case, *lo* (not *le* nor *la*) would be used.

Lo is used in Spanish for *so* in English, when the latter means *it;* as—

Vmd. piensa que ella es rica, pero no lo es, *you think that she is rich, but she is not so.*	Sí lo es, *if it be so.* Diego lo hace, *James does so.*

Lo is often used for *le* when the latter refers to a masculine noun and is immediately governed by a verb (though this use of *lo* is not grammatically correct); as—

Espero que lo véo en perfecta salud.	*I hope that I see him in perfect health.*

DEMONSTRATIVE PRONOUNS.

The demonstrative pronouns *este* and *aquel* are often used without any noun, and in such a case they have the sense of *this one* and *that one*, or *the one;* as—

Este es aquel de quien yo dije,	*This one is the one of whom I said;* or, *this is he of whom I said.*

Todo aquel que is used in the sense of *every one who;* as—

Todo aquel que bebe de esta água,	*Every one who drinks of this water.*

Quien often means *he who, she who, one who;* and *quienes* is used for *they who;* as—

Quien calla otorga, *he who is silent, consents.* María fué quien lo dijo, *Mary was she who said it.*	Porque los enseñaba, como quien tiene autoridad, *for he taught them as one who has authority.*

Such expressions as *it is I, it is thou, it is he, it is she, it is we*, etc., are rendered in Spanish by *I am, thou art, he is, she is, we are*, etc.; as—

Yo soy, *it is I.* Ella es, *it is she.*	Ellos son, *it is they.* ¿ Es vmd.? *is it you?*

THE VERB.

AGREEMENT OF THE VERB WITH ITS SUBJECT.

The verb agrees, in number and in person, with its subject or nominative, expressed or understood; as—

Soy general, *I am a general.* Ella ama la verdad, *she loves the truth.*	Los Americanos aman las riquezas, *the Americans love riches.*

When a verb has two or more subjects, each in the singular, it is put in the plural; as—

Mi padre y mi madre me aman, *my father and my mother love me.*	Pedro ó Diego vendran,* *Peter or James will come.*

When a verb has two or more subjects of different persons, it is put in the plural, and agrees with the first person in preference to the other two; as—

Mi hermano y yo estamos malos, *my brother and I* (i.e., *we*) *are ill.*	Tú y yo estamos buenos, *thou and I* (i.e., *we*) *are well.*

If the second person should be used with the third, without any first person, the verb must be in the second person plural:—

Tú y ella estais buenas,	*Thou and she* (i.e., *you*) *are well.*

When a relative pronoun is the subject of the verb, the latter must agree, in person and number, with the noun or pronoun to which the relative relates; as—

Yo soy que hablo contigo, *it is I who speak with thee.*	Vosotros que sois sábios, *ye who are wise.*

A collective noun, taken in a general sense, that is, a noun representing the whole of the persons or things mentioned, requires the verb to be of the singular number; as—

El ejército de los Caldéos persiguió al rey,	*The army of the Chaldeans pursued the king.*

A subject which is a collective noun, taken in a partitive sense, that is, representing a part of the whole of the collective noun, and conveying plurality of idea, requires the verb to be in the plural; as—

Parte creían lo que les decía, y parte no lo creían,	*Part believed what he told them, and part believed it not.*

This last rule is not always followed, even by the best Spanish authors.

In cases in which a verb appears to have two subjects, it must agree with that noun to which it seems more particularly to belong; as—

Los gages del pecado son muerte,	*The wages of sin are* (*is*) *death.*

USE OF THE MOODS AND TENSES OF VERBS.

THE INFINITIVE, GERUND, AND PARTICIPLE.

The present tense of the infinitive expresses affirmation in an indefinite manner, without reference to number or person; as, decir, *to say;* dar, *to give.*

The infinitive is used in Spanish when in English the present participle, preceded by a preposition, is used; as—

En derramar torrentes de sangre, *in spilling* (*to spill*) *torrents of blood.*	Vengo de comer, *I come from dining* (*to dine*), i.e., *from dinner.*

The infinitive is frequently used as a verbal noun or present participle, by placing the masculine definite article before it; as in these examples:—

Al caer del dia, *at the fall* (*at the to fall*) *of the day.* El leer me gusta, *reading* (*the to read*) *pleases me.*	El murmurar de las fuentes, *the murmuring* (*the to murmur*) *of the fountains.*

The infinitive is often rendered in English by the present

* This is different, as will be perceived, from the rule in English syntax, which requires two singular nouns connected by a disjunctive conjunction, to have the verb agree with them in the singular form.

participle, when in Spanish it is governed by another verb; as—

La oimos cantar, *we heard her singing* (*to sing*).

Le ví correr, *I saw him run, or running* (*to run*).

In Spanish the gerund is employed in the sense of the present participle in English; as—

Queriendo seguir dispensándolos, plantó árboles frutales, *desiring to continue dispensing them, he planted fruit-bearing trees.* [*speaking.*

María está hablando, *Mary is*

Estando enfermo el presidente, *the president being sick.*

Habiendo conspirado unos caballeros, *some cavaliers having conspired.*

In sentences such as *Charity is increased by cultivating it*, it is allowed in Spanish to use either the gerund without the preposition, or the infinitive mood preceded by the preposition *con*; as—

Nuestros deberes se hacen agradables cumpliéndolos; *or*, Nuestros deberes se hacen agradables con cumplirlos,

Our duties are rendered agreeable by performing them.

Instead of the gerund of the past, the gerund of the present is sometimes employed, preceded by the preposition *en*; as—

En oyendo esto, salió para Bóston; *or*, Habiendo óido esto, salió para Bóston,

On hearing this, he set out for Boston; having heard this, he set out for Boston.

The gerund in Spanish is often employed in a manner that requires the adverb *while* to be used in translating it into English; as—

El que vive en deleites, viviendo está muerte,

He who lives in pleasures, while living is dead.

The past participle is indeclinable when used to form the compound tenses with the auxiliary verb *haber*; as—

Las mugeres han hablado, *the women have spoken.*

Ella ha hablado, *she has spoken.*

When the past participle is used with any other verb than *haber*, it is declinable; as—

Ella ha sido seducida, *she has been deceived.*

Mis caballos estan lastimados, *my horses are injured.*

Mis hijas se hallan molestadas, *my daughters find themselves molested.*

Mis hermanas quedan satisfechas, *my sisters remain satisfied.*

Ellas van satisfechas, *they go satisfied.*

Ella anda pasmada de mis palabras, *she walks enraptured with my words.*

Tiene escritas tres cartas, *he has three letters written.*

Lleva escritas tres cartas, *he carries written three letters.*

These last examples, it will be perceived, require the participle to agree with the noun governed (*cartas*). *Tener* and *llevar* are, as above, sometimes used as a kind of auxiliary verbs, and can always be rendered by *have*; thus each of these examples may be translated, *he has written three letters.*

The past participle is in Spanish used with a noun or pronoun in the case absolute; thus, *hallado* means *found*, and absolutely, *being found*; *enviado* means *sent*, and absolutely, *being sent*; *recibido* means *received* and *being received*. In general, the participle is placed before the noun of the case absolute, with which it agrees (though the rules of Spanish construction admit of its being placed after the noun); as—

Tormada Vera-Cruz, el General Scott salió para Jalapa,

Vera Cruz being taken, General Scott set out for Jalapa.

TENSES OF THE INDICATIVE MOOD.

The present tense expresses an existing state or an action occurring at the time in which we are speaking; as—

Mi hermano escribe, *my brother writes.*

Estas doncellas son amadas, *these maidens are beloved.*

The verb *estar* can be used with the gerund in Spanish, as in English the verb *to be* with the present participle; as—

Juan está leyendo, *John is reading.*

Ellos están cantando, *they are singing.*

The verbs *ir* (to go) and *venir* (to come) do not admit of the verb *estar* coming before their gerund as in the above rule. Thus we cannot say in Spanish, *yo estoy yendo* and *yo estoy viniendo*, but *yo voy* and *yo vengo* (I go and I come), I am going and I am coming.

The imperfect tense is used to express what is past, and, at the same time, present, with regard to something else which is past; that is, it is a past tense which was still present at the time spoken of. It may always be employed in Spanish when in English the word *was* can be used with the present participle, or *used to* can be employed with the verb, or when we speak of habitual actions; as—

Cervántes era un escritor elegante, *Cervantes was an elegant writer.*

Neron era un tirano, *Nero was a tyrant.*

Cuando fuí niño, hablaba como niño, *when I was a child, I spoke as a child.*

Ella ascribía entónces, *she was writing then.*

Seneca razonaba bien, *Seneca reasoned well.*

Ellos marchaban por las calles cuando los vimos, *they were marching through the streets when we saw them.*

It is evident that *Seneca reasoned well* means *Seneca used to reason* (or *was accustomed to reason*) *well.*

The perfect definite tense shows the action or being affirmed by the verb to be completed, at a time of which nothing more remains, often specified by an adverb or some other circumstance expressed or understood; as—

El presidente no le perdonó, *the president pardoned him not.*

Diego vivía cuando le ví, *James was living when I saw him.*

Escribió una carta ayer, *he wrote a letter yesterday.*

Recibió dos cartas la semana pasada, *he received two letters last week.*

Luego que Juan se lo dijo, lloraron, *as soon as John told it to them, they wept.*

PLANE TRIGONOMETRY.—IV.

XVIII. *Application of the foregoing Formulæ.*—It will be readily seen how the power to work out numerical values for functions of different angles is extended by the results of the last few sections. We may now obtain values for the half or third, or for twice or three times any of the angles whose values were computed geometrically in Section V., and for any combinations arising by addition or subtraction of angles so calculated. In this way, by steps which cannot be followed here, the entire table of natural sines and cosines has been constructed, and by means altogether foreign to this treatise the corresponding logarithms have been worked out for every degree and minute from 0° to 90° (see, amongst other works, Galbraith and Haughton's Mathematical Tables). Moreover, the numerous formulæ derived from the "four fundamental formulæ" are of great use in helping us to simplify trigonometrical expressions, and to change them into forms more suitable for logarithmic calculation, or otherwise more convenient to deal with. The following cases, given as examples, show how apparently formidable expressions can be turned into simple ones, easily solved, by mere knowledge how to make use of the formulæ:—

1. Reduce $\frac{1-\cos. A}{\sin. A}$ to a single trigonometrical function.

By (63) and (60)—

$$\frac{1-\cos. A}{\sin. A} = \frac{2\sin.^2 \frac{1}{2} A}{2\sin. \frac{1}{2} A \cos. \frac{1}{2} A} = \frac{\sin. \frac{1}{2} A}{\cos. \frac{1}{2} A} = \tan. \tfrac{1}{2} A.$$

2. Simplify $\frac{1+\cot.^2 A}{2\cot. A}$. By (25) and (52)—

$$\frac{1+\cot.^2 A}{2\cot. A} = \frac{\operatorname{cosec.}^2 A}{2\cot. A} = \frac{1}{\sin.^2 A} \cdot \frac{\sin. A}{2\cos. A} = \frac{1}{2\sin. A\cos. A}$$
$$= \frac{1}{\sin. 2A} = \operatorname{cosec.} 2A.$$

3. Reduce cosec. A + cot. A to a single function. By (62) and (60)—

$$\operatorname{Cosec.} A + \cot. A = \frac{1}{\sin. A} + \frac{\cos. A}{\sin. A} = \frac{1+\cos. A}{\sin. A} = \frac{2\cos.^2 \frac{1}{2} A}{2\sin. \frac{1}{2} A \cos. \frac{1}{2} A}$$
$$= \frac{\cos. \frac{1}{2} A}{\sin. \frac{1}{2} A} = \cot. \tfrac{1}{2} A.$$

4. Express tan. A + cot. A by a single function.

$$\operatorname{Tan.} A + \cot. A = \frac{\sin. A}{\cos. A} + \frac{\cos. A}{\sin. A} = \frac{\sin.^2 A + \cos.^2 A}{\sin. A\cos. A} = \frac{1}{\sin. A\cos. A}$$
$$= \frac{2}{2\sin. A\cos. A} = \frac{2}{\sin. 2A} = 2\operatorname{cosec.} 2A.$$

5. Reduce $\frac{\sin. A}{1+\cos. A}$ to a single function. This is similar to Case 1.

$$\frac{\operatorname{Sin.} A}{1+\cos. A} = \frac{2\sin. \frac{1}{2} A\cos. \frac{1}{2} A}{2\cos.^2 \frac{1}{2} A} = \frac{\sin. \frac{1}{2} A}{\cos. \frac{1}{2} A} = \tan. \tfrac{1}{2} A.$$

6. Express $\frac{\cos. A}{1+\sin. A}$ by a single function. This is again similar.

$$\frac{\text{Cos. } A}{1+\sin. A} = \frac{\sin. (90^\circ - A)}{1+\cos. (90^\circ - A)} = \frac{2 \sin. (45^\circ - \frac{1}{2} A) \cos. (45^\circ - \frac{1}{2} A)}{2 \cos.^2 (45^\circ - \frac{1}{2} A)}$$
$$= \frac{\sin. (45^\circ - \frac{1}{2} A)}{\cos. (45^\circ - \frac{1}{2} A)} = \tan. (45^\circ - \tfrac{1}{2} A).$$

7. Bring $\cos.^4 A - \sin.^4 A$ to a single function.

$$\text{Cos.}^4 A - \sin.^4 A = (\cos.^2 A + \sin.^2 A)\ (\cos.^2 A - \sin.^2 A)$$
$$= 1 \times \cos. 2 A = \cos. 2 A.$$

8. Bring sec. A + tan. A to a single function (remember that $90^\circ + A$ = complement of A, and bear in mind signs of angles in second quadrant).

$$\text{Sec. } A + \tan. A = \frac{1}{\cos. A} + \frac{\sin. A}{\cos. A} = \frac{1+\sin. A}{\cos. A} = \frac{1-\cos. (90^\circ + A)}{\sin. (90^\circ + A)}$$
$$= \frac{2 \sin.^2 \frac{1}{2} (90^\circ + A)}{2 \sin. \frac{1}{2} (90^\circ + A) \cos. \frac{1}{2} (90^\circ + A)} = \tan. (45^\circ + \tfrac{1}{2} A).$$

9. Reduce sin. A tan. $\frac{1}{2}$ A.

$$\text{Sin. } A \tan. \tfrac{1}{2} A = 2 \sin. \tfrac{1}{2} A \cos. \tfrac{1}{2} A \cdot \frac{\sin. \frac{1}{2} A}{\cos. \frac{1}{2} A} = 2 \sin.^2 \tfrac{1}{2} A$$
$$= 1 - \cos. A = \text{versin. } A.$$

10. Simplify $\frac{\cot. A + \tan. A}{\cot. A - \tan. A}$.

$$\frac{\text{Cot. } A + \tan. A}{\text{Cot. } A - \tan. A} = \frac{\dfrac{\cos.^2 A + \sin.^2 A}{\sin. A \cos. A}}{\dfrac{\cos.^2 A - \sin.^2 A}{\sin. A \cos. A}} = \frac{\cos.^2 A + \sin.^2 A}{\cos.^2 A - \sin.^2 A}$$
$$= \frac{1}{\cos. 2 A} = \sec. 2 A.$$

11. Express $\frac{\sin. A + \sin. 3 A}{\cos. A + \cos. 3 A}$ by a single function. By (41) and (43)—

$$\frac{\text{Sin. } A + \sin. 3 A}{\text{Cos. } A + \cos. 3 A} = \frac{2 \sin. \frac{A + 3 A}{2} \cos. \frac{A - 3 A}{2}}{2 \cos. \frac{A + 3 A}{2} \cos. \frac{A - 3 A}{2}} = \tan. 2 A.$$

12. Reduce $\frac{\sin. A + \sin. 3 A + \sin. 5 A}{\cos. A + \cos. 3 A + \cos. 5 A}$. Apply (41) and (43) as before, but only to first and last terms of numerator and denominator; then—

$$\frac{\sin. A + \sin. 3 A + \sin. 5 A}{\cos. A + \cos. 3 A + \cos. 5 A} = \frac{\sin. 3 A (1 + 2 \cos. 2 A)}{\cos. 3 A (1 + 2 \cos. 2 A)} = \tan. 3 A.$$

13. Show that $\sin. (A + B) \sin. (A - B) = \sin.^2 A - \sin.^2 B$. By (33) and (34)—

$$\text{Sin. } (A + B) \sin. (A - B) = \sin.^2 A \cos.^2 B - \cos.^2 A \sin.^2 B$$
$$= \sin.^2 A (1 - \sin.^2 B) - \sin.^2 B (1 - \sin.^2 A)$$
$$= \sin.^2 A - \sin.^2 A \sin.^2 B - \sin.^2 B + \sin.^2 A \sin.^2 B$$
$$= \sin.^2 A - \sin.^2 B.$$

14. Show that $\cos. (A + B) \cos. (A - B) = \cos.^2 A - \sin.^2 B$. Proceed as in last case, by (35) and (36).

15. Solve the equation, $a \tan. x = b \cos. x$. Multiply both sides by cos. x; then—

$$a \sin. x = b \cos.^2 x = b (1 - \sin.^2 x);$$
$$\therefore \sin.^2 x + \frac{a}{b} \sin. x - 1 = 0;$$
$$\therefore \sin. x = \frac{-a \pm \sqrt{4b^2 + a^2}}{2b}.$$

16. Show that $\tan.^2 A - \tan.^2 B = \frac{\sin. (A + B) \sin. (A - B)}{\cos.^2 A \cos.^2 B}$.

$$\text{Tan.}^2 A - \tan.^2 B = (\tan. A + \tan. B)\ (\tan. A - \tan. B)$$
$$= \left(\frac{\sin. A}{\cos. A} + \frac{\sin. B}{\cos. B}\right) \left(\frac{\sin. A}{\cos. A} - \frac{\sin. B}{\cos. B}\right)$$
$$= \left(\frac{\sin. A \cos. B + \cos. A \sin. B}{\cos. A \cos. B}\right) \left(\frac{\sin. A \cos. B - \cos. A \sin. B}{\cos. A \cos. B}\right)$$
$$= \frac{\sin. (A + B)}{\cos. A \cos. B} \cdot \frac{\sin. (A - B)}{\cos. A \cos. B} = \frac{\sin. (A + B) \sin. (A - B)}{\cos.^2 A \cos.^2 B}.$$

17. Solve the simultaneous equations, $\sin. x + \sin. y = a$, $\cos. x + \cos. y = b$.

By (41) and (43)—

$$2 \sin. \tfrac{1}{2} (x + y) \cos. \tfrac{1}{2} (x - y) = a.$$
$$2 \cos. \tfrac{1}{2} (x + y) \cos. \tfrac{1}{2} (x - y) = b.$$

Dividing the first equation by the second, we obtain

$$\tan. \tfrac{1}{2} (x + y) = \frac{a}{b}.$$

Again, squaring both equations, and adding together, we obtain

$$4 \cos.^2 \frac{x - y}{2} \left(\sin.^2 \frac{x + y}{2} + \cos.^2 \frac{x + y}{2}\right) = a^2 + b^2.$$

But the last factor of left-hand side = 1,

$$\therefore \cos.^2 \tfrac{1}{2} (x - y) = \tfrac{1}{4} (a^2 + b).$$

From these two results the unknown quantities x and y may be found by addition and subtraction.

XIX. *Subsidiary Angles.*—Trigonometrical calculations may often be simplified in form by introducing a *subsidiary* or imaginary angle, by which the sum or difference of two or more magnitudes may be expressed by a product or quotient—often a matter of importance in calculating with logarithms. An example or two will best explain our meaning:—

Solve the equation, $x = a \sin. A + b \cos. A$.

Now assume a subsidiary angle θ, such that $\frac{b}{a} = \tan. \theta$, and substitute this value in above equation.

$$\text{Then } x = a \left(\sin. A + \frac{b}{a} \cos. A\right)$$
$$= a (\sin. A + \tan. \theta \cos. A)$$
$$= a \frac{\sin. A \cos. \theta + \sin. \theta \cos. A}{\cos. \theta}$$
$$= a \frac{\sin. (A + \theta)}{\cos. \theta}.$$

This is a much more manageable expression to deal with, θ being already known by the assumption. As tan. θ may be anything from 0 to ∞, the relative values of a and b are immaterial; but had it been desired to introduce sin. θ, it would have been necessary to see that the ratio assumed to represent it did not exceed unity, as sin. θ cannot exceed 1.

Solve the equation $a \sin. x \quad b \cos. x = c$.

$$a \sin. x - c = - b \cos. x.$$
$$(a \sin. x - c)^2 = b^2 \cos.^2 x = b^2 (1 - \sin.^2 x).$$

Reducing this equation, we obtain the following quadratic for sin. x:—

$$(a^2 + b^2) \sin.^2 x - 2ac \sin. x - (b^2 - c^2) = 0.$$

The solution of which is—

$$\text{Sin. } x = \frac{ac \pm b \sqrt{a^2 + b^2 - c^2}}{a^2 + b^2}.$$

Now assume that $\frac{b}{a} = \tan. \theta$, or $b = a \tan. \theta$, and substitute this in the above equation; then we obtain—

$$a (\sin. x + \cos. x \tan. \theta) = c.$$

Multiply each side by cos. θ, and—

$$a (\sin. x + \cos. \theta + \cos. x \sin. \theta) = c \cos. \theta;$$
$$\text{or,} \quad a \sin. (x + \theta) = c \cos. \theta.$$

From which we obtain the value of $x + \theta$, and ultimately of x, θ being already known from $\tan. \theta = \frac{b}{a}$.

XX. *Ratios between Sides and Angles of Plane Triangles in general.*—The solution of right-angled triangles was explained in Section X., and offered little difficulty. But for the solution of oblique-angled triangles more complex ratios have to be established between the sides and angles, which are contained in the following propositions and formulæ:—

1. *Any two sides of a plane triangle are in the same ratio as the sines of the opposite angles.*

For example, in any triangle A B C, $\frac{a}{b} = \frac{\sin. A}{\sin. B}$ .... (65)

Let ABC be the triangle (Figs. 12 and 13). From C drop CP perpendicular to AB, or, as in Fig. 13, to AB, produced either way;

Fig. 12.

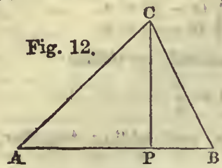
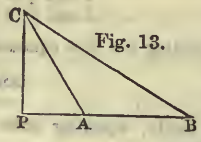


Fig. 13.



then $\sin. A = \frac{CP}{AC}$, and $\sin. B = \frac{CP}{CB}$;

$$\therefore \frac{\sin. A}{\sin. B} = \frac{\frac{CP}{AC}}{\frac{CP}{CB}} = \frac{CB}{AC} = \frac{a}{b}.$$

Similarly, $\frac{a}{c} = \frac{\sin. A}{\sin. C}$; $\frac{b}{c} = \frac{\sin. B}{\sin. C}$.

If A or B be a right angle, there is no need to drop the perpendicular above referred to. The sine of the right angle will of course be unity, but the above reasoning will hold good, and the result be the same.

This statement of ratios between sides and sines of opposite angles is called *the rule of sines*, and may be thus written :—

$$\frac{\sin. A}{a} = \frac{\sin. B}{b} = \frac{\sin. C}{c} \quad \text{.................. (66)}$$

2. *The sum of any two sides is to their difference as the tangent of half the sum of the opposite angles is to the tangent of half their difference.*

By the last proposition, $\frac{a}{b} = \frac{\sin. A}{\sin. B}$.

Then, *componendo et dividendo*—

$$\frac{a+b}{a-b} = \frac{\sin. A + \sin. B}{\sin. A - \sin. B}.$$

Whence, by (47), $\frac{a+b}{a-b} = \frac{\tan. \frac{1}{2}(A+B)}{\tan. \frac{1}{2}(A-B)}$ ...... (67)

This may be written differently; for $\frac{1}{2}(A+B) = \frac{1}{2}(180° - C)$;

$$\therefore \tan. \tfrac{1}{2}(A+B) = \tan. (90° - \tfrac{1}{2}C) = \cot. \tfrac{1}{2}C;$$

$$\left.\begin{aligned} \therefore \frac{a+b}{a-b} &= \frac{\cot. \frac{1}{2}C}{\tan. \frac{1}{2}(A-B)} = \cot. \tfrac{1}{2}(A-B) \cot. \tfrac{1}{2}C \\ \text{Whence,} \quad \frac{a-b}{a+b} &= \tan. \tfrac{1}{2}(A-B) \tan. \tfrac{1}{2}C \end{aligned}\right\} \text{... (68)}$$

3. *The sum of any two sides is to the third side as the cosine of half the difference of the opposite angles is to the cosine of half their sum.*

Since $A + B = 180° - C$, $\sin. (A+B) = \sin. C$;

$$\therefore \frac{a}{c} = \frac{\sin. A}{\sin. (A+B)}, \text{ and } \frac{b}{c} = \frac{\sin. B}{\sin. (A+B)}.$$

Adding these equations, and using (41) and (60), we get—

$$\frac{a+b}{c} = \frac{\sin. A + \sin. B}{\sin. (A+B)} = \frac{2 \sin. \frac{1}{2}(A+B) \cos. \frac{1}{2}(A-B)}{2 \sin. \frac{1}{2}(A+B) \cos. \frac{1}{2}(A+B)};$$

$$\therefore \frac{a+b}{c} = \frac{\cos. \frac{1}{2}(A-B)}{\cos. \frac{1}{2}(A+B)} \quad \text{............... (69)}$$

Similarly (by subtracting the second from the first equation above, instead of adding them together), we find that

The difference of any two sides is to the third side as the sine of half the difference of the opposite angles is to the sine of half their sum;

$$\text{or } \frac{a-b}{c} = \frac{\sin. \frac{1}{2}(A-B)}{\sin. \frac{1}{2}(A+B)} \quad \text{................. (70)}$$

4. *The square of any one side = the sum of the squares of the other sides less twice the rectangle contained by them multiplied into the cosine of the opposite angle* (*i.e.*, the angle included between the sides last mentioned).

If the opposite angle be a right angle, the "contained rectangle," being multiplied by cos. 90°, *i.e.*, by 0, disappears, and leaves only that part of the statement which concerns the squares of the sides, which is proved in Euclid I. 47.

If the opposite angle be acute (Fig. 12), by Euclid II. 13,

$$BC^2 = AC^2 + AB^2 - 2\,AB \cdot AP.$$

But since $\cos. A = \frac{AP}{AC}$, $AP = AC \cdot \cos. A$:

$$\therefore BC^2 = AC^2 + AB^2 - 2AB \cdot AC \cdot \cos. A;$$

or writing a, b, and c for BC, AC, and AB,

$$a^2 = b^2 + c^2 - 2bc \cos. A.$$

If the opposite angle be obtuse (Fig. 13), by Euc. II. 12,

$$BC^2 = AC^2 + AB^2 + 2AB \cdot AP;$$

but $AP = AC \cdot \cos. A = AC \cdot \cos. (180° - A) = - AC \cdot \cos. A$ (A being in 2nd quadrant);

$$\left.\begin{aligned} \text{therefore, as before,} \quad a^2 &= b^2 + c^2 - 2bc \cos. A \\ \text{Similarly,} \quad b^2 &= a^2 + c^2 - 2ac \cos. B \\ \text{and,} \quad c^2 &= a^2 + b^2 - 2ab \cos. C \end{aligned}\right\} \text{...(71)}$$

5. *Sines and cosines of angles in terms of sides.* From (71), by transposition,

$$\left.\begin{aligned} \text{Cos. } A &= \frac{b^2 + c^2 - a^2}{2bc} \\ \text{Cos. } B &= \frac{c^2 + a^2 - b^2}{2ac} \\ \text{Cos. } C &= \frac{a^2 + b^2 - c^2}{2ab} \end{aligned}\right\} \text{..................... (72)}$$

Since $\sin.^2 A = 1 - \cos.^2 A$,

$$\text{Sin.}^2 A = (1 + \cos. A)(1 - \cos. A)$$

$$= \left(1 + \frac{b^2 + c^2 - a^2}{2bc}\right)\left(1 - \frac{b^2 + c^2 - a^2}{2bc}\right)$$

$$= \left(\frac{2bc + b^2 + c^2 - a^2}{2bc}\right)\left(\frac{2bc - b^2 - c^2 + a^2}{2bc}\right)$$

$$= \left(\frac{(b^2 + 2bc + c^2) - a^2}{2bc}\right)\left(\frac{a^2 - (b^2 - 2bc + c^2)}{2bc}\right)$$

$$= \left(\frac{(b+c)^2 - a^2}{2bc}\right)\left(\frac{a^2 - (b-c)^2}{2bc}\right)$$

$$= \frac{(a+b+c)(b+c-a)(a+b-c)(a+c-b)}{4b^2c^2}$$

This expression for $\sin.^2 A$ (and therefore sin. A by extracting the root) is in better form for calculation than (72), as it consists entirely of factors. It can, however, be further simplified by taking

s = *semiperimeter* of triangle;

then $2s = a + b + c$,

and $2(s-a) = b + c - a$,

$2(s-b) = a + c - b$,

$2(s-c) = a + b - c$;

therefore, extracting the root, and simplifying,

$$\sin. A = \frac{2\sqrt{s(s-a)(s-b)(s-c)}}{bc} \quad \text{..................... (73)}$$

The expressions for sin. B and sin. C are similar, but the denominator is ac in the one case and ab in the other.

6. *Sines, cosines, and tangents of the semi-angles.*

By (62), $1 + \cos. A = 2 \cos.^2 \frac{1}{2} A$.

But by the preceding calculations, $1 + \cos. A = \frac{4s(s-a)}{2bc}$;

$$\therefore 2 \cos.^2 \tfrac{1}{2} A = \frac{2s(s-a)}{bc};$$

$$\left.\begin{aligned} \therefore \cos. \tfrac{1}{2} A &= \sqrt{\frac{s(s-a)}{bc}}. \\ \text{Similarly,} \quad \cos. \tfrac{1}{2} B &= \sqrt{\frac{s(s-b)}{ac}} \\ \text{and} \quad \cos. \tfrac{1}{2} C &= \sqrt{\frac{s(s-c)}{ab}} \end{aligned}\right\} \text{.............. (74)}$$

Deducing in a similar manner from other values of $1 - \cos. A$, etc., we get expressions for the sines of the semi-angles, and by dividing the latter by the corresponding expressions for the cosines (74), we get the tangents, as under—

$$\left.\begin{aligned}
\text{Sin. } \tfrac{1}{2} A &= \sqrt{\frac{(s-b)\ (s-c)}{bc}} \\
\text{Sin. } \tfrac{1}{2} B &= \sqrt{\frac{(s-a)\ (s-c)}{ac}} \\
\text{Sin. } \tfrac{1}{2} C &= \sqrt{\frac{(s-a)\ (s-b)}{ab}}
\end{aligned}\right\} \quad \ldots\ldots\ldots\ldots (75)$$

$$\left.\begin{aligned}
\text{Tan. } \tfrac{1}{2} A &= \sqrt{\frac{(s-b)\,(s-c)}{s\,(s-a)}} \\
\text{Tan. } \tfrac{1}{2} B &= \sqrt{\frac{(s-a)\,(s-c)}{s\,(s-b)}} \\
\text{Tan. } \tfrac{1}{2} C &= \sqrt{\frac{(s-a)\,(s-b)}{s\,(s-c)}}
\end{aligned}\right\} \quad \ldots\ldots\ldots\ldots (76)$$

If one of each set be remembered, the other two formulæ can be brought to mind at once in all these cases, owing to the symmetry and obviousness of the system on which the formulæ are constructed.

LESSONS IN ENGLISH LITERATURE.—XX.

THE RESTORATION PERIOD: DRYDEN AND THE POETS.

From what we have said in earlier lessons, our readers will be able to realise to some extent the strength of the reaction which followed upon the downfall of the Puritan influence and the victory of the Court party at the Restoration, and the effect which this change produced upon the literature of the age. Nothing can better show this contrast than a comparison of the character and career of Milton with that of Dryden; Milton the very type of a Puritan poet, Dryden by far the greatest, and probably the best, among the literary offspring of the Restoration.

John Dryden was born in 1631, of an ancient and honourable family, in the county of Northampton. After commencing his education at a school in the neighbourhood of his home, he was removed to Westminster School, then under the government of the celebrated Dr. Busby. From Westminster he was elected to a scholarship at Trinity College, Cambridge, where he took his bachelor's degree in 1654, though he continued to reside at the University for several years after this time. Dryden then removed to London, having in the meantime become possessed of a small fortune by the death of his father. His relatives were all of the Puritan party, and Sir Gilbert Pickering, a near kinsman, under whose immediate auspices Dryden entered public life, was a trusted friend and follower of Cromwell. Naturally, therefore, Dryden's first public efforts were upon the same side. The earliest of his poems of any great pretension is his "Heroic Stanzas on the Death of Oliver Cromwell." But Cromwell was dead, and the Restoration soon followed; and Dryden, like many another, abandoned the fallen creed to worship the rising sun. This event, however, brought Dryden no immediate improvement in fortune or circumstances, but the reverse; for the friends upon whose influence and protection he had formerly relied remained faithful to the fallen cause, and Dryden, separated from them, was left to rely upon his own resources. The first fruits of Dryden's political conversion were two poems—"Astræa Redux," a poem in honour of the king's return, and "A Panegyric on the King on the occasion of the Coronation." But Dryden had to live by his pen, and he therefore applied himself to that form of literature for which, in the reaction from the spirit of Puritanism, the demand was greatest and the reward surest—the drama. For many years, beginning very soon after the Restoration, he produced, in pursuance of an agreement into which he had entered, three pieces for the stage every year; and his plays show an inexhaustible variety in subject and character, though they are all alike in the dramatic defects which we shall have to refer to hereafter. Nor was his diligence in other departments less remarkable, in poetry and in prose alike. In 1670 he was appointed to the office of poet laureate, and, unlike the modern holders of the office, became court poet in reality as well as in name, zealously devoting his great powers to the most servile and indiscriminate flattery of the king and his favourites, and the most violent attacks on all who opposed the party in power. Dryden had been educated among Puritans, but at the Restoration became a rigid Anglican, and wrote one of his greatest poems in defence of the Anglican position. But soon after the accession of James II. he abandoned his old faith, and professed himself a Roman Catholic. Of course the honesty of a change of creed so sudden and so opportune has been much impugned; and though we may not be called upon to suspect Dryden of conscious insincerity in this change any more than in any other of his transitions, religious or political, they at least show the absence of that earnestness of purpose and strength of conviction which characterised the preceding generation, and the want of which marked the age of the Restoration beyond all other periods in our history.

Dryden married, in 1663, Lady Elizabeth Howard, daughter of the Earl of Berkshire, but the marriage was not a happy one. His literary labours were carried on with unceasing diligence down to the time of his death. He died of dropsy in the year 1700.

Before speaking in any detail of Dryden's works individually, it may be well to point out what were the leading features of his genius, what qualities as a poet he had, and what he wanted. The power of pathos is wholly absent in him; he neither arouses our sympathies nor touches our pity. He addresses himself to the reason and judgment, not to the passions or emotions of his readers. The dramatic faculty, again, is very defective in Dryden. He can describe characters with unequalled power and felicity, the satirist's art; but he cannot place them before our eyes living and in action, the dramatic art. But Dryden was a man of immense intellectual ability, capable of being applied with success to almost any task, equally strong in argument and in satire. His observation of the salient points of character was keen, and his judgment in handling every subject with which he dealt admirable. But his greatest gift—that in which he specially excels alone among poets—is his power of expression, style, and versification. His language is everywhere a perfect model of English style, clear, simple, nervous, full of variety and of dignity. In every line there is a force and elevation rarely attained by any other poet, the unmistakable presence of the *vis divinior* of the Latin poet. His verse has been the admiration of each succeeding generation.

From what we have said, it will easily be believed that Dryden's plays are not the works on which his fame should be rested. They are brilliant frequently, with plenty of variety of incident, and the versification (for his plays are, for the most part, in regular rhymed verse) admirable. When they were produced they enjoyed an unbounded popularity. But that was an age in which Shakespeare was despised, and the Elizabethan drama held barbarous. And to a sounder taste Dryden's plays are wearisome, wanting in every dramatic element. But their number is an extraordinary evidence of the unwearied diligence of their author.

The second class of Dryden's works consists of poems in honour of public persons or public events. Some of this class, those addressed to Cromwell and to Charles II., we have already mentioned; but the most remarkable of such poems is the "Annus Mirabilis," the first in point of date of his more ambitious poems. Its subjects are the Great Fire of London, and certain successes gained by the English fleet in the Dutch war, both happening in the year 1666; hence named by the poet "Annus Mirabilis." The poem consists of more than three hundred stanzas of four lines each, the lines being ten-syllabled lines rhyming alternately. This was a favourite metre in Dryden's day, but it is one that wearies the ear, and is peculiarly ill suited for the purposes of narrative. Indeed, the "Annus Mirabilis" is, on the whole, one of the least pleasing of its author's works; and it is deformed by occasional examples of ingenious extravagance, showing that Dryden had not yet fully escaped the influence of the metaphysical style prevalent in his younger days.

The next class of Dryden's works which we have to consider are his satires; and in them we find his genius displayed in its highest excellence. The most important of these are of the nature of political satires, written in the interest of the king, and in favour of the Duke of York's succession to the throne, in opposition to the party which called itself the Protestant party, led by the ambitious and unscrupulous Earl of Shaftesbury, and whose nominal rallying point was the unfortunate Duke of Monmouth, natural son of the king. The first and most successful of these satires is the first part of "Absalom and Achitophel." This work was published in 1681, and published with the view of producing a specific effect upon the public mind. The anti-Popish feeling of the country was very strong. It had shown itself especially in the horrible cruelties, the murders of innocent men in the name of justice, which arose out of the so-called Popish Plot—a plot which was mainly, at all events, the creation of popular alarm and excitement deliberately stimulated by the party of Shaftesbury for their own selfish end. And the friends of genuine liberty, alarmed at the violence of the king, were to a great extent driven to support Shaftesbury. But the tide had somewhat begun to turn; and Shaftesbury himself was in the Tower under a charge of treason. At this juncture Dryden produced his satire in the hope of exciting popular ill will against him, and so securing his ruin. Under the guise of the Scriptural story of David and his rebellious son, Absalom, he presents to us the history of the moment. The too indulgent David is the king himself. Absalom stands for the beautiful, weak, and ungrateful Monmouth; Achitophel, the crafty and faithless counsellor, for Shaftesbury; while the minor characters of the Scripture story have all their counterparts in the modern history. The satire is one of the finest in the language; its peculiar merit consists in the extraordinarily powerful portraits it contains of the chief characters. The picture of Shaftesbury himself is an admirable example:—

"The false Achitophel was first,
A name to all succeeding ages cursed;
For close designs and crooked counsels fit;
Sagacious, bold, and turbulent of wit;
Restless, unfixed in principles and place;
In power unpleased, impatient of disgrace;
A fiery soul which, working out its way,
Fretted his pigmy body to decay,
And o'er-infirmed the tenement of clay.
A daring pilot in extremity;
Pleased with the danger when the waves went high,
He sought the storm; but, for a calm unfit,
Would steer too near the sands to show his wit.
Great wits are sure to madness near allied,
And thin partitions do their bounds divide;
Else why should he, with wealth and honours blest,
Refuse his age the needful hours of rest?
Punish a body which he could not please;
Bankrupt of life, yet prodigal of ease?
And all to leave what with his toil he won
To that unfeathered two-legged thing, a son."

Finer still is the portrait of the Duke of Buckingham, so celebrated for his varied and brilliant abilities, his vice and extravagance, and his miserable end:—

"In the first rank of these did Zimri stand;
A man so various that he seemed to be
Not one but all mankind's epitome.
Stiff in opinions, always in the wrong,
Was everything by starts, and nothing long;
But in the course of one revolving moon
Was chemist, fiddler, statesman, and buffoon;
Then all for women, painting, rhyming, drinking,
Besides ten thousand freaks that died in thinking.
Blest madman, who could every hour employ
With something new to wish or to enjoy!
Railing and praising were his usual themes;
And both, to show his judgment, in extremes;
So over-violent, or over-civil,
That every man with him was god or devil.
In squandering wealth was his peculiar art;
Nothing went unrewarded but desert.
Beggared by fools, whom still he found too late,
He had his jest, and they had his estate.
He laughed himself from court, then sought relief
By forming parties, but could ne'er be chief;
For, spite of him, the weight of business fell
On Absalom and wise Achitophel.
Thus wicked but in will, of means bereft,
He left no faction, but of that was left."

In the following lines Dryden gives us a life-like picture of the notorious Titus Oates, the professional false-witness who, after a long course of perjury, first on one side and then on the other, at last ended his career of infamy in imprisonment and the pillory:—

"Sunk were his eyes, his voice was harsh and loud,
Sure signs he neither choleric was nor proud;
His long chin proved his wit; his saint-like grace
A church vermilion and a Moses' face."

This satire was a great success, and its fame immediate. But Shaftesbury, nevertheless, escaped, for the grand jury of London rejected the indictment against him; and his admirers struck and distributed a medal in honour of the event. This gave occasion to another satire from the pen of the Court poet. "The Medal" is scarcely less powerful than its predecessor, but it is very different in tone and manner. The cool dissection of character which we find in "Absalom and Achitophel" is replaced by violent, even savage attack. It is an onslaught upon Shaftesbury alone. The following is a specimen of its spirit:—

"A martial hero first, with early care
Blown, like a pigmy by the winds, to war.
A beardless chief, a rebel ere a man;
So young his hatred to his prince began.
Next this—how wildly will ambition steer—
A vermin wriggling in the usurper's ear;
Bartering his venal wit for sums of gold,
He cast himself into the saintlike mould;
Groaned, sighed, and prayed while godliness was gain,
The loudest bagpipe of the squeaking train.
But, as 'tis hard to cheat a juggler's eyes,
His open lewdness he could ne'er disguise.
There split the saint, for hypocritic zeal
Allows no sins but those it can conceal."

A second part of "Absalom and Achitophel" was published the next year; it is not, however, for the most part the work of Dryden but of a very inferior hand, and has little of the power of the first part.

"McFlecknoe" is a satire of a very different class. Dryden, like most of the wits of his day, as well as of the periods which preceded and immediately followed his time, was always in the heat of controversy, and always at war with rival writers and literary men. In "McFlecknoe" he intended to inflict summary vengeance upon Shadwell, a second-rate poet, with whom Dryden was constantly at war. The satire is very brilliant, very severe, and very unjust.

The next class of Dryden's writings of which we have to speak consists of his poems on controversial subjects. Of these the most important two are the "Religio Laici," written by Dryden while still a Protestant, in defence of the Anglican Church; and the "Hind and the Panther," written after his conversion to the Roman Catholic religion," in defence of the Church of Rome. The first of these poems, in the form of an epistle, contains an elaborate argument in favour of the author's then position. In point of expression, and the admirable adaptation of style and versification to the subject-matter, it is almost without a rival among poems of its class. The effect of the "Hind and the Panther" is rather spoiled, notwithstanding its many beauties, by its half-allegorical form.

A very high place among Dryden's poems must be awarded to his odes. Of all the lyrics in our language of the more ambitious, the heroic or Pindaric kind, Dryden's great ode on "Alexander's Feast" is the finest. It was written in the year 1697, and, like his ode for St. Cecilia's Day and some other well-known odes by other authors, was written for the musical festival then annually held on St. Cecilia's Day. Dryden's extraordinary energy and vigour of style was precisely suited for such poetry, while his deficiency in pathos was not felt, for in the Pindaric ode there is little space for pathos.

Dryden's "Fables," many of which are from Chaucer, are either adaptations in modern language of some of the "Canterbury Tales," or original tales in imitation of Chaucer. As poems they are pleasing; but they are not Chaucer either in spirit or in style.

Dryden's translations consist of the whole of Virgil, several of the Satires of Juvenal, and some of Ovid's Epistles. His prose works are entirely critical; the most important being an "Essay on Dramatic Poetry." They are distinguished, for the most part, by admirable good sense and judgment in their criticism, and always by a style manly and vigorous, the counterpart in prose of Dryden's manner in verse.

Of poets other than dramatic, there is none but Dryden, in the age of the Restoration, worthy of any prolonged notice. Poetry was the fashion; and dilettanti noblemen in numbers wrote poetry, to which their rank gave a momentary prominence. To this class belonged Roscommon, Rochester, Buckingham, and also Dorset. Some, like Sir Charles Sedley, wrote graceful and lively songs. Perhaps the poem best worthy of mention is the "Splendid Shilling," by John Phillips, a mock-heroic poem not destitute of humour.

RECREATIVE SCIENCE.—XIX.

THE COLOUR-TOP, INVENTED AFTER MR. ROSE'S OPTICAL CONTRIVANCE CALLED THE KALOTROPE.

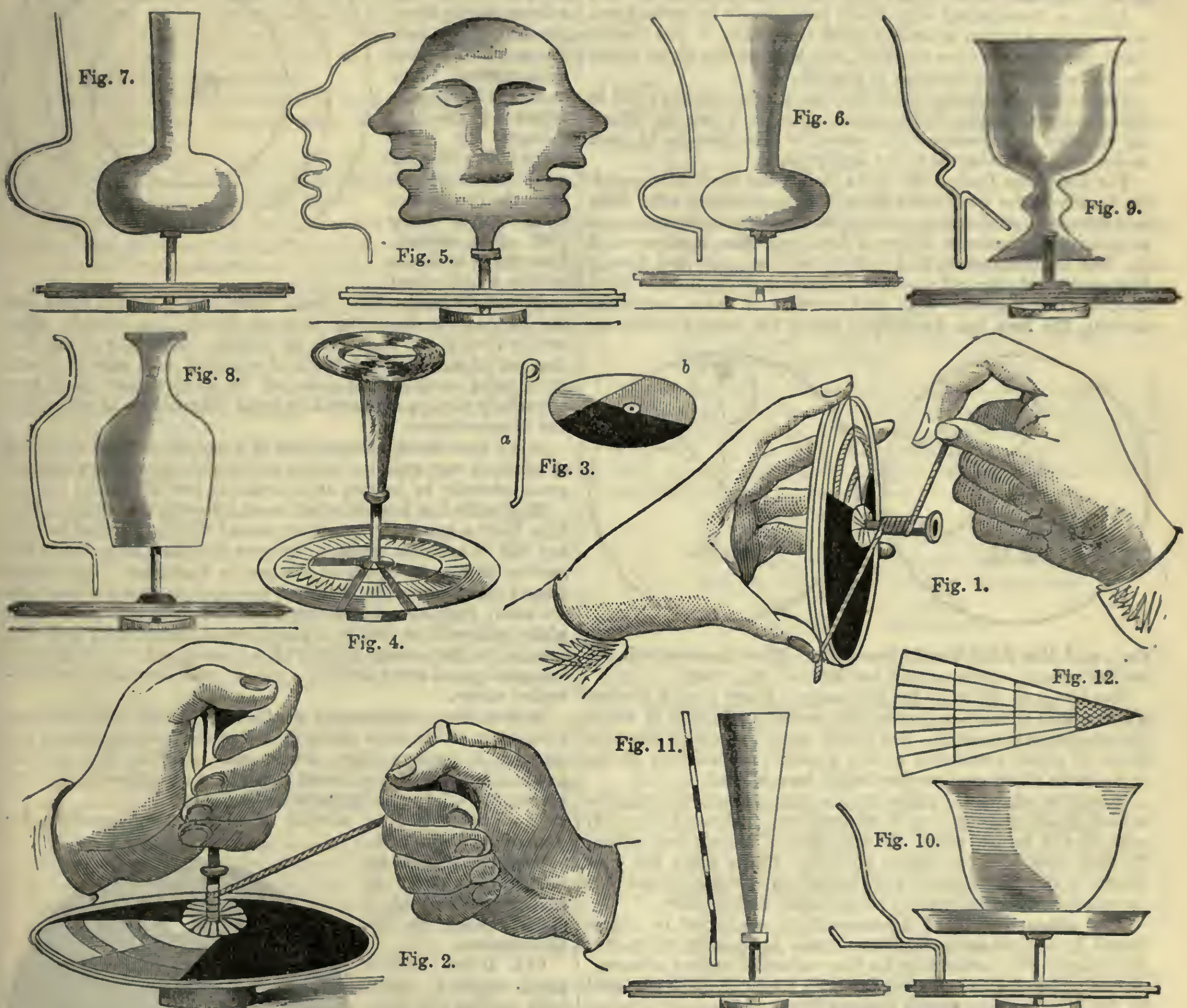
Walking about the streets of the Hague one day, the writer met with a most excellent and cheap toy, combining the ordinary effects of persistence with the various changes of colour obtainable by using a disc upon which red, yellow, and blue are painted in unequal proportions, and exposed to view through an opening in an opaque disc working upon but independently of the coloured one. This top, under various denominations, has been sold throughout England, and has, in fact, become quite a household toy. In Fig. 1 is shown the mode of winding the top, and in Fig. 2 the spinning is easily managed by holding the wire inserted in the hollow central axis and pulling away the string with the other hand. The colours of the painted disc are made to change rapidly by touching the top opaque disc, and whatever colours then predominate give the prevailing tints to the revolving disc, in a manner that will be explained more carefully when Mr. King's revolving coloured disc for the oxyhydrogen light is described.

The toy is made still more amusing by the insertion into the hollow and central axis of the top, wires bent into various forms. Thus the wire (a) and disc (b) of Fig. 3 will produce Fig. 4. Another wire, bent into the form of the profile of the face, when spinning round appears like some of those horrible casts of celebrated homicides whose physiognomic and phrenological developments delight the inquiring minds of a certain morbidly-inclined class of philosophers, as is shown in Fig. 5; a vase (Fig. 6), variously shaped bottles (Figs. 7 and 8), a goblet (Fig. 9), a tea-cup and saucer (Fig. 10), and a champagne glass (Fig. 11).

Thus by ingeniously modifying the old expedients of moving in a circle the lighted stick, or the more brilliant effects obtainable from certain fireworks, such as squibs or fire-wheels—in which a revolving point of light produces the effect of a wheel of fire emitting sparks—are these very entertaining and (for children) harmless illustrations of persistence of vision produced.

The idea of making *colour tops*, called *kaleidoscope tops*, *chameleon tops*, *cinephantic tops*, *trocheidoscopes*, etc.—all of which owe their effects to open-work or perforated discs running over coloured ones—may be traced back to the first beautiful contrivance invented by Mr. Thomas Rose, of Glasgow, called the Kalotrope, or *beauty-turner*, which was exhibited by the writer for the first time in London at the Royal Polytechnic in the early part of the year 1856, its leading features (to use the words of the inventor) being the multiplication, combination, and involution of simple figures into compound devices of singular beauty, both as regards form and variety of tint.

The instrument consists of two concentric wheels, two feet in diameter, working nearly in contact, and in *contrary* directions, and with equal or varying velocities. The movement is a combination of wheels, by which a velocity of at least 1,000 revolutions per minute can be obtained. Discs of devices are provided for the hinder wheel (corresponding to the disc of a



coloured top), and a number of perforated black discs for the front wheel, similar to the opaque disc of a coloured top, with a slice cut out to show the changing effects. The instrument could be used to show simple persistence of vision by merely removing the front perforated black disc; as, for instance, the re-composition of the colours forming white light by the rapid rotation of a disc bearing the prismatic colours, when each colour is presented to the eye so nearly at the same instant that proximate whiteness is produced. By rotation of a disc having alternate sections of two colours a third was produced, as imitated in the colour-top; thus red and blue, by rapid alternate presentation to the eye, produced a purple spectrum.

Again, a disc charged with black balls nearly in contact presents under rotation a shaded solid ring, dark in the centre, where the balls are close together, and light at the edges, where the white interstices increase in breadth.

For the true kalotrope effects the two wheels are used; and in 1855 the inventor was kind enough to give the writer the following valuable information with regard to the discs to be used and devices best adapted to the kalotrope.

The Kalotrope Discs.—Mr. Rose claims the merit of suggesting variety in the perforated discs, which, combined with different velocities, produces those illusions which make the kalotrope an optical arrangement different from any other that preceded it. But he prepared at first only three discs, the first having twelve slots, the second having twenty-four slots, and the third divided as in Fig. 12. This last consists of three concentric circles; the first has forty-eight slots, the second thirty-six

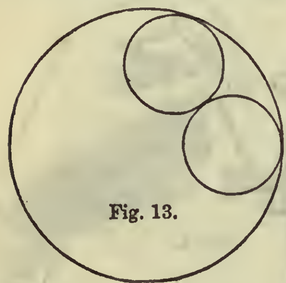


Fig. 13.

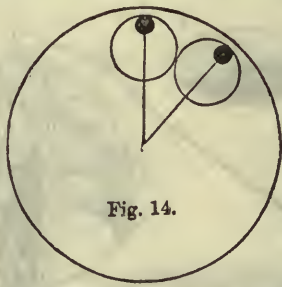


Fig. 14.

slots, and the third twenty-four slots. Thus in every inch the multiplications, combinations, involutions, etc., vary.

The Range of Effects by the Kalotrope.—Every disc of devices will not with advantage bear all the varieties of action of which the apparatus is capable. But it may serve to indicate the wide range of effect producible by the apparatus to mention all the varieties to which any one disc *might* be subjected.

It may be shown (1) under simple persistence; (2) with the second wheel playing over it, without any perforated disc; (3) with disc of twelve slots; (4) with disc of twenty-four slots; (5) with disc of three circles of slots. Under these five conditions it may be combined with variations of velocity, and also variations of relative velocity of one wheel to the other.

Now although some of these variations would not be appreciated by a sight-seeing audience, there is scarcely one that is not fraught with instruction for the student in optical science.

The Series of Discs of Devices.—The series of discs prepared by the inventor were simple and unartistic, and are not in every case the best devices for the intended purposes. His views expanded as he proceeded in the arrangement of the apparatus, and hence, as the idea was not at the first present to him in all its unity, there is necessarily some want of coherence of plan and adaptation in the details. Indeed, the main object he had in view was to analyse disc action, ascertain its capabilities, and give examples of action just sufficient to indicate a highly useful and interesting apparatus. The kalotrope may be perfected by artistic ingenuity in the construction both of the devices and the perforated discs. The inventor merely claims to have laid down a principle in an intelligible and workable form, and to have produced a working model quite sufficient as a guide to any one who would take up the kalotrope and produce it under the best auspices.

The discs are two feet diameter. The first (Fig. 13) contains twelve circles, about three inches diameter, round its margin, painted with intense black. The effect of this disc has been already described as a ring—a ring divided into twenty-four sections, twenty-four ovals, forty-eight involuted figures—a compound involuted figure.

The second disc (Fig. 14) is a bold and simple thaumatrope device of rings and interim balls, with other moving details. It changes to forty-eight involved rings, full of motion, and again to a compound involution of much beauty.

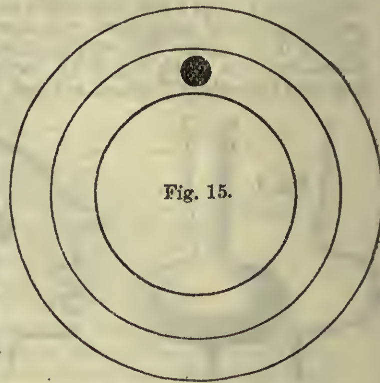


Fig. 15.

The third disc (Fig. 15) is a black ball within two black concentric circles: revolving twenty times per second, it is lost. The apparatus gives mathematical data in regard to the phenomenon; the ball changes its place every 600th of a second, and returns upon the eye in the same point every 20th of a second. Thus far it is shown by the single wheel under simple persistence. Next, screw on the second wheel and the twelve-slot disc, and turn at twenty per second, when twenty-four black balls will be visible. In this case the ball changes its place every 1,200th of a second, and returns to any given point every 20th of a second. This experiment shows how powerfully the eye is affected by rapid alternations of apparition and disappearance.

It is a fact worth naming that if a person can get the habit of winking very rapidly, he can impress the eye with a light of great intensity by looking at an ordinary gas bat's-wing burner.

The fourth disc is a white ball in an intensely black circle (Fig. 16). With a speed of twenty per second this ball cannot be lost, but will be a visible white circle over the black one—hence the greater impression made on the eye by whiteness. Taking the second wheel and twelve-slot disc, twenty-four strong white balls are seen; then take the twenty-four slot disc, and forty-eight white balls will be visible; thus showing that a white ball may change its place every 2,400th of a second, and return again to the same point every 20th of a second, and be visible by interrupted vision.

In both these experiments all the balls appear and disappear alternately at the same instant; but in the first experiment the interval of passage from slot to slot is 480th of a second, and in the second experiment 960th of a second—intervals, of course, too brief to be appreciated by the eye.

The fifth disc is a circular arrangement of spectrum for composing white light, merely introduced as the simplest effect of persistence, and as a starting-point in the illustrations.

Fig. 16.

6th Disc.—Nine parti-coloured stars, with *falling aërolites*, simply to show the first elements of circumferential revolution, when the twelve-slot disc revolves in front of them.

7th Disc.—Four circles of balls, number different in each circle, to show the principle on which circumferential motion is accelerated—fewest balls move the swiftest. This disc may be used with different perforated discs, and the wheels moved with different velocities, by which means figures are multiplied by persistence and singular varieties of motion are observed.

8th Disc.—Nine bold rings with interim action, to be submitted to all the perforated discs in succession, when remarkable involutions and disturbances of motion will be seen, according to the velocity of the wheels.

9th Disc, arranged for eccentric motion, shows pleasingly under simple persistence. If spokes of second wheel play over it, flashes of light radiate from centre to circumference. Remarkable effects of motion, etc., are produced by the three perforated discs in succession.

10th Disc.—Three circles of balls, arranged for contrary motion, show by simple persistence; with spokes of second wheel, become striped circles revolving; with the perforated discs, present a succession of truly beautiful changes.

11th Disc.—Three circles heavily charged with coloured and black balls; all the balls disappear under simple persistence and twenty revolutions per second. With twelve-slot disc, the balls reappear; with twenty-four slot disc, they are resolved into a surface of uniform colour.

12th Disc.—A rich mosaic device for composition of colour by simple persistence. Demonstrates the power of the brighter colours on the eye.

13th Disc.—Another rich mosaic for composition of colours; but shows a succession of pleasing effects with spokes of second wheel and the three perforated discs.

14th Disc.—Two balls and two arrow-heads, 90° distant, become, with twelve-slot disc, twenty-four regular figures.

15th Disc.—An elaborately irregular figure, by rapid revolution and with twelve and twenty-four slot discs multiplied, combined, and made regular, and denominated the principle of the anorthoscope, or instrument for changing to symmetrical figures others without form or symmetry.

16th Disc.—Six balls, two rings in three pieces, and six half handles, disposed round disc, become, with twelve-slot disc, twenty-four egg-shaped bodies, with perfect ring and handle to each (*thaumatrope*).

17th Disc.—Disc charged with six large circular figures, to exhibit and explain different stages of involution and combination.

18th Disc.—Black star of six points, etc., with spokes of second wheel playing over it. The black star and the general device come up white and light-coloured. Shows various effects of multiplication and combination with perforated discs.

19th Disc.—A bold device for involution and variety of motion, according to perforated discs and velocity of wheels.

20th Disc.—Circle of wheels and centre. Show first by simple persistence. With twelve-slot disc shows thaumatrope action; with twenty-four slots, beautifully involuted; with compound slots, the effect enhanced.

21st Disc.—A bold device of black and coloured circles for general effects.

22nd Disc.—Three circles of bold lines arranged for contrary motion. With spokes of second wheel the lines become white; lines multiplied by perforated discs of twenty-four and various slots.

Mr. Rose's pulley of equal motion has a mathematical difference in its grooves, and when the velocity is highest the figures are not quite stationary, although the number of slots and figures be the same. This slight imperfection has suggested in connection with disc 22 the practicability of a travelling vernier for reading off the velocity of a wheel even if it were moving at 3,000 revolutions per minute.

23rd Disc.—Three circles of wheels, with contrary motions, exhibiting a pleasing variety of effects under different treatment.

The discs, when arranged, form a consecutive series for showing all the usual effects of the thaumatrope, thaumascope, anorthoscope, etc., and the capabilities of the kalotrope for exhibiting a variety of beautiful changes.

LESSONS IN GREEK.—XLVIII.

INVARIABLE WORDS (*continued*)—ADVERBS.

4. *Quantity.*

The adverbs of quantity are susceptible of the same terminations as those of manner. Here are some of them:—αγαν, *too much*; λιαν, *extremely*; αδην, *abundantly*; αλις, *sufficiently*.

Those which particularly mark number end in ακις:—

ποσακις (from ποσος, *how many?*) *how often? how many times?*
πολλακις (from πολυς, *numerous*), *many times.*
τετρακις (from τετταρες, *four*), *four times.*
πεντακις (from πεντε, *five*), *five times.*

The rest of the adverbs formed from the cardinal numbers follow this analogy, except ἁπαξ, *once* (semel); δις, *twice* (bis); τρις, *three times* (ter).

5. *Interrogation.*

ἦ asks a question simply: *Do you say this?* ἦ λεγεις τουτο;

ἆρα asks a question mostly with an expressive *then*: *Do you, then, say this?* ἆγα λεγεις τουτο;

μῶν (μη οὖν) expects a negation, *num*: μων λεγεις τουτο; *you do not say this, do you?* It is also used in simple interrogations.

6. *Affirmation.*

ἦ, ἦ μην, *yes, certainly, in truth.*

αρα, ρα, τοι, δη (in the poets), *then, certainly, assuredly.*

μεν denotes a contrast, and strengthens, = *indeed* (quidem).

γε asserts something in addition, and gives emphasis to its word, = *at least.*

ναι (Latin *næ*, English *nay*), *yes, truly.*

7. *Negation.*

ου (ουκ before a vowel), ουχι, Attic ουδαμως, *by no means*	*no*, with direct negations and indicative mood.
μη, ου μη, μη ουχι μηδαμως, *by no means*	*that not*, with indirect negations and imperative mood.

8. *Doubt.*

ισως, ταχα, που (without accent), *perhaps, probably.*
δηκου, δῆθεν, *apparently.*

There are some words which, without being adverbs, are employed adverbially. We have seen adverbs which have the form of the genitives, datives, and accusatives. We are now to see those cases themselves perform the office of adverbs. Their cases are said to be owing to certain prepositions which have been dropped in conversation:—

Gen. νυκτος (δια), *by night, at night.*
Dat. βιᾳ (συν), *by force, forcibly.*
κυκλῳ (εν), *in a circular, circularly.*
Acc. δικην (κατα), *in the form* or *manner of.*
χαριν (προς), *in favour of.*
προῖκα (κατα), *gratuitously.*

Sometimes the preposition is expressed and united to the noun; as—

παραχρῆμα (παρα, *at*; χρῆμα, *the thing*), *at the moment.*
προυργον (προ, *for*; εργον, *the deed*), *usefully, beforehand.*
εκποδων (εκ, *from*; πους, *the foot*), *at a distance, far from.*

Adverbs formed from adjectives imply a substantive:—

Dat. ιδιᾳ (εν ιδιᾳ χωρᾳ), *in particular*; πεζῇ (εν πεζῇ ὁδῳ), *on foot.*
Acc. μακραν (εις μακραν ὁδον), *a long way, at a distance.*

The neuter of the adjective is often employed as an adverb; as the dative πολλῳ, *much, by much*; ἡδυ, *agreeably*; δεινον and δεινα, *terribly*; ποτερα, *whether?* επιτηδες, *on purpose.*

CONJUNCTIONS.

The following is a list of the chief conjunctions:—

και, τε, and.	ει, αν, εαν, if.	επει, because, since.
η, or.	ειτε, or, whether.	διοτι, because, that.
ουτε, μητε, ουδε, μηδε, nor.	ει μη, unless, if not.	γοῦν, therefore.
αλλα, δε, but.	ει και, and if.	επειδη, since.
μεντοι, however.	καν, and if.	επειδαν, after that.
καιτοι, yet.	ὁτι, that.	ὁτε, ὁταν, when.
αρα, then.	ὡς, ὡστε, so as, so that.	ἑως, until.
ουν, τοινυν, therefore.	ἱνα, in order that.	ὁπως, how?
γαρ, for.	ἱνα μη, in order that not, lest.	ὡς, ὡσπερ, as, as if.

Of these conjunctions some are simple, as και, τε, ὡς; others are compound, as ουτε (ου and τε), μεντοι (μεν and τοι), καιτοι (και and τοι), τοινυν (τοι and νυν), ὡστε (ὡς and τε), διοτι (δια οτι, neuter of ὁστις), γοῦν (γε and οὖν), επειδη (επει and δη), επειδαν (επει, δε, and αν), ὁταν (ὁτε and αν); and others are two separate words, as ει μη, ἱνα μη.

There are other conjunctions, whether a single word, as ἡνικα, *when*, or several words united, as τοιγαρτοι (τοι, γαρ, τοι), *now then*; τοιγαροῦν (τοι, γαρ, οὖν), *wherefore, on that account*; or, again, several words in a separate state, as ου μην αλλα, *however*; πλην ει μη, *if only*.

One or two others deserve notice, as ἁτε, *seeing that, as being*—for example, ἁτε αγαθος, *as being good* (Latin, *utpote bonus*); περ, *although*—for example, αγαθος περ, *although good.*

There are certain words employed as adverbs, in the composition of which there is a conjunction—for example, δηλονοτι, *evidently* (that is, δηλον εστιν ὁτι, *it is evident that*); ενιοτε, *sometimes*—made up of ενι, for εστιν, and ὁτε (in Latin, *est quando*).

INTERJECTIONS.

Interjections, as expressing almost inarticulately the passions and emotions of the mind, are also numerous in the language of the Greeks, who were a people of strong feelings. The principal interjections are these:—

ὦ, O! (sign of the vocative, ὤ, *O!* expressing pain or surprise).	ιεῦ, eheu! ho!	αι, οι, ιω, alas! (Lat. *hei!*)
ιου, ah! alas!	φευ, ah! [*papæ!*]	εια, come! (Lat. *eia!*)
	βαβαι, ah! oh! (Lat.	ευγε, well done! (Latin, *euge!*)
	ουαι, woe!	
	ἆ, ah!	

Some imperatives are used as interjections; for example, αγε, φερε, ιθι, *come!* (Latin, *age!*), απαγε, *begone!* (Latin, *apage!*)

FORMATION OF WORDS.

NOUNS AND ADJECTIVES.

Simple words may be divided into two classes, the primitive and the derivative. Primitive words are those which are formed from a stem by the affixing of a nominal or a verbal termination. Thus λογος is a primitive, it being formed by the addition of ος to λογ. Also λεγω is a primitive, inasmuch as you form it by adding ω to λεγ.

Derivative words are such as are derived or formed from primitive words. Thus, from αρχ in αρχη, *beginning*, and αρχω, *I begin*, comes αρχαιος, an adjective formed by suffixing αιος to the stem; αρχαιος accordingly signifies *that which goes back to the beginning, ancient.*

Nouns are generally formed from either verbal or nominal stems by means of a termination. This termination may be termed a suffix or a formative. Thus, by means of the suffix ο is λογος formed from the verbal stem λεγ, and αρχαιος is formed from αρχα (nominative αρχη) by the addition of the suffix ιο.

Suffixes serve the end of showing the different relations under which the fundamental idea appears. Let us take as an example ποιεω (ποιῶ), *I make*. By cutting off the person-ending I obtain as the stem ποιε. From ποιε, with the lengthening of the ε into η, and the introduction of the suffix or formative, I make these words—

ποιεω (ποιῶ), ποιε-, ποιη-.
ποιητης, *a poet*; ποιησις, *poetry*; ποιημα(τ), *a poem.*

Having taken a verbal stem, let us now take a nominal stem—

βασιλευ (βασιλευς, *a king*).
βασιλευς, *a king*; βασίλειἄ, *a queen*; βασιλείᾱ, *a kingdom*; βασιλικος, *kingly*.

Substantives are formed by various suffixes, of which the following are the most important:—

The *doer*, or the person concerned with some act, is denoted by one of these terminations:—

1. ευς; as γραφευς, *a writer*, from γραφω; γονευς, *a parent*, from γιγνομαι.
2. τηρ, τωρ, της (masculine), τειρα, τρια, τρις, τις (feminine); as σωτηρ, *deliverer* (σωτειρα, fem.), from σωζω; ῥητωρ, *a speaker* (ῥε as in ερῶ); κριτης, *a judge* (κρι as in κρινω); ποιητης, *a poet* (ποιε as in ποιεω); ποιητρια, *a poetess*; αυλητης, *a flute-player* (αυλε as in αυλεω); αυλητρις, *a female flute-player* (αυλε as in αυλεω).

The *doing* is indicated by the following terminations:—

1. τις, σις, σια (from τις). The nouns hereto belonging are all feminine; as πιστις, *confiding, trust, faith* (from πιθ, as in πειθομαι); μιμησις, *imitation* (from μιμε, as in μιμεομαι); σκεψις, *consideration* (from σκεπ, as in σκεπτομαι); πραξις, *handling, action* (from πραγ, as in πρασσω); γενεσις, *begetting* (from γεν, as in γιγνομαι); δοκιμασια, *proving* (from δοκιμαδ, as in δοκιμαζῶ).
2. μος; as σπασμος, *cramp, spasm* (from σπα, as in σπαω); δεσμος, *chain* (from δε, as in δεω); οδυρμος, *wailing* (from οδυρ, as in οδῦρω).

The *result* of action is denoted by—

1. μα (neuter); as πραγμα, *a thing done* (from πραγ, as in πρασσω); ῥῆμα, *a thing spoken* (from ῥε, as in ερῶ); τμῆμα, *a cut* (from τεμ, as in τεμνω).
2. ος (neuter); as λαχος, *a lot* (from λαχ, as in λαγχανω; aor. ελαχον); εθος, *custom* (from εθ, as in ειωθα); τεκος, *a child* (from τεκ, as in τικτω).

The same suffix in derived words denotes the peculiar quality; as—

βαρος, *weight*,	adjective stem	βαρυ,	nominative	βαρυς.
βαθος, *depth*,	,,	βαθυ,	,,	βαθυς.
μῆκος, *length*,	,,	μακρο,	,,	μακρος.

The *instrument* or *means* of an action is denoted by τρο, nominative τρον, neuter (the Latin *trum*):—

αροτρον, *a plough*, from αρο, as in αροω (Latin *aratrum*).
λυτρον, *a ransom*, from λυ, as in λυω.
διδακτρον, *a teacher's fee*, διδαχ, as in διδασκω.

Less definite is the meaning of the related feminine suffix, τρα; as ξυστρα (ξυω, *I shave*), *a curry-comb*; ορχηστρα (ορχεομαι, *I dance*), *a dancing-place*, our *orchestra*; παλαιστρα (παλαιω, *I wrestle*), *a wrestling-place*.

Place is signified by—

1. τηριον, neuter (the Latin *torium*); as ακροᾱτηριον, *a place for hearing* (Lat. *auditorium*), from ακροα, as in ακροαομαι; δικαστηριον, *a judgment-hall*, from δικαδ, as in δικαζω.
2. εῖον (neuter); as λογεῖον, *a speaking-place*, from λογο, as in λογος; κουρεῖον, *a barber's shop*, from κουρευ, as in κουρευς; Μουσεῖον, *a museum*, from Μουσα, as in Μοῦσα.

Substantives denoting quality are derived from adjective stems by means of the following suffixes:—

		NOMINATIVE.	ADJ. STEM.	NOMINATIVE.
1. της (fem.), Lat. *tas, tus.*		ταχυτης, *quickness*,	ταχυ,	ταχυς.
		νεοτης, *youth*.	νεο,	νεος.
		ισοτης, *equality*,	ισο,	ισος.
2. συνη (fem.).		δικαιοσυνη, *justice*,	δικαιο,	δικαιος.
		σωφροσυνη, *sense*,	σωφρον,	σωφρων.
3. ια (fem.).		σοφια, *wisdom*,	σοφο,	σοφος.
		ευδαιμονια, *happiness*,	ευδαιμον,	ευδαιμων.

The suffix ια with the vowel of the adjective stem becomes εια and οια:—

	ADJECTIVE STEM.	NOMINATIVE.
αληθεια (αληθεια), *truth*,	αληθε(ς),	αληθης.
εννοια (εννοια), *benevolence*,	εννοο,	εννους.

Diminutives, or words denoting the quality in a less degree, are formed from nouns as stems by means of these suffixes:—

1. ιον (neuter); as παιδιον, *a little child*, stem παιδ, nom. παις; κηπιον, *a little garden*, stem κηπο, nom. κῆπος. Besides the form ιο there are these—namely, ιδιον, αριον, υδριο (υδριον); as οικιδιον, *a little house* (οικος); παιδαριον, *a little child* (παις); μελυδριον, *a ditty* (μελος, *a song*, our *melody*).
2. ισκος, ισκη; as νεανισκος, *a youth*, stem νεανια, nom. νεανιας; παιδισκη, *a little maiden*, stem παιδ, nom. παις.

VOLTAIC ELECTRICITY.—XV.

INDUCED CURRENTS — RHUMKORFF'S COIL — EXPERIMENTS WITH THE COIL—GEISSLER'S TUBES.

If we connect the poles of a battery-cell by a naked copper wire of sufficient length to bend down towards some iron filings, we shall find that the tiny metallic particles attach themselves to the wire. In other words, the wire conveying a current is magnetic. Faraday found that such a wire, if placed near another wire or coil quite unconnected with any electrical battery, *induced* a current in that wire or coil. The current so induced is not permanent, but transient. When contact with the battery is made with what we may call the primary circuit, a momentary secondary current is *induced* in the other wire. When the contact is broken, the current again makes itself evident, but in the reverse direction. Such currents are of a very feeble nature, but the principle has been taken advantage of in an instrument called the inductorium, or induction coil, where the effects are magnified to a surprising degree, and give results of a most brilliant and startling character.

A simple form of induction coil is shown at Fig. 86. It consists mainly of two separate coils of insulated wire, one within the other. The innermost consists of two layers of thick copper wire, which, by proper attachments, can be joined up with a battery. The secondary coil lies outside the primary, and is made of several layers of very fine silk-covered copper wire, measuring, in large coils, many miles in total length. These coils are firmly wound upon a hollow core, within which lies a bundle of iron wires, forming an electro-magnet whenever the current flows through the coil. In front of one end of this core is a vibrating armature, the to and fro movements of which cause the current to be made and broken several times in every second. The object of this is to gather up the transient currents in the secondary coil caused by induction, so as to make them behave somewhat like a continuous current. If this arrangement were not adopted, there would only be a current at the moment of joining the battery to the apparatus, and another current when it was detached. The vibrating armature causes these joins and breaks to occur several times (many hundred if required) in every second, so that we have a constant stream of electricity, but which we know really to be intermittent, from the circumstances under which it is produced. This contact-breaker, as it is called, acts in precisely the same manner as the hammer of a "trembler" electric bell; it is shown in detail at Fig. 87. Here B represents the magnetic core of the coil, C the armature set upon a springing piece of metal A. E and D are adjustable screws, the former causing the current to be broken directly A touches it, and the latter restoring the current, so that A is once more attracted towards the core B.

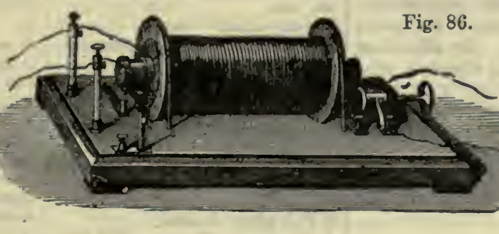


Fig. 86.

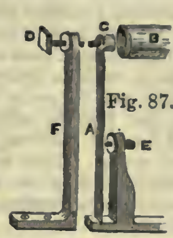


Fig. 87.

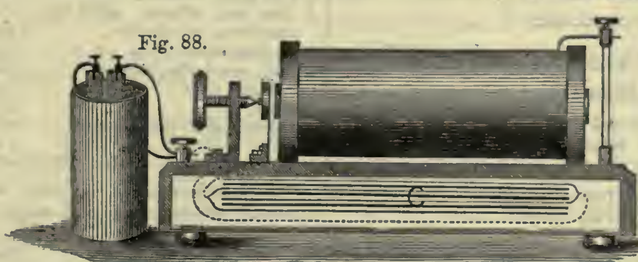


Fig. 88.

The phenomena connected with induced electricity can be very well studied by simple apparatus. A battery cell is indispensable, and perhaps the best for the purpose is that form known as the Bichromate battery. It is simple and clean in use, requires but one fluid, and gives off no unpleasant fumes. It is generally sold in the form of a bottle containing two plates of carbon and a central plate of zinc. These plates all hang by rods from the ebonite cover of the bottle or jar, but the central one, the zinc, is so arranged that it can be drawn completely up into the neck of the bottle, and out of the exciting solution. Owing to this arrangement, the bottle battery can be kept ready charged for months at a time, the zinc being depressed into the fluid only when the battery is required for use. The charging fluid is made thus: An ounce of bichromate of potash is dissolved in half a pint of boiling water. When the solution has become cold, one ounce of commercial sulphuric acid (oil of vitriol) is added to it. This addition will cause the liquid once more to become hot. When cold it is ready for use.

Fig. 88 shows an induction coil complete, with a condenser arrangement C, by which the induced or secondary current is increased materially. With such a battery, a galvanometer, and a few pieces of copper wire, some experiments may be performed showing clearly how a current circulating in one wire will induce a secondary current in another wire wholly detached from it. First, let one pole of the battery be connected with a wire stretched across two wooden uprights; let us call this wire A. A second wire, B, is stretched between the same uprights, half an inch below A. This second wire is placed in circuit with a galvanometer. On completing the battery circuit so that the current traverses A, the galvanometer needle is deflected for an instant. It again moves, but in the reverse direction, when the circuit is broken. This experiment proves two important facts: first, that a current is induced in a wire by the near presence of a wire through which a current is flowing; and, secondly, that the current so induced is but transient, and only occurs at the moment when the circuit of the A wire is completed or broken. By fastening a file to one wire leading from the battery (but in other respects maintaining the condition of affairs just described) and making contact by drawing the connecting wire slowly along the roughened surface, we shall have a ready means of making and breaking the current alternately, for as the wire is dragged over the projections and depressions of such a surface, the current is caused to be intermittent. Under such circumstances, the galvanometer needle will be kept oscillating so long as the wire is dragged over the file. The vibrating contact-breaker attached to the induction coil, or Rhumkorff coil, as it is sometimes called, after its inventor, accomplishes in a far neater manner the same work.

Referring once more to Fig. 86, we must notice that the wires from the battery (not shown in the sketch) are connected with the coil on the right-hand side. But the wires from the secondary coil are carried to the little glass pillars shown on the left-hand side. These pillars are furnished with binding screws, so that any piece of apparatus can be readily joined up to them.

A very important part of the induction coil is the condenser, which is usually contained in the base of the instrument. This consists of fifty or sixty sheets of tinfoil, nearly as large as the base; between each sheet of this there is placed a sheet of varnished paper so as to insulate them. The pieces of tinfoil are so arranged that one end of the lowest sheet is left out at one end of the pile, the next projects at the other end, and so on: thus they alternately overlap at each end. The free ends are then connected at each end of the coil, and thus the alternate sheets are connected together, half being joined at one end and half at the other. These ends are then connected with the sides of the break, and in some way, which has not yet been clearly explained, the power of the coil is greatly augmented thereby. If an arrangement be made by which the condenser can be thrown out of connection when the machine is at work, instead of bright flashes several inches in length, we shall only obtain thin and faint sparks.

If, when the coil is in action, wires attached to the terminals of the secondary coil be brought within a short distance of one another, a stream of sparks passes between them with a loud crackling noise. An induction coil is usually distinguished by the distance which these sparks will leap across, commonly called the length of the spark. Thus a small coil may give a half-inch spark, and a much larger one a four or six-inch spark. A few years ago, Mr. Spottiswoode, the late President of the Royal Society, had constructed a giant coil, which gave astonishing effects. Supported on two massive pillars of wood, the weight of the mass necessitated a third support midway between them. There are two primary coils which are readily interchangeable. One differs somewhat from the other, and is intended for a special class of experiments. The primary coil, more generally used, contains 660 yards of copper wire. It is 44 inches long, and weighs 67 lbs. The secondary coil contains 280 miles of fine wire. Under favourable conditions this giant coil will give a spark 42 inches in length. The contact-breaker is of special construction, and can be made to give 2,500 breaks per second.

But even with a small coil which gives a spark only a fraction of an inch in length, many interesting experiments can be performed. A piece of phosphorus placed so that the spark may pass through it is instantly inflamed. The same thing occurs if, instead of the phosphorus, a little cotton-wool moistened with ether is placed in the same position. A gas jet can be lighted if we carry the wires over it, so that the spark can jump across the space where the gas issues. Or if a candle be blown out and placed in the stream of sparks, it will be relighted.

But by far the most beautiful experiments with the coil are those where the electric discharge is caused to pass through rarified media. A glass globe with a stop-cock attached so that it can be partly exhausted of air is generally used for showing some of these experiments. Inside the globe are two knobbed wires, connected with terminal screws outside. When this apparatus is partly exhausted of air, and attached to the coil, a beautiful stream of light is seen playing between the terminals inside. And although the experiment may be performed with a coil giving only a half-inch spark, this stream of light will be several inches in length. If a little vapour of alcohol or naphtha be introduced within the exhausted globe, the luminous discharge assumes a curious stratified appearance. A metal wire, or other conductor, held to the side of the globe will cause the stream of light to seek that side. By admitting to the globe different gases, such as hydrogen, nitrogen, etc., the colour of the discharge can be made to vary with each. Geissler, of Bonn, was the first to construct glass tubes blown into all kinds of fanciful patterns, and charged with minute traces of different gases. These tubes give the most beautiful effects, particularly if they be mounted on small magnetic engines, and be caused to revolve. They are known as Geissler's vacuum tubes.

LESSONS IN ITALIAN.—XXXIX.

THE PREPOSITION.

THE preposition is a word placed before the nouns and pronouns which it governs, and before some verbs, to connect words one with another, and to show the relation between them.

DENOTING THE CAUSE AND MEANS.

Attéso, per cagióne, *considering, on account of, owing to.*
Per mézzo, mediánte, *by, by means of, for, on condition.*
Da, dal, per via, per, *by, through.*

DENOTING THE OBJECT.

Vérso, *to, towards.*
Per, *for.*
Círca, *about, concerning, touching.*

DENOTING OPPOSITION.

Cóntro *or* cóntra, *against.*
Malgrádo, *in spite of.*
Nonostánte, *notwithstanding.*

DENOTING ORDER.

Avánti *or* príma, *before.*
Dópo, *after.*
Diétro, *behind.*
Fra, *between.*

DENOTING PLACE.

A, *at.*
In, *in* or *into.*
Da, *from.*
Sótto, *under.*
Sópra, *on* or *upon.*
Vérso, *towards.*

DENOTING SEPARATION.

Eccétto, fuorchè, sálvo, tránne, trattone, *except.*
Sénza, *without.*

DENOTING UNION.

Con *or* col, *with.*
Duránte, in témpo, *during.*
Óltre, *besides.*
Secóndo, confórme, *according to.*

EXAMPLES.

Attéso il cattívo témpo, *or* per cagióne del cattívo tempo, *on account of the bad weather.*
Per mézzo délla vóstra grázia, *or* mediánte la vóstra grázia, *by means of your favour.*
È státa feríta da úna saétta d' óro, *she has been wounded by a golden arrow.*
Tútto fu creáto dálla paróla di Dio, *everything has been created by the word of God.*
Andáre a Nápoli per Róma, *or* per via di Róma, *to go to Naples through Rome.*
Párlo per vói, *I speak for you.*
Caritatévole vérso i póveri, *charitable to the poor.*
Círca a quest' affáre, *concerning this affair.*
Chi può andár cóntro, *or* cóntra la, *or* délla fortúna? *who can go against fortune?*
Malgrádo mía, *in spite of me.*
È partíto nonostánte il pericolo, *he is gone, notwithstanding the danger.*
Égli arrivò avánti di me, *he arrived before me.*
Príma délla guérra, *before the war.*
Égli entrò dópo me, *he came in after me.*
Diétro all' úscio, *behind the door.*
Fra dúe montágne, *between two mountains.*
Andáre a Parígi, *to go to Paris.*
Andrò in campágna fra dúe settimáne, *I will go into the country in a fortnight.*
Allontanársi da Róma, *to remove from Rome.*
Sótto il létto, *under the bed.*
Sópra la távola, *on the table.*
Égli córre vérso me, *he runs towards me.*
Tútto è perdúto eccétto l' onóre, *all is lost except honour.*
Sénza dúbbio, *without doubt.*
Veníte con me, *come with me.*
Duránte la guérra, *or* in témpo di guérra, *during the war.*
Óltre di ciò, *besides that.*
Mi régolo secóndo le círcostánze, *I act according to circumstances.*

THE CONJUNCTION.

The conjunction is a word used to connect one word with another, and sentences with sentences.

COMPARATIVE.

Cóme, *as.*
Nel módo che, *just.*
Similménte, *likewise.*
In óltre, *besides.*

ADVERSATIVE.

Ancorchè, benchè, comeché, *though.*
Tuttavía, púre, per áltro, *yet.*
Ma, *but.*
Se non, *unless.*
Non di méno, nondiméno, *nevertheless.*
Perciò, per quésto, *therefore.*
Non per tánto, *not however.*

DISJUNCTIVE.

O o, sía che, *either, or.*
Oppúre, ossía, ovvéro, *or, or else, either.*

CASUAL.

A fíne, affíne, *in order.*
A fíne che, affinchè, acciò che, acciocchè, *in order that.*
A cagióne, *on condition.*
Perchè, perciò che, *because.*
Póscia che, *since.*
Per, *for.*
Perocchè, perciò che, *therefore.*

CONCLUSIVE.

Così, *thus.*
Laónde, *therefore.*
Di mániera che, *so that.*
In sómma, *in short.*
Ónde, dúnque, adúnque, *whence, then.*
Per ciò, *for this.*
E cosi, *and so.*
Per la quál cósa, *wherefore.*
Per tánto, *in the meantime.*

CONDITIONAL.

A condizióne che, con pátto che, *on condition that.*
Ben intéso che, *provided.*
Dáto che, pósto che, *supposing that.*
In cáso che, *in case that.*
Quándo, *when.*
Se, *if.*
Da che, poichè, póscia che, *since.*
Ógni vólta che, *whenever.*
Altriménte, *otherwise.*

TRANSITIVE.

Ancóra, di più, *yet, further.*
Altresì, *but.*
Eziandío, *also.*
In óltre, *besides.*
Appresso, *after.*
Oltracciò, óltre che, *besides that.*

THE INTERJECTION.

The interjection is a word which serves to express the different affections of our mind. They may be divided as follows:—

ADMIRATION.

Oh! oh! *oh! oh!*
Ah! *ha!*
Può éssere! possíbile! *is it possible!*
Che! *what!*
Cóme! *how!*

AVERSION, CONTEMPT, AND DISGUST.

Oh vergógna! *fie, for shame!*
Oibò! *O fie!*
Eh vía! puh! *foh! pish!*
Andáte, andáte! *go, go!*
Deh! *eh!*

AFFLICTION OR GRIEF.

Aimè! oimè! ohimè! lásso! lásso me! *alas!*
O Dio! *O God!*
Ah Signóre! *ah Lord!*
Ah! áhi! oi! óhi! oh! *ah!*
Mísero me! meschíno me! dolénte me! *unfortunate that I am!*

DERISION.

Oibò! ciáncie! *fiddlestick!*
Vía vía! *pshaw!*

FEAR.

Dio mi benedíca! Dio mi sálvi! misericórdia! *God bless me!*
Dio buóno! oh che giórno! *lack-a-day!*
Gran Dio! *good Heaven!*
Oh Dio! *oh Heaven!*
Oimè! *alas!*
Sta! *stop!*

JOY AND DESIRE.

Oh! ah! *O! oh!*
Béne! *well!*
Buóno! *good!*
Ah! ah! *ah! ah!*
Ah! ah! *ah!*
Víva, víva! eh víva! evvíva! *long live!*
O che allegrézza! allegrézza, allegrézza! *oh, what joy!*

APPROBATION OR APPLAUSE.

Béne! *well!*
Va béne! *very well!*
Così! *so!*
Sì! *yes!*
Mi piáce! *very well.*
Víva! eh víva! *huzzah!*
Brávo! bravíssimo! *bravo!*
Buóno! *good!*

ENCOURAGING.

Su présto! vía! su vía! vía su! orsu! ánimo! *come on! come then!*
Su, su! *now then!*
Ánimo su! *cheer up!*
Corággio! *courage!*

SURPRISE.

Cápperi! cáppita! cappiterína! cánchero! cánchitra! *heyday!*
Cóme! *how so!*
Oh! *oh!*
Ah! *ah!*
Per bácco! *upon my word!*

CALLING.

Éia! oh, oh! *halloo!*
Éhi! olà! *here!*
Al fúoco! *fire!*
Ajúto! *help, help!*
All' ármi! *to arms!*

* Black here cannot take either the Bishop or the Knight, as White would give mate with his Queen.

WARNING.

Badáte! guárda! lárgo, lárgo! óhe, óhe! *take care!*
Ecco! éccoti! *behold! lo!*
Alto! *halt! stay!*
Via! via! *away! away!*
Séuti! ódi! adágio! *softly!*

SALUTATION.

Sálve! salvéte! *hail!*

SILENCE.

Sta, sta! zitto! tacéte! *peace there!*
Siléuzio! chéto! *silence!*

SYNTAX.

The Italian Syntax is the art of uniting together the words and phrases of an Italian sentence.

THE ARTICLES.

THE DEFINITE ARTICLE.

Rule 1.—The definite article il, lo, la, *the*, must agree with nouns in gender and number; as—

Seguite il sentiero, *follow the path.*
Passate il ruscello, *cross the brook.*
Lo studio è piacevole, *study is pleasant.*
La zuppa era fredda, *the soup was cold.*
Porta i tondi, *he carries the plates.*

Rule 2.—The definite article il, lo, la, *the*, is used before substantives taken in a *general sense;* as—

Gli Inglese sono generosi, *the English are generous.*
Gli uomini sono mortali, *men are mortal.*
La giustizia è assai rara, *justice is very rare.*
L' industria ci arricchisce, *industry enriches us.*
Il nero e il rosso son più stimati del giallo e del grigio, *black and red are more esteemed than yellow and grey.*

Rule 3.—The definite article il, lo, la, *the*, is used before substantives taken in a *particular sense;* as—

La carità è nel cuore delle donne, *charity is in the heart of women.*
Sento le campane della chiesa, *I hear the bells of the church.*
Ho smarrita la chiave dell' uscio, *I have mislaid the key of the door.*
I piaceri sono I fiori della vita, *pleasures are the flowers of life.*
Sono stato in tutte le città dell' Italia, *I have been in all the cities of Italy.*

Rule 4.—The definite article il, lo, la, *the*, is generally used before names of countries, kingdoms, mountains, provinces, rivers, seasons, and winds:—

Le quattro parti del mondo sono l' Europa, l' Asia, l' Africa, e l' America, *the four parts of the world are Europe, Asia, Africa, and America.*
Il Rodano è un grandissimo fiume il quale esce di quella medesima montagna, della quale escono il Danubio e 'l Reno, *the Rhone, which springs from the same mountain which produces the Danube and the Rhine, is a very large river.*
La Francia è più popolata dell' Inghilterra, *France is more populous than England.*
L' eruzioni del Vesuvio hanno più volte coperto di sue ceneri le contrade vicine, *the eruptions of Vesuvius have several times covered the neighbouring places with its cinders.*
Il norte, il sud, l' oriente, e l' occidente, sono i venti principali, *north, south, east, and west are the principal winds.*

Rule 5.—The definite article il, lo, la, *the*, is used before the names of dignities, offices, professions, and qualities, and also before *signore, signora,* and *signorina** :—

Il generale Buonaparte, *General Buonaparte.*
La Regina Carlotta, *Queen Charlotte.*
Il maresciallo Soult, *Marshal Soult.*
Il signor Pietro è perduto, *Master Peter is lost.*
Parlo della signora Francesca, *I speak of Mistress Frances.*

Rule 6.—The definite article il, lo, *the*, is used before infinitives and adverbs, taken substantively:—

Il ballare mi secca, *dancing tires me.*
Non mi ricordo nè il dove, ne il quando, nè il come, *I recollect neither where, nor when, nor how.*
Il leggere è utile, *reading is useful.*
Sto tra 'l si e 'l no, *I am in an uncertainty.*
Dite il perchè, *say the why.*

Rule 7.—The definite article il, lo, la, *the*, is suppressed before nouns taken in a general, proverbial, or usual sense:—

Audacia, fortuna, e virtù gli dettero trono e potenza, *audacity, good luck, and merit gave him the sceptre and power.*
Io non ho tempo, *I have not time.*
Consiglio, e ragione conducono la vittoria, *counsel and reason lead the victory.*
Necessità non ha legge, *necessity has no law.*
Andate a casa, *go home.*

Rule 8.—The definite article il, lo, la, *the*, is suppressed before the number of a chapter, or of a page, and before the title of any literary performance:—

Libro quarto, capitolo quinto, parte prima, *book the fourth, chapter the fifth, part the first.*
Storia d' Italia scritta da Carlo Botta, *History of Italy, written by Charles Botta.*
Arte d' amare da Ovidio, *the Art of Loving, by Ovid.*
Lettere sull' Indie Orientali, *Letters on the East Indies.*
Discorso sopra la lingua Italiana, *Discourse on the Italian tongue.*

Rule 9.—The definite article il, *the*, is suppressed before numbers denoting the succession of sovereigns:—

Ho letto il secolo di Luigi decimoquarto, *I have read the age of Louis XIV.*
Guglielmo terzo fu un gran conquistatore, *William the Third was a great conqueror.*
Carlo decimo non è re di Francia, *Charles the Tenth is not king of France.*
Enrico quarto fu un buon principe, *Henry the fourth was a good prince.*

THE INDEFINITE ARTICLE.

Rule 10.—The indefinite article uno, una, un, *a* or *an*, must agree with nouns in gender; as—

Troverete un villaggio, *you will find a village.*
Tuo nepote è uno scioccherello, *your nephew is a heedless boy.*
Portate una sedia, *bring a chair.*
Una vespa m' ha punto, *a wasp has stung me.*
Avremo una state molto calda, *we shall have a very hot summer.*

Rule 11.—The indefinite article uno, una, un, *a* or *an*, is repeated before every Italian noun:—

Ho veduto un' uomo, una donna, e un bambino, *I have seen a man, woman, and a child.*
Aveva la signoria di una città e d' un popolo, *he had the principality of a city and a people.*
Mettete un tovagliolo, ed una bottiglio sopra la tavola, *put on the table a napkin and a bottle.*
Ho comprato una tavola, ed uno specchio, *I have bought a table and a looking-glass.*

THE PARTITIVE ARTICLE.

Rule 12.—The partitive article di, del, dello, della, *some*, is used to express a portion or a part of anything:—

Datemi del pane, *give me some bread.*
Comprate delle pernici, *buy some partridges.*
Ecco della salsa, *here is some sauce.*
Portategli dell' arrosto, *bring to him some roast meat.*
Prendete della cioccolata, *take some chocolate.*

Rule 13.—The Italians use no partitive article when they express the quality or species of a noun taken in a general sense:—

Bevete vin nero o vin bianco? *do you drink red or white wine?*
Buone pane, e buon' acqua bastano per la nutrizione del corpo umano, *good bread and water are sufficient for the food of the human body.*
Sono donne leggiadre, *these are pretty women.*
Mangiano come lupi, *they eat like wolves.*
Grandi avvenimenti, e grandi rivoluzioni seguirono la morte di Cesare, *great events and revolutions followed the death of Cæsar.*

NOUNS.

Rule 14.—When two nouns in English are united by the preposition *of*, di is used before the latter, if it requires no article; but if it does, it is preceded by *del, dello, della;* as for example:—

L' amore di Dio, *the love of God.*
La cattedrale di Firenze, *the Cathedral of Florence.*
I flutti del mare, *the waves of the sea.*
Il valore dei Francesi, *the valour of the French.*
Il dente di giudizio spunta tardi, *the tooth of wisdom springs late.*

Rule 15.—If in English a noun is in the possessive case, and followed by another noun, in Italian the former is placed after the latter, preceded by *di, del, dello, della,* or *dei*, etc.; as in these examples:—

La chiesa di S. Paolo, *Saint Paul's church.*
Il palazzo di S. Giacomo, *Saint James's Palace.*
Le leggi del Gran-Duca di Toscana, *the Great Duke of Tuscany's laws.*
La figlia del re, *the king's daughter.*
I guanti della moglie del maestro di casa del fratello del re, *the king's brother's steward's wife's gloves.*

Rule 16.—When two nouns are joined together in English, forming a compound noun, and showing the matter of which a thing is made, the preposition *di* is put between the two nouns:—

Vedo una casa di mattoni, *I see a brick house.*
Ecco la statua di marmo, *behold the marble statue.*
È un dio di legno, *it is a wooden god.*
Datemi un orologio d' oro, *give me a gold watch.*

* The titles of *Monsignore, Madama,* and *Madamigella,* take no article; as, *Monsignore arcivescovo,* etc.

PAINTING IN WATER-COLOURS.—VI.

FOREGROUND, MIDDLE, AND EXTREME DISTANCE.

Our remarks in this lesson will be in a great measure directed to tones, and their gradations, as they recede from the foreground to the remotest part of the pictnre. The subject has been introdnced before, but only in reference to other matters, merely stating that colours as well as forms become more generalised and melted together as they recede: in other words, colours as they retire are more subdued by and intermingled with grey tones, and the details of forms are lost in the united combination of masses. But yet there must be one and the same principle carried throughout; whilst objects in the foreground should be crisply rendered and well defined, there must still be one harmonious union of the whole; no one part must appear prominently at the expense of another, and the masses in representing, is but daubing. At the same time, we decidedly object to microscopic manipulation: in other words, whilst there must be a truthful embodiment of all that is indispensable for the preservation of character, regard must be paid to the masses as they stand related to each other, some more prominent and defined as they approach the light, others subdued and generalised as they recede into half-tint and shadow. It will not be difficult, then, to understand why we lay so much stress upon drawing, and the power of drawing to enable us to accomplish all that we desire; not, perhaps, that we are able to see all at first, as this is an increasing faculty, perfecting itself by experience; but a mind habitually directed towards the attainment of this power of discriminating the most delicate tones and the most minute characteristic differences of form, however insignificant each may seem to be when taken by itself, will quickly discover them, and fully understand that it is the combination

Fig. 8.—FOREGROUND, MIDDLE, AND EXTREME DISTANCE.—SKETCH OF WINDSOR CASTLE.

of light and shade must be so managed that the recognised features of the landscape may present themselves with sufficient force and identity to give individuality to the scene. We may make the same observations respecting the middle distance, but with this exception, that particulars should be less defined, and still less as the subject recedes in the distance. If these characteristic distinctions are observed throughont, with a dne regard to the requisite amount of labour each respectively demands, we shall in the end attain our object in giving expression to form, and of combining harmony of colour with unity of tone.

First, with regard to foregrounds. As the drawing, or description of particulars, is so very essential towards making a successful picture, we advise our pupils to attempt the present illustration (Fig. 8) first in sepia, solely with a view of improving their power of giving expression to all the various details throughout. Those who have earnestly taken up the subject of painting, and have accompanied us from the commencement of these lessons, will have found out by this time how much depends upon a conscientious and scrupulous observance of drawing details faithfully; for mere washing in colour, without any regard to the form of the object which it is intended to assist of all these as a whole that makes the difference we acknowledge to exist between one object and another of the same class. This enviable power, then, is to be acquired by close observation and study; it is one that gains additional strength from every effort, and he who possesses it will become more and more convinced of the fact, that without a strict attention to all characteristic details, whether they refer only to parts of objects, with respect to their individual forms, or the same under some special influence of light, or subjugation by shade, no satisfactory result can possibly reward his efforts.

After the whole of the drawing has been very carefully made out, commence by putting in the dark broad shadows on the trees, and paint them in such a way that the high lights and middle tone may be left. When this part of the work is dry, tone down some of the more subdued parts with a middle tint, preserving those branches which are to receive the greatest proportion of light; this will enable the pupil to understand the tone necessary for the sky afterwards, which must be painted with a flat light tint, leaving the clouds to be broken off at those edges which are *away from the light;* when this is dry a somewhat darker tint must be used for the cloud shadows, and their edges *towards the light* broken off as before. By *breaking off the* *edges* we do not mean entirely washing them off, but only partially so, as some portions of the edges must be left sharp and distinct, whilst others as they round off into shade may be softened a little, in proportion to the force of light cast upon the parts respectively. We shall have but few additional remarks to make upon the process of painting this subject in sepia, as the substance of much that has been already given in previous lessons applies equally to this case; generally speaking, let the trees be somewhat advanced—that is, to use an artistic phrase, "blocked in," then the principal masses of light and shade may be attended to in the middle distance. This distribution of labour will assist the judgment of the pupil to determine the strength of tone to be applied to the several parts, according to their positions in the landscape.

We will now open the colour-box :—Commence with the blue (cobalt) of the sky at A (Fig. 8) and pass it over the paper where the trees are to be painted to about B. As a rule, we may generally go over a dark tint with a light one, or, which amounts to the same, where a dark tint is afterwards to be painted; therefore, as the trees are darker than the sky, and besides, as there is blue in the green, no particular damage can be done to the trees with the blue of the sky; but should portions of the trees upon the sky be prominently exposed to the light, making the branches of a warmer or lighter tone, the blue of the sky may be spared, as this colour neutralises or subdues every light or warm colour over which it passes. The lights of the clouds are all marked *a*—these are to be left, and the blue passed over the portions marked *b*; the edges of the blue over which the shadows of the clouds are to be made out must be softened down, and the rest must be treated as we have explained in the sepia drawing. Add a little sepia and very little lake to the cobalt that remains in the saucer for the shadows of the clouds marked *c*. As these shadows approach the light they must be broken; on the sides away from the light they may be left a little more decisive—that is, they must be very little softened. Whilst the sky is drying, cover the high lights of the trees at *d* with a light tint of yellow ochre. (Our pupils must recollect a former caution of not using too powerful tints, as they may be increased afterwards, when dry, if necessary.) The foreground may receive the same colour in those parts where the light is strongest. If we were painting from Nature, we might probably see some warmer tints, on branches, or where fallen leaves may lie in the foreground. In this case, a little burnt sienna might be added. After this, the foreground and trees may be carried on for the sake of other parts of the picture, as we explained in the sepia painting. When the lights of the trees are dry, mix a little brown pink with indigo and lake in the proportion of 2, 2, and 1, for the shadows and depths of the trees (this tint we will call No. 1); also have in another saucer the same tint with the addition of more indigo (this cooler tint we will call No. 2); then with two brushes, one for each tint, proceed as follows:—Paint in with No. 2 the lower depths of the trees that are more remote from the light, as at *e*, and with No. 1 paint in the outer branches nearer the light; these two tints being laid side by side whilst wet, as described, will harmonise well, and produce an atmospheric effect amongst the branches. The bright lights on the ground and on the most prominent branches may receive a little gamboge at *s*. At the lower parts of the middle distance, where the town is seen above the trees at *o*, the same atmospheric effect may be preserved with a tint of cobalt and a little lake. The shadows and darker parts of the houses may be made out with this last tint, when the foreground and trees are somewhat advanced, but not finished; the dark parts and details of the castle may be made out with the grey of the clouds, the light sides with a little yellow ochre, and we might add, but it must be done judiciously, a very small portion of raw umber; too much of this latter colour would probably dirty the tints, but when moderately used the yellow ochre will be a little subdued. Paint the red bricks of the houses with a tint of Indian red, observing the gradations of tone, some stronger than others. This colour works well with the cobalt and lake of the shadows. The hills and the distance must be carefully picked out with cobalt and lake. Amongst the shadows of this part of the picture, a grey composed of terre-verte and very little lake will be useful; even yellow ochre, sparingly employed as a glazing colour over

Fig. 9.—SKETCH OF WINDSOR CASTLE.—EFFECT OF FINISHED DRAWING.

some of the brighter lights, will give value by contrast to the pearly greys and blue tones. Return to the trees and foreground, and break over the masses with brown pink and terre-verte, dipping the brush into a little gamboge for the brighter parts: this will flatten them a little, but they can afterwards be relieved and the details assisted with touches of brown, pink, and indigo; all the previous greyer tones painted with the indigo tint will still keep their places, if the terre-verte and brown-pink tint is not too freely spread over them.

The above instructions may be observed for the general treatment of the subject, but our pupils must bear in mind that there are many minor and additional particulars which relate to accidental effects that could scarcely be introduced here. As we have before remarked, close and continual observation on their part will make them acquainted with many facts relating to colours and tints. A great deal of what we have written can hardly be considered as more than a foundation for an art which must eventually be perfected by unwearied application and perseverance.

LESSONS IN GERMAN.—LXIX.

§ 92.—PARADIGM OF A COMPOUND VERB SEPARABLE.

Anfangen, to begin.

IND. *Pres.* Ich fange an, du fängst an, er fäng an; wir fangen an, ihr fangt an, sie fangen an.—*Imp.* Ich fing an, du fingst an, er fing an; wir fingen an, ihr fingt an, sie fingen an.—*Perf.* Ich habe angefangen; wir haben angefangen.—*Plup.* Ich hatte angefangen; wir hatten angefangen. —*First Fut.* Ich werde anfangen; wir werden anfangen.—*Second Fut.* Ich werde angefangen haben; wir werden angefangen haben.

SUB. *Pres.* Ich fange an, du fangest an, er fange an; wir fangen an, ihr fanget an, sie fangen an.—*Imp.* Ich finge an, du fingest an, er finge an; wir fingen an, ihr finget an, sie fingen an.—*Perf.* Ich habe angefangen; wir haben angefangen.—*Plup.* Ich hätte angefangen; wir hätten angefangen.—*First Fut.* Ich werde anfangen; wir werden anfangen.—*Second Fut.* Ich werde angefangen haben; wir werden angefangen haben.

COND. *First Fut.* Ich würde anfangen; wir würden anfangen — *Second Fut.* Ich würde angefangen haben; wir würden angefangen haben.

IMP. *Pres.* Fange (du) an, fange er an; fangen wir an, fanget (ihr) an, fangen sie an.

INF. *Pres.*—Anfangen or anzufangen, to begin.—*Perf.* Angefangen haben, to have begun.—*First Fut.* Anfangen werden, to be about to begin.

PART. *Pres.* Anfangend, beginning.—*Perf.* Angefangen, begun.

§ 93.—OBSERVATIONS ON THE PARADIGM.

(1.) An inspection of the above paradigm will show that the separation of the prefix from the radical part of the verb takes place in the indicative, subjunctive, imperative, infinitive (when preceded by zu), and the perfect participle. In the indicative and subjunctive, however, the separation is *not* made when, in dependent sentences, the verb is placed at the end of a clause or period; thus, als die Sonne diesen Morgen aufging, so verschwand der Nebel, when the sun rose (aufging) this morning, the fog disappeared.

(2.) In regard to the *position* of the particle, when separated, it must be noted that in the indicative, subjunctive, and imperative, it stands *after* the radical; often, also, after the several words dependent upon it; thus, ich fange das Buch an (where an, belonging to fange, comes after the object), I begin the book.

(3.) In the infinitive and the perfect participle, on the contrary, the particle comes *before* the radical; being separated from it, in the *infinitive*, by zu (when that preposition is employed), and, in the *participle*, by the augment ge, which is peculiar to that part of the verb; thus, anzufangen (an+zu+fangen), to begin, to commence; vorgestellt (vor+ge+stellt), placed before one, represented.

(4.) It remains to be added, that particles, when separated from the radicals, receive the full or principal accent; and that the radicals (if verbs) have the same form of conjugation, old or new, regular or irregular, as when employed without prefixes.

§ 94.—INSEPARABLE PREFIXES.

The prefixes of this class, as the name implies, are always found in close union with their radicals. They allow not even the augment syllable ge, in the perfect participle, to intervene, but reject it altogether; from this, however, must be excepted the case of the prefix miß, which, in a few instances, allows the augment ge to be *prefixed;* thus (from mißdeuten, to misinterpret) we have, in the perfect participle, gemißdeutet; as, bedeckt (not begedeckt), covered, from bedecken, to cover. Neither is zu (when used) allowed to come between the prefix and the infinitive, but stands before the two combined into one word; as, zu empfangen (not empzufangen), to receive; except in case of compound prefixes, wherein the first component is a separable and the second an inseparable particle, zu being then inserted between the two particles, as, anzuerkennen (from anerkennen). The inseparable prefixes are always unaccented, except After and Miß.

§ 95.—SIMPLE PREFIXES INSEPARABLE.

After,	after, behind;	Afterreden, to talk behind (one's back); to slander.
Be,	near, by, over, to make.	Bekommen, to come by, *i.e.*, to get; to obtain.
Emp,	in, within;	Empfinden, to find or feel within; to perceive.
Ent,	apart, away, to deprive of;	Entgehen, to go away or off; to escape.
Er,	forth, for, on behalf of;	Erklären, to make clear for (*one*); to explain.
Ge,	(mainly, *intensive* or *euphonic*);	Gedenken (same as denken), to think of.
Miß,	wrong, erroneously;	Mißdeuten, to misinterpret.
Ver,	away, at a loss;	Verschlafen, to sleep away, *i.e.*, lose by sleeping.
Wider,	against;	Widerstehen, to stand against; to resist.
Zer,	apart, asunder	Zerschneiden, to cut apart, or in pieces.

§ 96.—VERBS WITH INSEPARABLE PREFIXES DERIVED FROM COMPOUND NOUNS.

Beanspruchen, to claim, lay a claim to anything.	Verabscheuen, to abhor, detest.
Beaufsichtigen, to inspect, control.	Verabschieden, to send away, dismiss.
Beauftragen, to commission.	Veranlassen, to occasion, cause.
Verabreden, to concert, agree upon.	Verausgaben, to spend, pay away.

§ 97.—OBSERVATIONS.

(1.) Be has in German the same power which it has in English. It is, therefore, in most cases, better *transferred* than *translated.* Its uses will be easily learned from examples. Thus, from

Klagen, to moan.	Beklagen, to *be*moan.
Streuen, to strew.	Bestreuen, to *be*strew.
Lachen, to laugh.	Belachen, to laugh at.
Flügel, a wing.	Beflügeln, to furnish with wings, hasten.
Glück, happiness.	Beglücken, to make happy.
Frei, free.	Befreien, to set free.

In some instances it is merely *euphonic.*

(2.) Emp and ent. Emp is, probably, only another form of ent; occurring, however, only in three verbs (empfinden, to feel; empfangen, to receive; empfehlen, to recommend), and bearing a sense but remotely related to its original. The prime and predominant power of ent is that of indicating *separation, departure, privation.*

In some instances it has the kindred sense of *approach* or *transition* from one point or condition towards another. For example:—

Gehen, to go.	Entgehen, to get off, escape.
Ziehen, to draw.	Entziehen, to withdraw.
Haupt, the head.	Enthaupten, to deprive of the head, to behead.
Kraft, power.	Entkräften, to deprive of power, weaken.
Blöde, dim-eyed, dull, bashful.	Entblöden, to divest of shame, be bold.
Sprechen, to speak.	Entsprechen, to answer, or correspond to.

Ent is sometimes, also, merely *intensive* or *euphonic;* as, entleeren (from leer, *empty*), to empty out.

(3.) Er and ver. Er, as a general rule, conveys the idea of *getting* or *gaining for* some one, by means of that which is expressed by the word connected with it; as, erbitten, to get, or try to get, by begging. It finds its exact opposite in ver, which marks what is *against* or *away* from some one's interest or benefit; as, verbitten, to beg off, to decline. The force and use of these particles are best illustrated by examples :—

Finden, to find.	Erfinden, to find out for one's self, invent.
Stehen, to stand.	Erstehen, to arise, originate.
Bauen, to build.	Erbauen, to erect, to produce.
Spielen, to play.	Verspielen, to play away, to lose by gambling.
Führen, to carry, or lead.	Verführen, to lead away, to seduce.
Salzen, to salt.	Versalzen, to oversalt, spoil in salting.

(4.) Er and ver are also both employed in converting nouns and adjectives into verbs expressive of *transition* from one state or condition into another; thus—

Erkalten, (kalt, cold) to get cold.	Veredeln, (edel, noble) to ennoble.
Erkühnen, (kühn, bold) to become bold, dare.	Vergöttern, (Gott, God) to deify.
Erlahmen, (lahm, lame) to become lame.	Veralten, (alt, old) to grow old or obsolete.

In some instances, moreover, er and ver are only *euphonic* or *intensive*.

§ 98.—PREFIXES SEPARABLE AND INSEPARABLE.

(1.) The prefixes of this class, when separable, are always under the full accent; when inseparable, the accent falls upon the radical.

(2.) Their effect, *when separable*, is, in union with radicals, to produce certain *intransitive* compounds, in which each of the parts (prefix and radical) has its own peculiar and natural signification.

There are, however, some compounds of durch and um in which, though these particles are separable, the verbs are, nevertheless, transitive. Still, it will be found that in such cases the signification of the compound is figurative; as, umbringen, to bring about (*one's death*), *i.e.*, to *kill*.

(3.) Their effect, *when inseparable*, is, in connection with the radicals, to form certain *transitive* compounds; which, for the most part, are used in a figurative or metaphorical sense.

(4.) We subjoin a list of the prefixes of this class, illustrating each by a couple of examples; the first being one in which the prefix is separable, the second one in which it is inseparable :—

Durch, through;	Durch'dringen, to press or force through. Durchdrin'gen, to *penetrate*.
Hinter, behind;	Hinter'gehen, to go behind. Hinterge'hen, to *deceive*.
Ueber, over;	Ue'bersetzen, to set or put over. Uebersetz'en, to *translate*.
Um, around;	Um'gehen, to go around. Umgeh'en, to *evade*.
Wieder, again; back;	Wie'derholen, to fetch or bring back. Wiederho'len, to *repeat*.

§ 99.—VERBS COMPOUNDED WITH NOUNS AND ADJECTIVES.

(1.) A variety of compounds is produced by the union of verbs with nouns and adjectives. These follow the same general laws which govern those produced by means of prefixes. Some of them, accordingly, are *separable*; as—

Fehlschlagen, to miscarry;	from	fehl	and	schlagen.
Freisprechen, to acquit;	,,	frei	,,	sprechen.
Gleichkommen, to equal;	,,	gleich	,,	kommen.
Losreißen, to tear away;	,,	los	,,	reißen.
Stattfinden, to take place;	,,	statt	,,	finden.

(2.) Some are *inseparable*; as—

Handhaben, to handle;	from	hand	and	haben.
Liebäugeln, to ogle;	,,	lieb	,,	äugeln.
Muthmaßen, to suspect;	,,	muth	,,	maßen.
Vollziehen, to perform;	,,	voll	,,	ziehen.
Willfahren, to gratify;	,,	will	,,	fahren.
Weissagen, to foretell;	,,	weis	,,	sagen.

(3.) These verbs take the augment syllable ge in the perfect participle; except vollziehen, which has vollzogen. In some cases, however, verbs compounded with voll, also, take the augment; as, vollgegossen, from vollgießen, to pour full.

KEY TO EXERCISES IN LESSONS IN GERMAN.

EXERCISE 180 (Vol. III., page 379).

1. I wish you a good morning. 2. I have the honour to wish you a good morning. 3. I remember my friends with sincere affection. 4. In times of prosperity he did not think of him, but in the hours of anxiety and distress he remembered him. 5. I intend to go on a journey. 6. I intend to return soon. 7. We intend to go on a journey. 8. You intended to do me mischief. 9. The father intends to agree to it. 10. I did not intend to go there. 11. I am packing my trunk, because I intend in a few days to go on a journey. 12. I am on the point of departing. 13. I am on the point of going out. 14. They conduct the criminal to the place of execution. 15. The duke's son led the troops to the assault himself. 16. He led them to the attack. 17. Russia waged war with Poland. 18. The merchant brings goods to the market. 19. A little child was leading the blind man. 20. Alaric was buried by the Goths in the Busento, after they had first turned off the current. 21. He guides every one according to his counsel. 22. He who does not submit to be guided by reason, runs the risk of being led by his passions to ruin. 23. The diligent scholar overtook his comrades in learning the English language, although they had begun to learn it about four weeks sooner. 24. We overtook the friends on their journey, although they went away half an hour earlier. 25. Men do not attain to so great an age now-a-days as in former times. 26. At the present day one hears of nothing else than war. 27. At the present day one hears much complaining of bad times.

LESSONS IN ALGEBRA.—XXXIX.

GEOMETRICAL PROPORTION AND PROGRESSION (*continued*).

CASE IV.—ADDITION AND SUBTRACTION OF EQUAL RATIOS.

If to or from two analogous or two homologous terms of a proportion, two other quantities having the same ratio be added or subtracted, the proportion will be preserved. (Euclid V. 2.)

For a ratio is not altered by adding to it, or subtracting from it, the terms of another *equal* ratio.

If $a:b::c:d$, and $a:b::m:n$,

Then, by adding to, or subtracting from, a and b, the terms of the equal ratio $m:n$, we have,

$$a+m:b+n::c:d, \text{ and } a-m:b-n::c:d.$$

And by adding and subtracting m and n to and from c and d, we have,

$$a:b::c+m:d+n, \text{ and } a:b::c-m:d-n.$$

Here the addition and subtraction are to and from *analogous* terms. But by alternation these terms will become *homologous*, and we shall have,

$$a+m:c::b+n:d, \text{ and } a-m:c::b-n:d.$$

Cor.—1. This addition may evidently be extended to *any number* of equal ratios. (Euclid V. 2, *Cor.*)

$$\text{Thus, if } a:b::\left\{\begin{matrix} c:d \\ h:l \\ m:n \\ x:y \end{matrix}\right\} \text{ then } a:b::c+h+m+x:d+l+n+y.$$

Cor.—2. If $\left.\begin{matrix} a:b::c:d \\ \text{And } m:b::n:d \end{matrix}\right\}$ then $a+m:b::c+n:d$. (Euclid V. 24.)

$$\left.\begin{matrix}\text{For by alternation } a:c::b:d \\ \text{And } \qquad m:n::b:d\end{matrix}\right\} \text{hence } \left\{\begin{matrix} a+m:c+n::b:d, \\ \text{or } a+m:b::c+n:d.\end{matrix}\right.$$

Hence, if two analogous or homologous terms be added to or subtracted from the two others, the proportion will be preserved.

Thus, if $a:b::c:d$, and $12:4::6:2$, then,

1. *Adding* the *last* two terms to the *first* two,

$a+c:b+d::a:b$	$12+6:\ 4+2::12:4$
and $a+c:b+d::c:d$	$12+6:\ 4+2::\ 6:2$
or $a+c:a::b+d:b$	$12+6:12::4+\ 2:4$
and $a+c:c::b+d:d$	$12+6:\ 6::4+\ 2:2$

2. *Adding* the two *antecedents* to the two *consequents*.

$a+b:b::c+d:d$	$12+4:\ 4::6+2:2$
$a+b:a::c+d:c$, etc.	$12+4:12::6+2:6$,

This is called *composition*. (Euclid V. 18.)

3. *Subtracting* the *first* two terms from the *last* two,

$$c-a:a::d-b:b, \text{ or } c-a:c::d-b:d, \text{ etc.}$$

4. *Subtracting* the *last* two terms from the *first* two,

$a-c:b-d::a:b$, or $a-c:b-d::c:d$, etc.

5. *Subtracting* the *consequents* from the *antecedents*,

$a-b:b::c-d:d$, or $a:a-b::c:c-d$, etc.

The alteration expressed by the last of these forms is called *conversion.*

6. *Subtracting* the *antecedents* from the *consequents*,

$b-a:a::d-c:c$, or $b:b-a::d:d-c$, etc.

7. Adding and subtracting, $a+b:a-b::c+d:c-d$; that is, the sum of the first two terms is to their difference as the sum of the last two to their difference.

Cor.—If any compound quantities, arranged as in the preceding examples, are proportional, the simple quantities of which they are compounded are proportional also.

Thus, if $a+b:b::c+d:d$, then $a:b::c:d$. This is called *division.* (Euclid V. 17.)

CASE V.—COMPOUNDING PROPORTIONS.

If the corresponding terms of two or more ranks of proportional quantities be multiplied together, the products will be proportional.

This process is called *compounding proportions.* It is the same as *compounding ratios.* It should be distinguished from what is called *composition*, which is an *addition* of the terms of a ratio.

If	$a:b::c:d$	$12:4::6:2$
And	$h:l::m:n$	$10:5::8:4$
Then	$ah:bl::cm:dn.$	$120:20::48:8.$

For, from the nature of proportion, the two ratios in the first rank are equal, and also the ratios in the second rank. And multiplying the corresponding terms is multiplying the *ratios*—that is, multiplying *equals by equals*, so that the ratios will still be equal, and therefore the four products must be proportional.

The same proof is applicable to any number of proportions.

$$\text{If } \left\{\begin{matrix} a:b::c:d \\ h:l::m:n \\ p:q::x:y \end{matrix}\right\} \text{ then } ahp:blq::cmx:dny.$$

From this it is evident that if the terms of a proportion be multiplied each into *itself*, that is, if they be *raised to any power*, they will still be proportional.

If	$a:b::c:d$	$2:4:6:12$
	$a:b::c:d$	$2:4:6:12$
Then	$a^2:b^2::c^2:d^2.$	$4:16::36:144.$

Proportionals will also be obtained by *reversing* this process, that is, by extracting the *roots* of the terms.

If $a:b::c:d$, then $\sqrt{a}:\sqrt{b}::\sqrt{c}:\sqrt{d}$.

For taking the products of the extremes and means, $ad=bc$.

And extracting the root of both sides, $\sqrt{ad}=\sqrt{bc}$.

That is, $\sqrt{a}:\sqrt{b}::\sqrt{c}:\sqrt{d}$.

CASE VI.—INVOLUTION AND EVOLUTION OF THE TERMS.

If several quantities are proportional, *their like powers or like roots are proportional.*

If $a:b::c:d$,

Then $a^n:b^n::c^n:d^n$, and $\sqrt[m]{a}:\sqrt[m]{b}::\sqrt[m]{c}:\sqrt[m]{d}$.

And $\sqrt[m]{a^n}:\sqrt[m]{b^n}::\sqrt[m]{c^n}:\sqrt[m]{d^n}$; that is, $a^{\frac{n}{m}}:b^{\frac{n}{m}}::c^{\frac{n}{m}}:d^{\frac{n}{m}}$.

It must not be inferred from this, that quantities have the *same ratio* as their like powers or like roots.

If the terms in one rank of proportionals be *divided* by the corresponding terms in another rank, the quotients will be proportional.

This is sometimes called the *resolution* of ratios.

If	$a:b::c:d$	$12:6::18:9$
And	$h:l::m:n$	$6:2::9:3$
Then	$\frac{a}{h}:\frac{b}{l}::\frac{c}{m}:\frac{d}{n}$	$\frac{12}{6}:\frac{6}{2}::\frac{18}{9}:\frac{9}{3}$

This is merely *reversing* the process in Case V., and may be demonstrated in a similar manner.

N.B. This should be distinguished from what geometricians call *division*, which is a *subtraction* of the terms of a ratio.

When proportions are compounded by multiplication, it will often be the case that the *same factor* will be found in two analogous or two homologous terms.

Thus, if	$a:b::c:d$
And	$m:a::n:c$
	$am:ab::cn:cd$

Here a is in the first two terms, and c in the last two. Dividing by these, the proportion becomes

$m:b::n:d$. Hence,

In compounding proportions, *equal factors* or *divisors* in two analogous or homologous terms may be *rejected.*

If	$a:b::c:d$	$12:4::9:3$
	$b:h::d:l$	$4:8::3:6$
	$h:m::l:n$	$8:20::6:15$
Then	$a:m::c:n$	$12:20::9:15$

This rule may be applied to the cases to which the terms "*ex æquo*" and "*ex æquo perturbata*" refer. One of the methods may serve to verify the other.

When four quantities are proportional, if the *first* be greater than the *second*, the *third* will be greater than the *fourth*; if equal, equal; if less, less.

$$\text{Suppose } a:b::c:d, \text{ then if } \left\{\begin{matrix} a=b,\ c=d. \\ a>b,\ c>d. \\ a<b,\ c<d. \end{matrix}\right.$$

If four quantities are proportional, their *reciprocals* are proportional, and *vice versa.*

If $a:b::c:d$, then $\frac{1}{a}:\frac{1}{b}::\frac{1}{c}:\frac{1}{d}$.

For in each of these proportions, we have, by reduction, $ad=bc$.

PROBLEMS IN GEOMETRICAL PROPORTION.

EXAMPLE.—Divide the number 49 into two such parts, that the greater increased by 6 may be to the less diminished by 11 as 9 to 2.

Let $x=$ the greater, and $49-x=$ the less.

By the conditions proposed,	$x+6:38-x::9:2.$
Adding terms,	$x+6:44::9:11.$
Dividing the consequents,	$x+6:4::9:1.$

Multiplying the extremes and means, $x+6=36$; and $x=30$, the greater part, and $49-x=49-30=19$, the lesser part.

EXERCISE 70.

1. What number is that, to which if 3, 8, and 17 be severally added, the first sum shall be to the second as the second to the third?
2. Find two numbers, the greater of which shall be to the less as their sum to 42, and as their differeuce to 6.
3. Divide the number 13 into two such parts, that the squares of those parts may be in the ratio of 25 to 16.
4. Divide the number 14 into two such parts, that the quotient of the greater divided by the less shall be to the quotient of the less divided by the greater as 16 to 9.
5. If the number 20 be divided into two parts, which are to each other in the *duplicate* ratio of 3 to 1, what number is a mean proportional between those parts?
6. There are two numbers whose product is 24, and the difference of their cubes is to the cube of their difference as 19 to 1. What are the numbers?
7. There are two numbers in the proportion of 5 : 6; the first being increased by 4 and the last by 6, the proportion will be as 4 : 5. What are the numbers?
8. A farmer has a quantity of corn in his granary, and sells a certain number of bushels, which is to the number of bushels remaining as 4 : 5. He then feeds out 10 bushels, which is to the number sold as 1 : 2. How many bushels had he at first, and how many did he sell?
9. There are two numbers whose product is 135, and the difference of their squares is to the square of their difference as 4 to 1. What are the numbers?
10. What two numbers are those, whose difference, sum, and product are as the numbers 2, 3, and 5 respectively?
11. Divide the number 24 into two such parts, that their product shall be to the sum of their squares as 3 to 10.
12. In a mixture of rum and brandy, the difference between the quantities of each is to the quantity of brandy as 100 is to the number of gallons of rum; and the same difference is to the quantity of rum as 4 to the number of gallons of brandy. How many gallons are there of each?
13. There are two numbers which are to each other as 3 to 2; if 6 be added to the greater and subtracted from the less, the sum and remainder will be to each other as 3 to 1. What are the numbers?
14. There are two numbers whose product is 320; and the difference

of their cubes is to the cube of their difference as 61 to 1. What are the numbers?

15. There are two numbers, which are to each other in the duplicate ratio of 4 to 3, and 24 is a mean proportional between them. What are the numbers?

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XII.—ROME.

For a thousand years the Romans made conquest their policy. They were essentially a martial people. Warfare, however, is destructive of the means of subsistence. While, therefore, we inquire into the industry and commerce of the Romans, with the view of ascertaining how much of our present prosperity is due to them, there is also, on the other side, the question of how much has been lost by the repression or destruction of the genius and individuality of nations of which they were guilty. The patriotic spirit which leads men to die for their country lost its force in a common subjection to Rome. The sentiment of devotion could not be strong, when the only tie uniting the provinces to the capital was that of subjugation and tribute. The fall of Rome left Europe denationalised; a spurious civilisation was followed by centuries of barbarism.

Distaste for labour grew with the empire. While the Roman territories were small—as late, indeed, as the time of Alexander—agriculture was honoured, and the rulers of the state tilled their own lands. When the wealth of Rome increased by conquest, the cultivation of the land, and the manufactures in connection with it, were made servile occupations, so that the poor citizens who would have been skilled labourers, had there been no slaves, became state-fed paupers, ready for every political commotion. In the works of Roman writers there are allusions which prove that the Roman citizens did not despise the profits of commerce, and that where even a senator could engage, though illegally and under a feigned name, in the slave or corn traffic, or turn the skill of his slaves to account, his aversion to the occupation was overcome. Crassus and Cato in this manner gained much of their wealth. Rome, as the capital of the world, the centre of tribute flowing through a thousand channels, disposed of this revenue in a profuse and sumptuous luxury, without parallel either before or since. Denied natural resources fit for interchange, there poured in continuous streams of commodities both by land and sea, for which the tribute from the provinces and the plunder accruing from conquest afforded exhaustless means of payment. While the Roman citizens thus consumed the material wealth brought to their city, foreign merchants made it a cosmopolitan mart or clearing-house for a fresh dispersion of the products of the Alexandrian trade, the traffic with China and India, the Scythian fur trade, and the trade with Africa, Spain, and Gaul. The productions of every clime were thus brought to the imperial centre, and the merchants enjoyed the advantages of universal commerce, without the cost and time of extensive travel. Amongst the middle classes, in the early age of simple wants, a merchant's guild was instituted, which enlarged its operations as time went on, but was not held in honour. The fruit and corn dealers took a prominent place in the home trade. Tanners and cordwainers were the most thriving handicraftsmen. Weaving and dyeing were subsequently added to the limited list of manufacturing industries.

The facilities afforded at Rome for interchange were purely political. The revenue that poured into its treasury was prodigious. The private fortunes of some of its citizens exceeded the whole wealth of many modern kingdoms. The capital was never anything else than a depôt, importing everything, and exporting no produce of its own.

Thus corn arrived from Sicily, Sardinia, and Egypt; amber from the Baltic; fine cloths from Malta and Mauritania; silks, spices, and gems by caravan from the Indies. The produce of the soil, the mines and the industry of every province, as well as costly works of taste or genius, were at the command of a prodigal aristocracy and wealthy citizens, of victorious generals and of provincial governors, who returned to squander at Rome the treasures they had amassed by official avarice and extortion. This profusion was copied in other cities. The disinterment of Pompeii and Herculaneum from their graves of Vesuvian ashes and lava has disclosed the splendid decoration common in the apartments of the wealthy. The exteriors of the houses were plain, but the interiors astonish us with their adornments. In one house a mosaic has been found consisting of nearly a million and a half of separate pieces in 198 squares, upon which are depicted, of the size and colours of life, twenty-six horsemen and warriors, representing the battle between Alexander and Darius. Two edifices are of special interest as having belonged to the illustrious Caius Sallust and Marcus Arius Diomedes. The dwellings corresponded in their fashion and appointments to those of Rome, but did not equal the latter in their sumptuous embellishments, as we may justly infer from the difference which is known to have existed between the Pompeian baths, temples, and public buildings, and the more magnificent structures of Rome. It was a saying of Crassus that "no one was rich who could not support an army"—he himself was worth a million and a half sterling in landed property alone.

Scaurus, the step-son of Sylla, built an amphitheatre capable of accommodating 80,000 spectators. It was supported by 360 costly marble, glass, and gilt pillars, and beautified with 3,000 statues; even by such profuse expenditures as this, he was unable to dissipate the enormous fortune bequeathed to him by his father. Though the Roman houses were comparatively small, yet the sums lavished upon their construction and furniture altogether transcend modern notions of costliness. A single table, according to Pliny, was often valued at a price exceeding that of the spoils of a city. Cæsar states that the house of Clodius the tribune cost £120,000. The suburban and country villas likewise afford examples of Roman luxury. Baths covered immense areas. Ponds for fish and eels—of which the Romans were very fond—aviaries for birds, extensive parks for game, and gardens for the choicest fruits, were regarded as necessaries. Within doors were rooms for every division of the day and every season of the year.

Voluptuousness culminated during the time of the emperors. To the taste for profusion was added that for the rare delicacies of the table. Pyramids of fowl and game, Trojan horses (*i.e.*, wild boars filled with a variety of small game), peacocks, cranes, and nightingales, appeared at the dinners of the great. "If a man will eat daintily," a writer of the period observes, "he must indulge in Samian peacocks, Phrygian fowls, Melian cranes, Ætolian kids, Chalcedonian porpoises, Tarentine oysters, Chian mussels, Egyptian dates, Spanish acorns, murenæ or sea-eels from Tarshish, pikes from Pessinus, sea-fish from Rhodes." Mark Antony served up eight whole boars to twelve guests. Caligula wantonly dissolved priceless pearls in vinegar as part of the fare at his feasts. Thousands of peacocks and nightingales were destroyed for their brains alone. Vitellius and Heliogabalus are to this day held up as the types of gluttony. Lucullus, a more refined epicure, dedicated his saloons to certain gods, and affixed a scale of entertainment to each apartment. When acting as the host of his friends, Pompey and Cæsar, he directed his servants to furnish an extemporaneous supper in the room Apollo, and explained to his guests, when they were astonished at its magnificence, that it was the rule of his house to spend £1,250 upon every banquet in that apartment. The extravagance in dress corresponded with that in eating. Lucullus lent a hundred purple robes, and offered two hundred to one who wanted them for the actors in some public games.

It is related of the Roman Apicius, that when, by senseless extravagance at table, he had reduced his patrimony to the last hundred thousand pounds, he put an end to his life, as the only means of escaping destitution. Cæsar, when starting to administer the government of Spain, was arrested by his creditors for a debt of a million and a half sterling; nor would they allow him to set out till Crassus became his surety. A short tenure of office, however, enabled Cæsar not only to pay his debts, but to use a still larger sum in purchasing popularity at Rome. Mark Antony out-distanced all these examples. In a few years of his administration of the states of Asia Minor it is said that he appropriated about forty millions sterling of taxes, and then made the people pay the same amount as before twice a year instead of once.

Courage could co-exist with commerce, for Tyre withstood Nebuchadnezzar for thirteen years, and New Tyre Alexander for seven months, while Rome was a century in subduing Carthage. Roman domination was unfavourable to commerce:

the productive resources of the earth declined as it became Romanised.

The Romans were, however, too sagacious to rest satisfied with barren conquests. Though unwilling to labour, they stimulated industry to a certain degree in every country that came under their sway. They removed the sense of subjugation by enrolling the conquered people as part and parcel of the empire. They made roads and bridges, they built cities and aqueducts, and brought the soil into cultivation. They encouraged the arts and sciences of the Greeks, and extended their own civilisation to many other countries. The Romans, likewise, in obtaining the supremacy of the world, put an end to the incessant petty warfare between rival states, and established an unrestricted trade and a commnnity of interests in all their provinces. Their chief service to commerce was that of rendering intercommunication everywhere easy and safe. Their great works in road-making spread over every province, from Britain to the Euphrates. So broad and solid were many of these roads that parts still remain entire. Watling Street in our own country is an example. This road led from the Kentish coast through London to Carnarvon, and is still one of the best English roads.

After good roads followed the system of posts or stages, by which couriers in the service of the emperors could change horses—a plan said to have been first used by Cyrus. The posts only conveyed pnblic despatches. Post-offices, as we understand them, are quite of modern origin, Louis XI. having introduced them into France, and Charles II. into England.

Our monetary and banking systems have both been founded on Roman practices. The £ *s. d.* of accounts are the initials of *libræ*, *solidi*, and *denarii*—Latin terms applied to the metals used as media of exchange, whether by weight or coinage.

There were in Rome government banks, private banks, and loan banks. A prevalent prejudice against receiving interest for money lent cansed the private bankers to be bnt little esteemed; but the government banks were managed by men of high position. Loan banks lent money on land and other property, for a certain term, without interest. The Romans also (some say the Rhodians) introduced underwriting or marine insurance.

The downfall of the Western Empire marks an epoch in political and commercial history. The relation between the different nations entirely changed at this period. It is the historian's line of demarcation between ancient history and that of the Middle Ages.

CHAPTER XIII.—THE NATIONS OF THE MIDDLE AGES, FROM B.C. 476 TO A.D. 1453.

COMMERCIAL RELATIONS OF THE BYZANTINE OR EASTERN ROMAN EMPIRE.

SEATED upon two continents, on each side of the narrow strait between the Euxine and the Mediterranean, Constantinople has an unrivalled position. Its site was selected by the Greek colonisers with a sagacity to which, as Hallam observes, the course of events has given the appearance of prescience. Under the name of Byzantium, the city flourished for a thousand years (B.C. 658 to A.D. 330). It was alternately held dnring the Peloponnesian wars by the Athenians and Lacedæmonians, and after the expulsion of the latter (B.C. 390) by Thrasybulus, it remained for some time independent. The Macedonians were afterwards masters of the city. Severus (A.D. 196) took it after a three years' siege, and razed a large part of it to the ground. Constantine (A.D. 330) rebuilt it, called it after his own name, and removed thither the seat of empire from Rome. But the Eternal City conld not be thus easily stripped of its metropolitan rank. The removal of the capital led ere long to the division of the Roman world into Eastern and Western Empires. Constantinople became the centre of a power Greek in character, Roman in name.

We have seen how, after the conquest of Greece, Egypt, and the East, Rome was flooded with ill-gotten wealth. The citizens made display the chief aim of existence; wealth became mere tinsel, and outward prosperity a hollow mask. At length, Western and Southern Enrope were overrun by tribes of barbarians, who trampled in the dust the glitter of Rome, and with it destroyed the previous geographical knowledge arising out of the world's commerce.

The feudal system had its origin in the period of anarchy following the irruptions of the Goths and Huns, by whom industry and trade were regarded as effeminate. For centuries distinction amongst the great was measured by landed possessions and the number of vassals. War was the only means of increasing property, and bands of idle retainers were kept, ever ready to obey the behests of their chief.

The Byzantine empire at this epoch bridged over the interval between the past and the future. Constantinople, free from the Scythian hordes, which had darkened Europe, retained many of the traditions of Rome, and kept up a commercial intercourse with the countries of the East. It was mainly by its instrumentality that the restoration of art and science was effected. Italy was the first to exhibit the growth of new tastes, which, as they spread through Europe, changed the aspect of social life. The nobles, diverted from fighting, displayed their wealth in dress and equipage. Their retainers gradually became peaceable labonrers and handicraftsmen, and their descendants have placed within the reach of the poor of modern times many things either unobtainable, or obtainable only with great cost and difficulty even by the Emperors of Rome.

There were not wanting rulers who viewed the revival of commerce with alarm, and who enacted sumptuary laws, copied from those of Rome, concerning the number of guests, the variety of viands, and the cost of entertainments. Even in onr own country, for instance (1377), only two courses, and two kinds of food at each course, were permitted by law, except at festivals. Furs and silks were prohibited to any one with an income of less than £100 a-year. Foreign cloth was to be worn only by members of the royal family. Henry IV. restricted the breadth of the toes of shoes to six inches. Edward IV. commanded that only lords should wear a short mantle. An edict against gilt spurs and bridles was issued in Ireland (1447); and any one was empowered to seize and keep for his own use horses caparisoned contrary to law. Such measures are always impolitic and radically bad. Where people are inclined to extravagance, snmptnary laws are powerless to check it, and they are met by bad habits and evasion—they cannot alter dispositions.

It was in the reign of Jnstinian (527-565) that indnstry and commerce received from a foreign source an impulse, the influence of which has spread more and more in sncceeding ages. This was the introduction of the silkworm. For many centuries silk was thonght to be a vegetable down, like cotton, its true origin having been jealously concealed from merchants. Two missionaries returning from China concealed in a cane some silkworms' eggs, which they brought to Constantinople. Worms from these eggs were distributed throughout the Byzantine empire. Cyprus and Sicily soon produced great numbers, and the Peloponnesus became known as the Morea, from the white mulberry trees, which began to be abundantly cultivated there.

The early Byzantine trade with India was carried on through Egypt, the Persians at that time intercepting the direct overland traffic. Soon after, the Enphrates valley was once more opened to caravans. Syria and Mesopotamia were subdued by the Caliph Omar, who built the town of Bassora; yet few goods reached Constantinople, for the empire was nearly always at war with the Arabs. When Alexandria fell into the hands of the latter, the communication by way of Egypt was cut off, as the Christian states would enter into no dealings with the infidels. Such, however, was the desire for Indian commodities, that a route was opened by way of the Greek settlements on the Black Sea and Independent Tartary; and for 200 years the products of India and China reached Constantinople almost exclusively by this circuitous course.

Each generation improved the commerce of the Mediterranean coasts, and an active trade arose between the Greek empire and Spain, Africa, and the Republics of Italy.

Amongst the commodities from the East and the West, which passed through Constantinople, and showed the extent of Byzantine commerce during Justinian's reign, were Egyptian silks and half silks, raw silks, linen, and flax; sweet wines and fruits—especially dates and figs—sugar, cassia, and drugs; Indian spices, cloves, nutmegs, mace, cinnamon, galanga root, and large qnantities of pepper. Precious stones, perfnmes, and horses also came from India. Silver was imported by the Genoese, probably from Spain; while the Pisanese introduced woollen stuffs, scarlet, and fustian. Few of the exports were native produce, for Constantinople was an emporium rather than a manufacturing city. Grecian velvets, other silk stuffs, cotton cloths, linen, and wool; nuts, saffron, oil, timber, pitch, honey; gold, silver, mercury, copper, iron, tin, lead, weapons, and slaves are enumerated. Restrictive laws led to an illicit trade in some varieties of goods, of which purple state robes were an example, their export being prohibited. The commercial vigour of the ancient Greeks never distinguished their Byzantine posterity. The land trade of Constantinople was carried on with no great activity. A military people called the Avars, inhabiting the provinces of the Danube lying between the Greek empire and Germany, had, up to the ninth century, the management of the Western land traffic. They were the carriers of goods, some of which eventually reached the most northern kingdoms of Europe. The wealth accruing from this trade enervated these Avars. It made them "refined barbarians," but could not save them from the inroads of a hardier tribe, like themselves of Slavonian origin, and known as Bulgarians.

For two centuries the Bulgarians carried on the trade between Constantinople and Germany, till disputes arose between them and the Greeks, who were at first defeated in the fierce encounters that ensued; but the Bulgarians were at length subdued by the Emperor Basil in 1018. The Bulgarians had probably been driven to invade the Greek territory by the advance of the Ungrians and Magyars, who in the tenth century took possession of the plain of the Danube, and established there a kingdom, which still preserves in its name (Hungary) and that of its people (Magyars) the memory of its founders. The Ungrians made Semlin in Hungary the depôt of the international transport trade. They took upon themselves the conduct of the traffic throughout, built factories, and established agencies in the capital, where Stephen I., who died in 1038, erected for their encouragement a splendid place of worship. Hungary flourished in every town because of the rich profits of their extensive business as carriers and brokers. The Western land traffic waned, and in the end disappeared, before the rising maritime commerce of Venice, Genoa, and other Italian republics. The commodities which specially distinguished the Western trade consisted of raw produce, manufactures, and works of art; Greek artistic work; olives, saffron, and hazel nuts; oil, liquorice, raw silk, silk and mixed stuffs; purple and priestly robes; gold dust and Eastern spices; pepper, ginger, cloves, nutmegs, galanga root, and anise-seed. Sword belts bound with brass and copper were sent by sea to the West, and in the land traffic Constantinople received overland from Germany Wendish slaves or serfs; from Bohemia and Moravia, weapons of ancient German manufacture; wooden tools and saddles from the Low Countries; woollen and linen, principally of Friesland make, and metals, from Transylvania and Hungary.

During a part only of this period could Byzantine commerce take the old Chaldean road to India. Obstructed by Persia and by continual contentions with the Arabs from employing it, the route through Independent Tartary was made use of. Byzantine commerce both by land and sea at length lost all its importance, and fell almost entirely into the hands of the Italians.

ACOUSTICS.—II.

SAVART'S TOOTHED WHEEL—RANGE OF THE HUMAN EAR—THE SYREN—NUMBER OF VIBRATIONS REQUIRED TO PRODUCE ANY GIVEN NOTE.

In our last lesson we learnt that sound was produced when the air was set in vibration by a sonorous body. If in any way we can cause a succession of gentle taps to succeed one another with sufficient rapidity, we shall find that they lose their individuality, and merge into a continuous note.

An easy way of obtaining experimental illustration of this consists in holding a piece of card against the teeth of a rapidly revolving wheel. The separate taps produced as each cog strikes it will not be distinguishable, but will coalesce to form a clear and distinct note, the pitch of which becomes higher and higher as the wheel rotates more rapidly. In this manner we may measure the number of vibrations per second required to produce any given note, a number which will always be found uniform.

Savart's toothed wheel (Fig. 6) is an apparatus devised for this purpose. It consists of two wheels, A and B, mounted in a strong wooden frame-work. The larger of these, A, is fitted with a handle by which to turn it, and a strap passing over its own circumference and also over a pulley on the axle of the toothed wheel, B, causes the latter to rotate with considerable velocity. A piece of card is fixed to the plate E in such a way that the teeth of the wheel may catch against it and set it in rapid vibration, the rapidity of the pulsations being determined by the rate at which the teeth strike against it. To the axis of this wheel there is fixed an indicator, H, which shows the number of revolutions it makes, and, multiplying this by the number of teeth, we learn the number of vibrations. The best way of using the instrument is, when a steady note is being produced, to allow it to continue for several seconds, and then divide the number of vibrations made by the card by the number of seconds. We thus ascertain the number of vibrations per second required to produce the sound. To produce the note an octave higher, we must just double this number.

It is important for us to remember that when we speak here of a vibration, we mean the oscillation of the vibrating particles to *and* fro, that is, its complete double motion. In France, each single oscillation to *or* fro is counted, and hence twice the number of vibrations are said to be required to produce any note. If this distinction be clearly borne in mind, little inconvenience will be caused by the different modes of speaking of the same thing.

The question now suggests itself, how many vibrations per second are requisite in order to produce a distinct musical sound. To this we cannot give a decided answer, since different ears are found to vary considerably in their power of appreciating sounds. To ascertain the limit, Savart slightly modified his apparatus, removing the toothed wheel, and substituting for it an iron bar, which passed between two thin wooden plates, so placed as almost to touch it. When the bar passed between them, a grave sound was produced by the displacement of the air, and he imagined that a distinct but very deep sound could be perceived when the number of these pulsations was about 12 or 14 per second. Other observers have placed the number as high as 32, while some place it as low as 8.

The upper limit to the number of vibrations that can be heard also varies very considerably. It depends partly upon the intensity of the vibrations and their amplitude. Some place the limit at from 20,000 to 24,000 vibrations per second; there seems, however, little doubt that a sound corresponding to 38,000 vibrations is audible in most ears. By experimenting with very acute sounds, Dr. Wollaston found that the limits of hearing in different people varied greatly. He sounded a series of small pipes in succession, before a number of people, and found that frequently the ascent of a single note produced to some the change from sound to complete silence; and while some experienced a sound of penetrating shrillness, others were quite unconscious of any sound whatever.

There are in Nature sounds so shrill that they are beyond the hearing of many people; thus, for instance, the needle-like cries of the bat are unheard by many; some, too, fail to hear the chirp of the cricket.

We may say, then, that sounds which the ear can distinguish range between 14 and 40,000 vibrations per second. The practical range of musical sounds is, however, much more limited. The deepest sound produced by any musical instrument appears to require about 28 vibrations, and the highest note, which is probably the upper D of the piccolo flute, requires 4,752 vibrations. For ordinary purposes, however, the range is from 40 to 4,000 vibrations, that is, a compass of about seven octaves.

There are several other ways in which we may cause a regular series of pulsations to produce a musical note. If we can interrupt a stream of air sufficiently often, we shall produce a series of puffs, which will combine into a tone. This can be easily effected by taking a circular sheet of tin, or millboard, and puncturing a series of holes in a circle round its centre (Fig. 7). Fix the disc to a whirling table, or cause it, by means of a multiplying wheel, to revolve rapidly. Then take a blowpipe or a piece of india-rubber tubing with a jet at the end, and holding the jet opposite to the line of the openings blow through it; the current will be interrupted when the card is against the jet, but will pass whenever an aperture comes opposite it. In this way the current will be frequently interrupted, and a musical note will be produced, the pitch of which becomes higher and higher as the disc is made to rotate more rapidly.

If we construct a disc with several concentric rings, having varying numbers of apertures, we shall be able to produce different sounds according to which part we hold the jet against. It is somewhat difficult to ascertain by this arrangement the exact number of interruptions per second; an apparatus was, however, devised by an eminent French natural philosopher, Cagniard de la Tour, which serves to register them very accurately. This curious acoustic instrument, which was called by him the *Sirène*, or *Siren*, because of its power of emitting sounds under water, is represented in Figs. 8 and 9 in the annexed illustration, the former showing the instrument complete, and the latter a view of a vertical section of it. The wheel-work at the upper part of the siren is for the purpose of recording the revolutions of the disc, but we will turn our attention to the other part first. O is a brass cylinder into which air is driven from the acoustic bellows, E, arrangements being made by which the power of the blast can be modified at pleasure. The upper end of O is closed by a plate, B, of brass or copper, perforated with twenty holes, arranged in a circle as shown in Fig. 10; through these apertures the air escapes. We want now some means of interrupting the current from these so as to produce a series of puffs instead of a continuous stream.

This is accomplished by another disc, A, similar to that which closes O; this disc is mounted on a spindle, T, the ends of which are pointed so as to turn with as little friction as possible. A small depression is made in the centre of B to carry the lower end of this, and the upper end turns in a cavity in the end of the screw on the top of the instrument. The whole is very carefully constructed, so that friction is reduced to a minimum. The number of apertures in each disc is precisely the same, and they correspond in position, so that all the openings are opened or closed simultaneously. Only one puff is, therefore, produced by the twenty holes; the sound is, however, much more powerful than if there were only one aperture. Now it will be seen that for every revolution A makes, 20 distinct pulsations will be produced in the air, and we therefore only need some means of causing this disc to revolve rapidly, and of recording its revolutions.

The former of these is easily accomplished. The openings in B, instead of being at right angles to the plane of the disc, are slightly inclined, as at *m* (Fig. 10), so that the air issues in currents directed to one side. The rotating disc, A, has its apertures inclined slightly in the other direction, as at *n*, and thus it will be seen that the air as it issues strikes against the sides of these apertures, and sets the disc in rotation. The force produced in this way is but small, but as the disc turns very easily, it is quite sufficient, and by merely increasing the pressure of the air from the bellows, we can raise the pitch of the note as high as we desire.

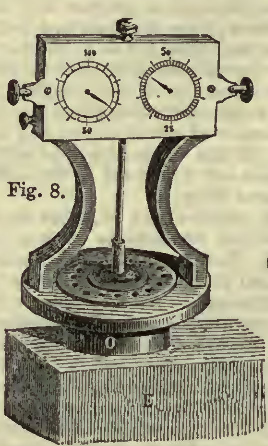
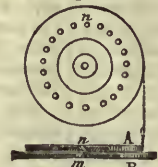


Fig. 8.

Fig. 10.



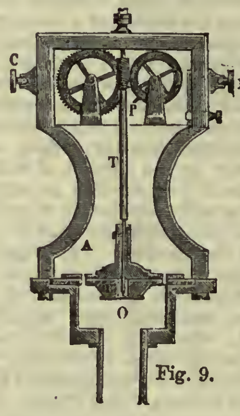


Fig. 9.

Fig. 11.

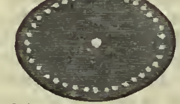
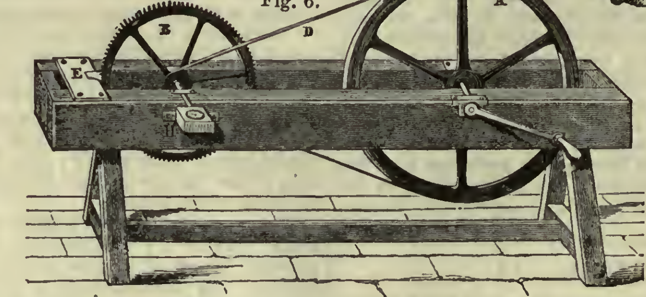


Fig. 7.

Fig. 6.



Now let us look at the recording portion of the apparatus. On the upper end of the spindle T there is cut a screw, which works in the teeth of the wheels that carry the hands. As the spindle turns, these wheels are moved by it, each revolution causing the wheel P to advance one tooth. The second wheel makes one revolution for every 100 made by the other. By pressing the stud, D, on the right-hand side of the instrument, the wheels are removed from the screw, on the upper part of the spindle, T, and thus cease to record; on pressing C, on the left-hand side of the instrument, contact is again renewed, and thus we can let the wheels remain in action as long as we like.

An illustration of the manner of using the apparatus will make this quite clear to the reader (Fig. 11). We will suppose that we have a tuning-fork, and want to ascertain the number of vibrations it produces in the course of a second. We place the siren in the wind-chest of the bellows, and cause it to sound, having first thrown the wheel-work out of gear; we then excite the tuning-fork by striking it or by drawing a violin-bow across it. The occurrence of *beats* in the sound will show us that the two notes are not in unison; we therefore adjust the force of the bellows till the beats gradually become slower and slower, and at last vanish, showing that now the siren and the fork are producing the same note. Keeping the pressure uniform, so that the same note continues to be uttered, we press C, and holding a watch in the hand, allow the wheels to record the revolutions for a given period, say, exactly one minute. At the expiration of this time we press the stud D, and having thus stopped the wheel-work, read off the number of revolutions indicated.

Suppose we find the revolutions recorded to be 768, then, since at every revolution the current of air is interrupted 20 times, we must clearly have produced 768×20, or 15,360 vibrations in the 60 seconds. Dividing this by 60, we obtain the quotient 256, which is the number of vibrations per second produced by the fork. The note is that generally known as middle C.

It has been noticed of late years that the pitch of the tuning-fork has been gradually getting higher, and, which is of more importance, that it differs considerably in different cities and countries. This is productive of some inconvenience, and in France a commission was appointed some ten or twelve years ago to inquire into the subject. After comparing the different standards, they recommended the adoption in France of a *normal diapason*. A standard tuning-fork was prepared in accordance with their recommendation. The fork, which gives the sound of the first A in the treble, produces 435 complete vibrations in the second. On this scale middle C requires 261, and the pitch is therefore slightly higher than the English. There being, however, no fixed standard in England, different makers vary slightly, and hence there is a want of that uniformity which is desirable.

LESSONS IN GEOLOGY.—XXVI.

PLIOCENE AND PLEISTOCENE PERIODS.

In the fossils yielded by the deposits of this period, more than one-half are found to be recent or existing species. The Pliocene period is but meagrely represented in England. In the counties of Suffolk and Essex are found beds of soft marly sands belonging to this age, containing large numbers of shells, reaching the thickness of some fifty or sixty feet. They have acquired the provincial name of "crag," and are used by the farmers to fertilise those heavy soils which are deficient in calcareous matter. On the Continent the Pliocene deposits attain a great magnitude. The Subapennine hills of Italy are accumulations of these beds, reaching a thickness of 2,000 feet; and in the east of Europe, to the north of the Black Sea, and stretching round the Caspian and Sea of Aral, is a widely-extended Pliocene area.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In England the Pliocene beds are divided into two—

1. The White or Coralline Crag.
2. The Red Crag.

The *Coralline crag* was the first formed. It only extends in a narrow belt for about twenty miles between the rivers Alde and Stour. It consists of a mass of broken shells and corals, which occasionally agglomerates into a soft building stone. Although called coralline crag, corals (as they are now defined) are not frequently found in it. The great mass of the fossils are *bryozoa*, or rather bryozoaria—that is, structures built up by colonies of bryozoa.

The term *bryozoa* (animal moss) was first used by Ehrenberg to denote those zoophytes of which the *Flustra* and *Eschara* are examples. These differ from the coral zoophytes in having two openings to the digestive sac instead of one.

In Fig. 154 we give a specimen of a bryozoaria, the *Fascicularia aurantium*. Each of the little punctures over the surface was the home or cell of a bryozoum. Probably by means of tentacles the animal caused a current of water to pass into its sac, and here not only was all the organic matter upon which it existed abstracted from the water, but also the lime which the water held in solution by virtue of the presence of carbonic acid gas, and with the lime the zoophyte added something to the structure which was the common work of the colony. The section we give shows how the work increased from a point —one generation building upon the cells in which their fathers lived and died. The same process is in operation to-day on the coral-reefs. The prolific growth of the echini, the presence of bryozoa, and the evidences we have of the existence of a multitude of testacea, prove that the Coralline crag must have been deposited in the tranquil waters of a deep sea. The temperature did not reach extremes, and was not tropical, for we find one of the most characteristic of the Coralline crag shells is the *Astarte Omalii*, which is a Northern form (Fig. 155).

The *Red crag* was probably formed when the sea was more shallow, and when the climate began to change prior to the setting in of the Glacial period, when an Arctic cold extended over Europe. Remains of the mastodon have been yielded by the crag, and some of the more prominent of its fossils are *Temnechinus excavatus* (Fig. 156), *Terebratula grandis* (Fig. 157), *Cardita senilis* (Fig. 158), *Voluta Lamberti* (Fig. 159).

The *Norwich crag*, which is sometimes called the *Mammaliferous crag*, because of the number of mammal remains which it contains, is found in the neighbourhood of Norwich. Its shells are much more recent than the Coralline crags, and more northern than those of the Red crag. Near Bridlington, on the coast of Yorkshire, is another deposit of a similar age. These and the Forest-bed are sometimes classed under the Post-pliocene.

The *Forest bed* occupies near Cromer the position of the Norwich crag. It is an ancient forest which was submerged beneath the sea-level, and then sands and clays were deposited upon it. The forest has been traced forty miles. The stumps of the trees are still in their upright positions: they are Scotch firs, yew, sloe, alder, and oak. These beds contain the remains of the elephant, mammoth, rhinoceros, hippopotamus, beaver, bear, deer, and other mammals.

THE PLEISTOCENE PERIOD,

or, as it is now generally called, the *Post-pliocene*, is the uppermost, and one of the most interesting of the stratified deposits.

The Northern Drift. — In those countries which lie north of latitude 50° is found a most peculiar deposit. It has received various names—*Northern drift*, *Diluvium*, *Boulder clay*, *Glacial deposits* — and it is known in Scotland as *Till*. It is a heap of *débris* of sand and clay, sometimes stratified—more often not—mixed with angular fragments of the rock of the neighbourhood. Sometimes these fragments are actually polished on one side, and the flat surface exhibits parallel scratches.

Whenever the drift rests directly on hard rock, such as granite, the face of the rock is found smoothed and striated similarly to the fragments. Moreover, in many parts of the British Isles the rocks of a valley are found smoothed and scratched. Take for example the neighbourhood of Snowdon. Six valleys radiate from the apex of the mountain, and in each of these valleys the rocks are all smoothed, and those which protrude above the surface of the ground near the bottom of the valleys are rounded. The scratchings are always parallel to the direction of the valley, and have evidently been made by some hard substance which filled the valley being dragged forcibly through it, a process which must have frequently been repeated, for one set of scratches may often be seen covering another older set, which have another inclination, or are not quite parallel to the new ones. These appearances were attempted to be explained by those who called the drift Diluvium, upon the supposition that they were the effects of the Flood; that when the "fountains of the great deep were broken up," surges of water rushed over the surface of the land, leaving heaps of gravel, and hurrying masses of rock through the valleys, scratching their sides.

But this explanation is evidently unsatisfactory; moreover, it is quite incapable of accounting for *erratic blocks*. Scattered over the country are blocks of rock—they are of all sizes, all shapes, and are found in all positions. They are generally not of the same kind as the rock of the country, but have, by some means or other, been transported many miles. Blocks of granite and gneiss from the Highlands are found fifty or sixty miles south. The "boulders," as they are called, which strew Lancashire, Cheshire, Shropshire, and Staffordshire, evidently are fragments of the rocks of Cumberland and Westmoreland. Perhaps the largest transported block is above the Devil's Glen, in County Wicklow, Ireland. It is of granite, twenty-seven feet long, fifteen feet broad, and eleven feet high. It is perched 650 feet above the sea, and is ten miles from the nearest granite. Now, how could any deluge place that boulder there? A rushing current might have rolled it along its bed, but never could have lifted it up a hill-side. Numerous instances of a similar kind might be cited, but our space forbids it. There is still one fact to add to the three above alluded to, before we draw to a conclusion. The true fossils of the boulder clay are all Arctic species; among them are *Astarte borealis* (Fig. 160), *Saxicava rugosa* (Fig. 161), *Pecten islandicus* (Fig. 162), *Natica clausa* (Fig. 163), *Trophon clathratum* (Fig. 164), *Leda oblonga* (Fig. 165).

Finding these species now existing on the ice-bound shores of northern latitudes, we naturally conclude that during the depositions of the drift, during the scratchings of the rocks, and during the transportation of the erratic blocks or boulders, the Arctic climate must have extended further south than it now does, even to a latitude of fifty degrees. We ought to say that the above phenomena are observed at the south pole, reaching to the same latitude. We turn to the agency of ice to explain what we have observed. We know that glaciers are always found on snow-clad mountains, because if there were no outlet for the frozen vapour which caps the heights with their eternal snows, the frozen water would accumulate continually until the mountains reached a stupendous height, and at last would overbalance and cause tremendous catastrophes. But as it is, when ice accumulates in large quantities it acquires the power of "flowing" precisely like water, only much slower. This motion is termed "viscous motion." The ice forming continually above the snow-line, descends down the mountain valleys in an ice-river or glacier, filling the valley exactly as if it were a river of water, contracting as it passes a gorge, and expanding again as it enters the open valley. None save those who have crossed a glacier can form any idea of the vast mass of ice of which it is composed, or of the enormous pressure it exercises against the sides of the valley. Its motion is about 400 feet a year; and the end of the glacier is that point where the ice is melted by the sun in the warm valley. As it scrapes along the sides of the hills, it not only scratches and polishes the rocks, producing precisely the same appearances as those which are found on our rocks, but also it gathers on its edges earth, stones, and rock, which fall upon it as it grates the valley-sides. This accumulation of *débris* is termed *moraine*. This the glacier carries down to the place where the sun melts it, and there it deposits its load, forming exactly the same accumulation as is found in the drift. In the Arctic regions the glacier continues its motion until it reaches the sea; for the snow-line is there at the level of the sea. Huge blocks of ice fall over the sea-cliffs into the water beneath, and become icebergs; and attached to them are huge stones, as well as portions of the moraine. The ocean currents bear them southwards, and in warmer latitudes they gradually melt, dropping the stones and gravel upon the ocean floor. This must have been the way in which the erratic blocks were placed in their present positions. Professor Ramsay, who has carefully studied the Welsh territory, has come to the conclusion that the land previous to the Post-pliocene, or at its commencement, was more elevated than it is now, and the climate intensely cold. All the highlands would then give rise to glaciers. A submergence then commenced, and all passed down below the sea-level; then a re-elevation set in, and brought the land above the water, and new glaciers formed. He estimates the probable maximum submergence at about 2,300 feet.

There is a deposit of drift near the summit of Moel Tryfaen, a mountain in North Wales, 1,360 feet above the sea. This puts beyond a doubt that there was a submergence to that extent at least.

It is difficult to imagine such a state of things so totally different to that which exists at the present day; but we must remember that the years which measured the Glacial epoch must have been untold, and the motion so slow and gradual as not to disturb the underlying strata. As to the cold, there are astronomical considerations, into which we cannot enter here, which, if they do not as yet account for such a change of climate, at least point the direction in which an explanation may be found.

CHARACTERISTIC FOSSILS OF THE CORALLINE CRAG.

Foraminifera.—Biloculina bulloides; Globulina gibba; Orbitolites complanatus; Textularia aciculata; Triloculina oblonga.

Zoophyta.—Cryptangia Woodii; Flabellum Woodii.

Polyzoa.—Cellaria fistulosa; Cellepora cellulosa; Eschara foliacea; Flustra coriacea, membranacea; Membranipora dentata; Tubulipora agaricia, arborea.

Brachiopoda.—Discina (Orbicula) lamellosa; Lingula Dumortieri; Terebratulina caput-serpentis.

Conchifera.—Avicula Tarentina; Lima hians; Pecten princeps; Astarte gracilis, incerta, parvula, Omalii; Cardium decorticatum; Cryptodon ferruginosum; Cytherea chione; Leda pygmæa; Lucina crenulata; Modiola phaseolina; Mytilus Hesperianus; Nucula trigonula; Pholadomya hesterna; Tellina balaustina; Teredo navalis.

Gasteropoda.—Actæon levidensis; Bulla acuminata, truncata; Cerithium adversum; Cypræa affinis; Fusus gracilior; Helix nemoralis; Pleurotoma brachystoma, concinnata; Scalaria cancellata, fimbriosa; Terebra canalis, inversa; Turritella planispira; Velutina virgata.

Echinodermata.—Echinocyamus hispidulus; Echinus Lyellii, Woodwardi; Spatangus purpureus; Temnechinus globosus; Uraster rubens.

Cirripedia.—Balanus bisulcatus.

Crustacea.—Cancer pagurus; Pagurus Bernhardus.

CHARACTERISTIC FOSSILS OF THE RED CRAG.

Foraminifera.—Cristellaria rotulata; Globigerina cretacea; Polymorphina communis.

Zoophyta.—Balanophyllia calyculus.

Polyzoa.—Flustra distans; Lepralia abstersa.

Conchifera.—Pecten gracilis; Astarte crebrilirata, obliquata; Cardium angustatum, venustum; Corbula complanata; Modiola barbata; Solen cultellatus; Tellina Benedenii.

Gasteropoda.—Conovulus myosotis; Cypræa Angliæ; Fusus altus; Hydrobia pendula; Natica hemiclausa; Patella vulgata; Pleurotoma Boothii, intorta; Purpura tetragona; Trochus cinerarius, multigranus.

Echinodermata.—Echinocyamus pusillus; Echinus Henslovii; Temnechinus turbinatus.

Annelida.—Vermicularia triquetra.

CHARACTERISTIC FOSSILS OF THE MAMMALIFEROUS CRAG.

Conchifera.—Astarte borealis, elliptica; Cardita analis; Cyrena consobrina; Donax anatinus; Leda pernula; Modiola discors; Mytilus antiquorum; Psammobia solidula; Tellina fabula.

Gasteropoda.—Helix arbustorum; Hydrobia subumbilicata; Limnæa palustris; Margarita elegantissima; Natica occlusa; Paludina lenta; Planorbis corneus.

Mammalia.—Elephas primigenius; Lutra vulgaris; Mastodon angustidens; Asinus; Sus.

The following species have been found in caverns only:—

Birds.—Alauda arvensis; Anas sponsor; Columba species; Corvus corax; Perdix cinerea.

Mammals.—Asinus fossilis; Bison minor; Canis familiaris, lupus; Cervus Bucklandi; Equus plicidens; Lepus cuniculus; Mus musculus; Ursus priscus; Vulpes vulgaris.

The following fossils have been found in Pleistocene deposits, and not in caverns:—

Mammalia.—Bison priscus; Bos longifrons, primigenius; Cervus elaphus; Elephas antiquus, primigenius (Mammoth); Felis catus, leo; Megaceros Hibernicus; Rhinoceros leptorhinus; Sorex fodiens; Sus scrofa; Trogontherium Cuvieri; Ursus arctus.

The following species have been found both in caverns and in Pleistocene deposits elsewhere:—

Mammalia.—Arvicola agrestis, amphibia; Cervus capreolus; Equus fossilis; Felis spelæa; Hippopotamus major; Hyæna spelæa; Rhinoceros tichorhinus; Talpa vulgaris; Ursus spelæus.

CHARACTERISTIC FOSSILS OF THE GLACIAL DEPOSITS.

Polyzoa.—Tubulipora verrucaria.

Brachiopoda.—Terebratula psittacea.

Conchifera.—Anomia ephippium; Ostræa edulis; Pecten islandicus, sinuosus; Astarte Damnoniensis; Cardium edule; Leda minuta, rostrata; Mactra truncata; Mytilus vulgaris; Nucula proxima; Saxicava sulcata; Tellina baltica, Greenlandica; Venus decussata.

Gasteropoda.—Buccinum ciliatum; Fusus Bamfius, despectus; Littorina littorea, palliata; Margarita undulata; Nassa pliocena; Natica Alderi; Patella lævis; Pleurotoma discrepans; Turritella terebra.

Annelida.—Serpula vermicularis; Vermilia triquetra.

Cirripedia.—Balanus communis.

Mammalia.—Balæna mysticetus; Monodon monoceras; Phocæna crassidens.

LESSONS IN SPANISH.—XX.

THE VERB.

THE TENSES OF THE INDICATIVE MOOD (*continued*).

As both the imperfect and perfect definite in Spanish are included in English in what is called the imperfect tense, it is important that the learner should be able to distinguish the use of each in Spanish. When an action or event is entirely past and finished, the perfect definite is used; but when it is meant to say that the action or event was taking place at a certain time, and that it is or may be still continued, the imperfect must be used. Thus, "los soldados marchaban por la ciudad" means *the soldiers were marching through the city*, and so far as the word *marchaban* is concerned, they may be marching still; but "los soldados marcharon por la ciudad" means *the soldiers marched through the city*, and from the tense employed are marching no longer.

The perfect indefinite is used to express an action or event, which, though entirely past, has taken place during a period of time (expressed or understood) of which the present forms a part, or at a time designated in an indeterminate manner; as—

He hablado á Rodrigo esta semana, *I have spoken to Roderick this week.*

The past actions of persons or things still in existence, if no particular time be mentioned, are expressed in this tense; as—

El general ha tomado varias ciudades, *The general has taken several cities.*

The only cases in which the English perfect tense and the Spanish perfect indefinite do not correspond are such as the following: "It has been snowing these three hours;" "he has been in Mexico for these ten years;" which in Spanish would be, "hace tres horas que nieva; hace diez años que estoy en Méjico;" which mean literally, *it is three hours that* (since) *it snows; it is ten years that* (since) *I am in Mexico.* If the sentence be negative, the perfect indefinite is employed; as, hace ocho dias que no la hemos visto, *it is eight days that we have not seen her*, that is, *we have not seen her for eight days.* If the action or event be completed, the perfect definite must be used; as, hace diez años que el rey le perdonó, *it is ten years that* (since) *the king pardoned him.*

Hay (or *ha*) is sometimes used instead of *hace* in cases like the examples in the last paragraph; as, hay pocos dias que entré en el cuarto de mi amigo, *it has few days that* (since) *I entered into the room of my friend*, that is, *a few days ago I entered my friend's room. Hay* is used at the beginning and *ha* at the end of a phrase; as, *hay pocos dias*, or *pocos dias ha.*

The first pluperfect is used to express an affirmation of what is past and took place before some other past action or event or time, expressed or understood; as—

Juan ya había comido cuando llegó Ricardo, *John already had dined when Richard arrived.*

Whenever the former action or event is mentioned as still continuing when the latter occurred, the imperfect tense is employed in Spanish to denote the former; as—

Había tres horas que ella estaba pintando cuando llegó Pedro, *It was three hours that she was painting when Peter arrived.*

This last example means in English, *she had been painting three hours when Peter arrived.*

The second pluperfect is used to express a past action or event that took place immediately before another action or event also past. It is never used except after some of the adverbs of time; cuando, *when;* así que, *as soon as;* no bien, *no sooner, but just;* apénas, *scarcely;* luego que, *immediately after;* despues que, *soon after;* as—

Apénas hubo salido cuando se cayó la casa, *Scarcely had he gone out, when the house fell.*

The first future tense affirms what is yet to be or to take place at a future time (mentioned or not); as—

Seré presidente, *I shall be president.* | Lucia vendrá mañana, *Lucy will come to-morrow.*

The second future tense affirms something future that will have taken place before or at the time of some other future action or event, or determinate time; as—

Habré escrito esta carta ántes que Juan llegue, *I shall have written his letter before John may arrive.* | Habrá acabado á las tres, *he will have finished at three o'clock.*

THE TENSES OF THE IMPERATIVE MOOD.

The imperative is that mood which commands, exhorts, or entreats; as in these examples:—

Hacédlo, *do it.* | Veamoslos, *let us see them.*

The imperative mood is not used in the first person singular; nor is it used in Spanish for forbidding, that is, it is not employed with a negative adverb, but the persons of the present subjunctive are used when a negative command or a prohibition is expressed; as—

No temas, *fear not* (i.e., *mayest thou not fear*). | No temais, *fear not* (i.e., *may ye not fear*).

The *s* of the first person plural and the *d* of the second are suppressed before *nos* and *os;* as—

Congratulémonos, *let us congratulate ourselves.* | Congratuláos, *congratulate yourselves.*

The *s* of the first person plural of the tenses of the indicative mood is suppressed when the reflective pronoun comes after it; as in this example:—

Amamonos, *We love ourselves.*

When the imperative is negative in English, as the subjunctive is employed in Spanish, the pronouns of the first objective case are not joined to it, but come before it; as—

No lo hagas, *do* (*thou*) *it not.* | No lo haga ella, *let her not do it.*

Que is sometimes used before the persons of the imperative mood; as—

Que uno de nosotros vaya, *Let one of us go* (*that one of us may go*).

The persons of the imperative, except the second persons singular and plural, are to be rendered into English by *may* or *let;* as, bendiganos el Señor, *may the Lord bless us;* vaya Juan, *let John go.* But *vmd.*, with its objective cases, although of the third person, is to be rendered as the second person; as, venga vmd. conmigo, *come with me* (let your worship come with me); alabese vmd., *praise yourself* (let your worship praise himself).*

THE TENSES OF THE SUBJUNCTIVE MOOD.

The tenses of the subjunctive mood differ in signification from those of the indicative only in expressing what they affirm in a *conditional* or *doubtful* manner, while the tenses of the indicative express certainty. Whenever, therefore, there is no doubt about what we affirm, we must use the tenses of the indicative.

The present tense of the subjunctive affirms some doubtful action or event that may take place, and is generally preceded by some conjunction or conjunctive phrase; as—

Hacéd esto para que vean vuestras buenas obras, *Do this in order that they may see your good works.*

As futurity is implied in the present tense of the subjunctive, the first future of the subjunctive may be used in its place; thus we may say, aunque lloremos, *though we may weep;* or aunque lloraremos, *though we should weep.* The present may therefore be used instead of the future, and the future instead of the present, unless the conjunction *si* (if) be employed, in which case the present subjunctive cannot be used.

The relative pronouns are generally followed by the present or some other tense of the subjunctive, when the sentence is interrogative or negative, or expresses a doubt, wish, or condition; as—

No conozco una sola muger, cuya alma sea mas sensible que la de la Señora Loader, *I know not a single woman whose soul* (*is*) *may be more sensible than that of Mrs. Loader.*

Words which in English are compounds of *ever*—such as quienquiera, *whoever;* cualquiera, *whosoever, whichsoever;* siempre que, *whenever;* por mas que, *however;* por mucho que, *whatever*—in Spanish generally require the present or some of the tenses of the subjunctive; as—

Por grande que sea tu mérito, *However great that thy merit may be.*

The imperfect tense of the subjunctive affirms an action or event of a doubtful or contingent kind as having to be, or to be done, or as conceived by the mind as having taken place at some time under certain conditions; as—

Juan leería, si tuviera libro, or Juan leería, si tuviese libros, *John would read, if he should have* (*if he had*) *books.*

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* In both Spanish and English the future is sometimes used as a command; as, no matarás, *thou shalt not kill*, i.e., *do not kill*, or *do not commit murder.*

There are in Spanish three forms of the imperfect subjunctive, one ending with *ra* (in the first person singular), another with *ría*, and the third with *se*. Each of these forms is generally to be rendered in English by some one of the auxiliaries, *should*, *would*, *might*, or *could*, as the sense may require. These forms of the imperfect are thus used :—

The form ending with *se* is employed only when a conditional conjunction, or an ejaculatory expression of desire, or a verb of command or permission, comes before it; as—

Era preciso que espusiese mis razones, *it was necessary that I should explain my reasons.*

Le dije que tomase esos libros, *I told him that he might take those books.*

Sometimes the conjunction *que* is not expressed, but understood; as—

Encargó le enviasen mayor cantidad, *He ordered (that) they should send him a greater quantity.*

The form ending with *se* can be employed after the relative pronouns, and after cuanto, *as much as*, cuantos, *as many as*, when they are preceded by a verb expressive of an action which the other part of the sentence shows to depend on choice or mere contingency; as—

Prometió que me daría todo lo que le pidiese, *He promised me that he would give me everything which I might ask of him.*

The form ending with *ría* is employed (generally to express a *wish* or *condition*, or what *would be* or *might be* done) when no conditional conjunction comes immediately before the imperfect tense; as—

¿Cual de los dos preferiría vmd.? *which of the two would you prefer?*

Si ella viniese, irian, *if she should come, they would go.*

This form can likewise be used when the imperfect is preceded by a verb that expresses *belief*, *trust*, or *promise*; and also when the conjunction *si* (if) is used in the sense of *whether*; as—

Prometió que me daría dos libros, *he promised that he would give me two books.*

Le preguntó si su hijo iría allá, *he asked him if (whether) his son would go there.*

The form of the imperfect ending with *ra* may in general be used for either the form in *se* or that in *ría*; and is especially to be preferred to the form in *ría*, when interrogative pronouns come before the imperfect; as—

¡Ojalá me hallara con ella! *Oh that I could find myself with her!*

Yo quisiera que viniesen, *I should like that they would come.*

It will be seen from the foregoing rules that the form in *ra* can generally be used instead of the forms in *se* and *ría*, for we can say, si yo amara, *or* si yo amase, *if I should love;* and we can say, el amara, *or* el amaría, *he would love.* But we cannot use the form in *ría* and that in *se*, the one for the other.

Sometimes the English auxiliaries, *could*, *might*, *should*, and *would*, are expressed in Spanish by a separate verb, followed by the infinitive; as—

No podía ver, *he could not see (was not able to see).*

No quería entrar, *he would not enter (was not willing to enter).*

The perfect indefinite tense of the subjunctive mentions a doubtful or contingent action or event as being completed, or that it would have been done in past time under certain conditions; as—

Poco me importa que lo haya oido decir ó no, *It concerns me little whether he may have heard it spoken or not.*

VOLTAIC ELECTRICITY.—XVI.

THE ELECTRIC TELEGRAPH.

It is seldom that any great discovery or invention can, with fairness to others, be assigned to a single individual. Suggestions and observations by thoughtful men often lie dormant for many years, and no immediate result flows from them until some master-mind gathers them up, pieces them together, and presents them to the world as a startling novelty. These remarks may well be applied to the electric telegraph, an invention which has caused more changes in the conduct of the world's affairs than any other contrivance conceived by the mind of men. Its history presents us with a succession of stepping-stones upon which inventors trod, until the present perfect results were achieved.

But long before electricity became a power in the world, the necessity of some means of conveying intelligence was recognised, and various modes were contrived for furthering that end. The signal-fires blazing out the one idea of approaching danger were soon replaced by the more efficient watch-towers placed at intervals for conveying signals, by means of semaphores, quickly across country. These semaphores consisted of an arrangement of shutters, by which several distinct signals could be forwarded, and they were in use in this country up to the year 1837. Long before this year had dawned, many experimenters in different countries had turned their attention to the mysteries of electricity. In Geneva, Lesage had invented a system of signalling by causing two pith balls to diverge by the action of a current sent through a wire at the end of which those balls were hung. Lomond, in Paris, carried out the same idea a few years later. The system was again brought forward in this country, in the year 1816, by Mr. Ronalds, who urged Government to take the matter up. But the Government of the day refused to have anything to do with it, asserting that the semaphore system was quite sufficient for every requirement. In the meantime other inventors had contrived systems in which the current was made to decompose chemical substances, as in the electro-chemical telegraph of Bain. But the most notable suggestion came from Ampère, of Paris, in 1821, who pointed out that a galvanometer needle, by its deflections to the right or the left, according to the direction of the current, could be made to give signals of a reliable character. Eventually, Cooke and Wheatstone, in the year 1837, carried this idea into practical use, and the first needle telegraph was produced.

In all the first forms of telegraph at least two line-wires were necessary, one to carry the electric current to the distant station, and the other to carry back again, so as to complete the circuit. But a most valuable discovery was made by Steinheil, of Munich, in 1837, who showed that a return wire was not necessary, and that the earth might be used in its stead. From that time, therefore, it became customary only to use one wire, the necessary connection with the earth being established by burying metallic plates in the ground.

Modern telegraphic instruments may conveniently be grouped into two classes. Firstly, those which transmit signals representing the letters of the alphabet by conventional signs, such as movements of a needle, or dots and dashes on paper; and, secondly, those which transmit signals and record them in ordinary printed type. In the first place we have simple apparatus, but the necessity for the employment of skilled operators to translate the signals into readable language; and in the second case we have complex mechanism, but the advantage of results which are decipherable by any one who has learnt to read. The latter plan has the further advantage of less risk of error than if the communication has to go through the process of translation before being available for use. The first method is adapted for the general work of the country, where a skilled staff is organised to work it; but the second has, up to recent times, been mainly used for private lines. We say, up to recent times, because the rapid introduction of the telephone has almost superseded the use of the telegraph for private uses, such as communication between offices and factories, and the like.

As representatives of the first class of instruments, we may select two well-known types: (1) the single needle telegraph and (2) the Morse key. Any student can easily contrive one of the first-named instruments with very little trouble, and at very small outlay; and a description of the means by which he may attain this end will be the best way to point out the phenomena upon which the working of this form of telegraph depends. A little toy compass, such as can be purchased for a shilling, must be wound round with several turns of silk-covered copper wire. It thus forms a galvanometer, the magnetised needle of which will place itself at right angles to the coil of wire across it, whenever an electric current is sent through that coil. The battery may consist of an ordinary Leclanché cell, such as is commonly used for ringing bells. When the current is cut off, the needle will instantly resume its normal position (*i.e.*, north and south). By reversing the direction of the current, by changing over the wires which touch the two poles of the battery, the needle is deflected in the opposite direction. By placing two little stops, one on either side of the needle, to confine its movements within narrow limits, we can stop its tendency to oscillate, and make its deflections to the right or left of a more marked and certain character. It is obvious that these movements, by being repeated and alternated, can be made to represent a variety of distinct signals, and that a certain number can be chosen to represent the letters of the alphabet, the numerals, and other necessary signs, so that words and sentences can be transmitted. Such, in brief, is the single needle instrument, although, in its working form, it is, of course, more conveniently arranged, the change of direction in the current being, for instance, managed by the depression of two keys, which give the right or left-hand deflection of the needle as required.

The Morse key, which we select as the other representative of Class I., works in a different manner altogether. In this case we have no change in the direction of the current sent, but only in its duration. The key is simply a knob, the depression of which by the finger will cause contact to be made with the battery, and so send a current along the line-wire. According to the time for which the knob is depressed, so is the duration of the current, and the signals therefore resolve themselves into short and long impulses, technically called dots and dashes. By making the dot to represent a left-hand movement of the galvanometer needle, and a dash, or long impulse, a right-hand movement, an alphabet used for the needle instrument is readily adapted to the Morse key. At the receiving end of the line these dots and dashes can be read off in two different ways. In the one case the message is recorded automatically upon paper, in the other case the operator trusts to his ear alone, although as a check there is generally a needle attached, whose movements he can watch at the same time. The Morse ink-writer in its simplest form consists of a little wheel at the end of a lever, which is covered with printing ink. The lever forms the armature of an electro-magnet, and is attracted to that magnet whenever a current is sent through its coils. The same movement causes the little ink-wheel to touch a band of paper kept moving by means of clock-work. If the current be short, the mark impressed upon the paper is a *dot*, but if the current be long, the wheel is of course kept for a longer time against the paper, and a *dash* is the result.

In what is known as the Morse sounder, the printing attachment is dispensed with, and a spring armature, which gives a click every time it is attracted towards the magnet, takes its place. The experienced operator can read off the meaning of these sound signals as easily as an ordinary person can comprehend speech; but, as already stated, a galvanometer needle is sometimes attached as a check on the correctness of his work. According to Mr. Preece, sound-reading is steadily gaining ground in this country. "There are," he says, "now 2,000 sounders; in 1869 there were none. In America scarcely any other instrument is used, but on the continent of Europe there is scarcely one." We learn from the same authority with regard to the needle instrument that 3,791 are employed by the Post Office, and that the different railway companies have in use no fewer than 15,702. Although, as we have seen, the needle instrument must be in skilled hands, its cheapness and general efficiency render it peculiarly suitable for railway work.

We will now select two instruments as representative of Class II., where the signals are received, and in many cases also printed, as ordinary letters of the alphabet. As our first example, we may point to Sir Charles Wheatstone's A B C instrument, which was so commonly used for private lines before the advent of the telephone. This form of telegraph was particularly well adapted for private use, not only because the signals given were expressed by ordinary letters of the alphabet, but also because it required no battery. The current was afforded by a small magneto-electric machine, which formed part and parcel of the instrument, and the mere act of keeping a handle turning with one hand, while the other was employed in signalling, caused a current to flow through the line-wire whenever required. The action of the magneto-electric machine will receive attention later on, and it is necessary here only to refer to its existence in the A B C instrument now under discussion. Outwardly, the instrument has the appearance of a mahogany box with a dial and pointer. Arranged round the dial are the letters of the alphabet. The pointer moves as required to the different letters, and the same movements are repeated on a similar dial at the other end of the line. As already indicated, this instrument has been mostly used for short circuits, but it has been tried on a line 100 miles long with success.

The other instrument which we select to illustrate those contained under Class II. is Hughes' printing telegraph. In this instrument a little wheel having letters on its edge revolves at an equal speed at either end of the line-wire. These wheels are so arranged that the same letter on each is always in the same position—that is to say, supposing there is a fixed mark at the lowermost part of each wheel, the same letter will pass that mark at the same time as each revolves. By the action of an electro-magnet, a little roller bearing a travelling strip of paper is brought against the type wheel when required, and a letter is printed without stopping the revolution of the wheel. A series of keys, like the keys of a pianoforte, each bearing a letter of the alphabet, are so arranged that their depression causes the particular letter which each represents to be printed on the paper. Each wheel is driven by clockwork, and special precautions are taken by mechanism we need not describe to ensure that the action of both is synchronous.

We therefore see that in all forms of electric telegraph the signals are produced by two well-known effects of the electric current, the one being the tendency of a magnetised needle to place itself at right angles to a wire conveying a current, and the other the circumstance that a piece of iron becomes magnetic when a current flows through a coil of wire surrounding it, the needle telegraph being an example of one, and the Morse sounder and printer, and the Hughes printing telegraph, being examples of the other.

In the British postal telegraph system we find that there are three forms of batteries in use—namely, the Daniell, the Leclanché, and the Bichromate. The currents can be conveyed overground, underground, or beneath the sea. Overground wires are commonly seen by the side of our railways, our canals, and many of our country roads. The poles to support them are in this country mostly of wood, but in our colonies iron supports are more commonly used. Iron wire is the material in general use for conductors, but in the neighbourhood of large towns, where smoke and corrosive vapours are prevalent, iron is often replaced by copper. Another metal called phosphor bronze, which possesses the conductivity of copper and the strength of iron, is also coming into extensive use. Those little porcelain knobs or cups, which are such familiar objects on our telegraph poles, are to insulate the wires, so as to prevent the current leaking to earth, as it certainly would do if placed in contact with anything acting as a conductor of electricity.

The underground lines, of which there are several thousands of miles in the United Kingdom, we occasionally get a glimpse of when under repair in our streets. The wires are of copper, encased in gutta-percha, and bundles of them are laid side by side in iron pipes, generally just below the curbstone of the pavement. Underground lines are far more expensive than overground lines, and it is estimated that if the whole of the telegraphs if this country were so laid, it would involve an expense of twenty millions sterling. There is occasionally, when wind and snow has broken down communication for a time, a loud outcry that all wires should be laid below ground, but, as we have stated, the expense is almost prohibitory, besides which there are technical reasons against such a course being pursued.

The art of laying submarine cables is now so well understood, that there is seldom any failure in that operation. The story of the laying of the first cable across the bed of the Atlantic is familiar to all; we know how it parted and was picked up again from the depths of the ocean, and how, finally, the great work was completed. There are now more than 80,000 miles of such cables at work, and no fewer than nine different lines span the Atlantic floor. The first enterprises of the kind, with their difficulties and failures, have been studied and improved upon with splendid results, and, although the cables as now constructed are of much the same pattern as formerly, the materials, from the inner metallic core to the outer protecting skin, have been brought to such perfection in their manufacture that the whole can be made to bear a breaking strain of little less than one hundred tons to the square inch. The inner core or conducting wire of the cable is usually made of the purest copper that can be obtained, and for greater strength is constructed of seven wires twisted together. Next to this core

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comes a coating of gutta-percha, followed by a covering of jute. Outside this last layer is the protecting sheath of the cable, made of thick iron wires, each of which is covered with hemp, and is otherwise protected from rust. The necessity of most thorough insulation will be appreciated when it is remembered that the water in which such a cable has to remain is itself a good conductor of electricity. The smallest flaw in the protecting covering would most probably cause a leakage which would ruin the cable.

There are many forms of telegraph to which we have not referred simply because they have not come to any practical importance. Like all great discoveries, where a heap of contrivances are quickly evolved from inventive brains, there is a process of natural selection through which such inventions must pass. The survival of the fittest is the consequence of such selection, and to those we have preferred to confine our readers' attention. But there is one aspect of the modern telegraph system which is so important that we must not pass it over, and that is the possibility of sending more than one message over the same wire at the same time. Let us once more quote the words of Mr. Preece which bear upon this subject:—"In ordinary working only one message can be sent in one direction at one time, but by a simple and ingenious contrivance, by which the neutrality of opposite currents is utilised to convey signals, duplex telegraphy is rendered possible, so that two messages can be sent on the same wire at the same time; and by a still further improvement, where currents of different strength are utilised, four messages are sent on one wire, two simultaneously in opposite directions at the same time. There are in England 319 duplex and 13 quadruplex circuits at work.

"The acme of efficiency in telegraphy is attained in the automatic system, in which manual labour is supplanted by mechanism in transmitting the messages. There are 71 circuits worked by these instruments, and 224 instruments in use, and a speed of working of 200 words per minute is easily maintained upon them. With the hand alone from 30 to 40 words per minute is the maximum rate attained, but by automatic means the limit is scarcely known. Since this system can be duplexed, and in many cases is so, 400 words per minute on one wire are easily sent. By the use of high-speed repeaters, the length of circuit for automatic working is scarcely limited. It would be easy to send 100 words per minute to India."

LESSONS IN LATIN.—LV.

VERBS GOVERNED BY VERBS—CONSECUTIO TEMPORUM.

NOT only in moods but in tenses has one verb an influence on another, in which case the latter may be said to be governed by the former. The facts connected with the influence which the tense of one verb has on the tense of another verb, combine to form the doctrine of what, in grammatical language, is called the consecutio temporum, or the *sequence of the tenses.* In the nature of things, a certain tense comes properly after another, and a certain other tense does not come properly after another: for instance, it is sense to declare *I hear what you say*, but not sense to declare *I hear what you said*, it being supposed that in both cases the time remains present. Instead of *I hear what you said*, the sense requires *I hear what you say;* or, if a past act is intended, then we may declare *I heard what you said.* You thus see that the tense of the latter verb is governed or determined by the tense of the former verb. The former verb is independent of the latter, and the latter verb is dependent on the former; so that it may be laid down as a general fact or law that the tense of the dependent verb is determined by the tense of the independent verb.

These general grammatical truths are recognised in Latin, but recognised under some qualifications. A few particulars are all that can here be given. A *present* then follows a *present* tense. A *present* also follows a *future* tense, when the dependent verb is in the subjunctive mood, for the Latins have no *future subjunctive.* If the independent verb is a *preterite*, the dependent verb must be a *preterite subjunctive.* But in Latin the preterite, for instance *docui*, has two significations, for *docui* means either *I taught* or *I have taught.* In the first an act is spoken of as merely and absolutely past; this is called an *aorist*, that is, an *undefined past tense*, or a past tense unlimited as to particulars, whether past in relation to another past act, or in relation to a present act. But *docui* in the sense *I have* taught has a relation to the present time, I have *recently* taught, indicating an act which in itself or its consequences comes down to or near to the present time. Now, when you wish to know what tense to put after *docui* a preterite, you must learn whether or not the verb is used in the *aorist* or *indefinite sense*, or in the sense of a *perfect present.* If the *preterite* or *perfect* is a perfect present, then the dependent verb will be a *preterite subjunctive;* if the *preterite* is employed as an *aorist*, then the dependent verb or verbs must be in the *imperfect* or the *pluperfect.* The preterite used as an *aorist* is called the *historic preterite*, or the *preterite of narration*, because it is employed in historical narrative, whose general office it is to speak of the past indefinitely, that is, simply as past. The following table will exhibit the chief facts of the

CONSECUTIO TEMPORUM.

Pres.	Video	quid agas, or quid egeris.	*Imp.*	Videbam	quid ageres, or quid agisses.
Perf.Pres.	Vidi		*Aorist.*	Vidi	
1st Fut.	Videbo		*Plup.*	Videram	
2nd Fut.	Videro				
Pres.	Rogo	ut scribas.	*Imp.*	Rogabam	ut scriberes.
Perf.Pres.	Rogavi		*Aorist.*	Rogavi	
1st Fut.	Rogabo		*Plup.*	Rogaveram	
2nd Fut.	Rogavero				
Pres.	Hoc ideo facio	ut intelligas.	*Imp.*	Hoc ideo faciebam	ut intelligeres.
Perf.Pres.	Hoc ideo feci		*Aorist.*	Hoc ideo feci	
1st Fut.	Hoc ideo faciam		*Plup.*	Hoc ideo feceram	
2nd Fut.	Hoc ideo fecero				

After the *imperative* stands the *present* or the *future;* as—

Scribi mihi quid agas, or quid egeris; cura ut valeas.

VERBS AND RELATIVES.

In compound sentences one of the members may be introduced by a relative. This is called a relative member or clause: for example—

Is, *qui omnia tenet*, favet ingeniis,
He who possesses all things patronises talent;

where *qui omnia tenet* is a relative member, so called because it is introduced by *qui.* The sentence is obviously made up of two sentences, as may be thus seen in these examples:—

Chief Sentence.—Is favet ingeniis.
Relative Sentence.—Qui omnia tenet.

CHIEF SENTENCE.	RELATIVE SENTENCE.
Cæsar *in fines Ambianorum pervenit,*	qui se ei dediderunt.
Cæsar came into the territories of the *Ambiani,*	*who surrendered to him.*
Virtuti opera danda est,	sine quâ virtutem assequi non possumus,
To virtue we must pay attention, without which all are	*unable to attain virtue.*

In these cases the relative merely qualifies the meaning. These, therefore, are illustrations of *qualification*, and not of *government.* But besides *qualifying*, a relative in union with a verb, or what is called a dependent relative, may govern the verb which is in a state of dependence. The dependent verb must be in the dependent, or what is commonly called the subjunctive (subjoined) mood. The general rule may be stated in these words: *A relative dependent clause takes its verb in the subjunctive mood.* Observe that the construction implies two things, namely, that the clause is a *dependent*, and that the clause is a *relative* clause; merely a relative clause does not require a subjunctive mood; and a dependent verb, we have already seen, may be in the infinitive mood; as—

Scio quid hoc *sit*,
I know what this is.

Here *sit* is in the subjunctive mood by the force of *scio quid.* The sentence consists of two members or two sentences—thus, *hoc est tale*, and *scio hoc esse tale;* the two put together make *scio quid hoc sit.* Note that the Latin *sit* is represented by the English *is;* consequently, in relative dependent clauses you must turn the Latin subjunctive into an English indicative, and the English indicative into a Latin subjunctive. The phrase *nescio quid hoc scit* may be regarded as an indirect question; thus, quid est hoc? *what is that?* nescio, *I know not;* or, in full, nescio quid hoc sit. Indirect questions have the second verb in the subjunctive mood.

The usages of the subjunctive mood in Latin, which are numerous, and which require study and practice to be clearly and fully understood, may in general be traced to the fact that the subjunctive is, in its essence, the mood which denotes dependence. Hence, when dependence is to be expressed otherwise than by the infinitive mood, the subjunctive must be employed. The necessity of employing another mood than the infinitive arises from the fact that for the expression of the sense, you have to use the relative pronoun, or some relative particle, such as *quod, quin, quum.*

In what is called the *obliqua oratio*, the relative clause takes the verb in the subjunctive mood. The *obliqua oratio*, or indirect mode of speech, takes place when a fact, instead of being simply related as a fact, is given as set forth or conceived by the speaker. The *obliqua oratio* supposes or implies the *recta*, the straightforward or simple statement; as—

The Recta Oratio.—Reversi sunt qui venerunt.
They who came returned.
The Obliqua Oratio.—Reversos esse qui venerint indignabatur Cæsar.
Cæsar was angry that they who came returned.

Here *qui venerunt* in the direct form is changed into *qui venerint* in the indirect form.

If the relative clause expresses an object or aim, the subjunctive is required; as—

Delecti Delphos missi sunt *qui consulerent* Apollinem,
Chosen persons were sent to Delphi to consult Apollo.

Here there is a latent reference to the understood or avowed design in the minds of those who chose the deputies. Had the word stood *qui consuluerunt*, the sense would have been that persons were sent, and that those persons did consult the oracle, whether chosen for that purpose or not.

A relative clause is put in the subjunctive when the relative has a causal force, that is, assigns the reason of the act, or the nature, the consequence, or the result of the thing; as—

Incidunt causæ *quæ conturbent* animos,
Events happen of such a nature as to disturb our minds;

a different statement from

Incidunt causæ quæ conturbant animos,
Events happen, and these events disturb the mind,

whether or not they are of a nature to do so.

The relative followed by a subjunctive is often preceded by *dignus, indignus, idoneus, aptus, tantus, talis, is, ejusmodi*, etc.: for example—

Tabulæ non satis *dignæ* sunt *quæ* iterum *legantur*,
The plays are not worth being read a second time.

There is a causal force in the phrases, is sum qui, *I am the person (to do so and so)*, est qui, sunt qui, reperiuntur qui, *there are such persons, persons are found who*, etc.: for example—

Ego is sum qui Cæsari concedi *putem* utile esse,
I am the person to think it useful to concede to Cæsar.

Somewhat similar are the negative phrases *nemo est quin, nihil est quin;* as—

Nego in Siciliâ totâ *ullam picturam* fuisse *quin* Verres *conquisierit.*
I deny that there was in all Sicily a picture but Verres made it his own.

Here the particle *quin* is equivalent to *quam non.*

As the relative *quin*, so the relative particles *quod* and *quum*, when they assign a reason, require a subjunctive mood; but these will be treated as conjunctions.

Sometimes the causal force of the relative must be given in English by a circumlocution; as—

Tarquinio quid impudentius, *qui* bellum *gereret* cum iis qui non tulerunt ejus superbiam?
What is more impudent than Tarquin, who made war against those who did not brook his arrogance?

In this translation the force of the *qui* with the subjunctive is hardly seen. It would be better to say FOR *he made war* or INASMUCH *as he made war*, or to paraphrase the words thus, *whose impudence was seen in that he made war.*

Occasionally the particles *utpote* and *quippe* are prefixed to the relative in order to increase its causal force; for example—

Antonius non procul aberat, *utpote* qui expeditus sequeretur,
Antony was not far distant, since he followed unencumbered.

CONJUNCTIONS AND VERBS.

Conjunctions are words which unite other words together. This is the meaning of the term *conjunction* (*con* and *jungo*), if we are guided by its etymology. A wider signification is required by the service which conjunctions render. Led by their application, we may define conjunctions as words which mark the relations in which sentences and clauses of sentences (or abbreviated sentences) stand to each other. How numerous those relations are may be learnt from these

CLASSES OF CONJUNCTIONS.

1. *Copulative*, or such as are used in combinations: et, *and;* que, *and* (*que* is called an enclitic, that is, it is subjoined to the word it qualifies, and throws its accent on the word; for example, hominum deorum*que*, *of men and gods*); etiam, *also;* quoque (enclitic), *also;* neque, nec, *neither*, and *not;* et—et, *both;* neque—neque, *neither—nor.*
2. *Adversative*, or such as denote opposition: at, *but* (ast, poetical); tamen, *yet;* verum, *truly;* vero, *in reality;* attămen (*at* and *tamen*), verumtămen, *but yet;* enimvēro, verum enimvēro, *but indeed;* sed, *but;* autem, *but;* atqui, *but yet.*
3. *Disjunctive*, or such as denote separation: aut, vel, ve (enclitic), *or;* aut—aut, *either, or;* vel—vel, ve—ve, *either—or.*
4. *Causal*, or such as assign a reason: nam, namque, enim, etenim (*et* and *enim*), *for;* quum (from *qui*), *since;* quod (from *qui*), *because;* quoniam (*quum* and *jam*), *since;* quandoquĭdem, *seeing that;* tanquam (*tam* and *quam*), *as, as if.*
5. *Conclusive*, or such as indicate a conclusion or inference: eo, ideo (*id* and *eo*), idcirco (*id* and *circa*), propterea (*propter* and *ea*), *on that account;* ergo (Greek ἐργον, er′-gon, *work, deed*), igitur, *therefore;* proinde, *accordingly;* quocirca, quamobrem, *wherefore.*
6. *Local*, or such as indicate place: ubi, *where;* unde, *whence;* quo, *whither;* qua, *by what road;* quatenus, *how far.*
7. *Temporal*, or such as signify time: dum, *whilst;* donec, *until;* quoad (*quod* and *ad*), *up to the time when;* quum, *when, since;* quum primum, *as soon as;* quando, *since;* priusquam, antequam, anteaquam, *before;* postquam, posteaquam, *after;* simulac (*simul* and *ac*), simulatque, simul, *as soon as;* ut, *as;* utprimum, *as soon as;* ubi, *where, since;* quoties, *as often as.*
8. *Comparative*, or such as imply a comparison: ut (uti), sicut, velut, ceu, *like, just as;* quomodo, quemadmŏdum, *in which manner, that, as;* quippe, *for, since.*
9. *Conditional*, or such as express a condition or stipulation: si, *if;* nisi (*ne* and *si*), *unless;* sin (*si* and *ne*), *but if;* si mŏdo, *if only;* dummŏdo, modo, *provided that;* dummodo ne, modo ne, *if only not;* sive (seu), *or if;* sive—sive, *whether that or.*
10. *Concessive*, or such as denote a concession or admission: etsi (*et* and *si*), *although;* etiamsi, *even if;* tametsi (*but if*), quanquam, *although;* quamvis, quamlibet, quantumvis, *however;* licet, *if indeed;* ut, *suppose that.*
11. *Final*, or such as assign the end, object, or result: ut, *in order that;* ne, *in order that not;* neve (neu), *and in order that not, nor;* quin, *that not, but;* quo, *wherewith;* quomĭnus, *wherewith not.*

It is not possible to assign to these and other particles meanings which shall be applicable in all cases. The meanings actually given must be modified by experience. The subject is one of special difficulty, and can be mastered only by long and careful study.

Some of these classes of conjunctions qualify rather than govern verbs; such are the copulative, the adversative, the disjunctive, the conclusive, etc. It is chiefly the causal, the conditional, the concessive, and the final that exert on verbs the peculiar influence which we have termed government—they have, that is to say, a direct action, and as a direct action, so a direct influence on verbs, producing in them a change of mood. The following sentence presents an instance of a qualifying conjunction and an instance of a governing conjunction:—

Legum *idcirco* omnes servi sumus, *ut liberi* esse possimus,
We are all slaves to the laws, on that account that we may be free.

Idcirco qualifies the first member of the sentence, and *ut* (that *or* in order that) governs the verb of the second, putting it into the subjunctive mood.

The subjunctive is for the most part the mood which governing conjunctions require; but *quod*, for instance, may stand with the indicative: for example—

Quanta est beniguitas naturæ *quod* tam multa ad vescendum gignit,
How great is the kindness of Nature that she produces so many things to eat.

The indicative is employed generally when the second member is explanatory of the first, and the *quod* is little more than a connecting particle.

LESSONS IN POLITICAL ECONOMY.—I.

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POLITICAL Economy is the latest of the sciences. It is also one of the hardest. But it is certainly one of the most important, for there is none whose aims are more beneficent. In so far as society understands and obeys its laws, it makes progress in opulence and civilisation; in so far as it neglects or disobeys them, it stands still, or goes back. Furthermore, it is what is called an inductive science. It is not like Geometry or Arithmetic—a series of long reasonings gathered from a few simple axioms and definitions—but it has to be carefully collected from facts, and what it lays down as a principle has to be measured by experience. In this first lesson I shall try to show what I mean by all these statements.

As soon as ever men began to reason about government, law, morals, and other subjects in which civilised society is interested, and by which it exists, they could not but take some note of the circumstances on which the wealth and prosperity of a nation depend. Thus, in the early days of ancient civilisation, the philosophers of Greece and Rome wrote on government and general politics, and sketched what in their minds was the ideal of a perfect state. But though they propounded a variety of ingenious theories, which are studied with advantage and interest in our own day, they made but little progress in the science whose aim it is to expound the manner in which wealth is obtained and distributed among the several classes of which society is composed—of the means, in brief, by which the largest number of persons can subsist in the greatest possible affluence by the least possible labour.

There is, I believe, a sufficient explanation of the fact that this topic did not occupy the minds of those acute thinkers, in the circumstance that every ancient community allowed or encouraged slavery. The moral evils which ensue from such a social state as that in which men hold their fellow-men in bondage need not be referred to here; they are so manifest that the whole civilised world is agreed in condemning the practice. But the peculiar economical mischief that ensues from slavery is, that as slavery degrades labour, so it prevents persons from seeing that labour is the cause of wealth, and that as labour is economised, wealth progressively increases. Besides, freedom is as essential to exchange as it is to morality. From the point of view which an economist takes, men are engaged in producing objects of desire or demand with as little labour as they can, and with a view to exchanging them as freely as possible. Now it is plain that when labour is enslaved the motive to make labour as effectual as possible is annulled, and that the full power of exchange is taken away. It cannot be by accident that the first promulgation of a system of political economy was made at the time in which slavery was condemned in principle, and only permitted in practice under protest. It must not indeed be supposed because freedom to labour at one's own discretion is accorded to all members of a civilised community, that perfect freedom of exchange is also allowed. But this at least is admitted: that whenever personal liberty is controlled by law or custom, the control is always on its defence, is always liable to be challenged, and must be approved before it can be allowed or continued. In short, the discretion of an individual is limited only on the plea that the public good requires such a limitation. Supposing two communities are at war with each other, it is plain that either may and should prevent any one of its subjects from supplying the hostile government with the means of continuing the war. Similarly, it has been alleged, and is still alleged, that a community is justified in forcing its members to deal with their fellow-countrymen only in particular articles, in order that the manufacture of such articles should be planted or established at home. We shall hereafter examine the grounds on which this plea is defended. It is sufficient to repeat here that any interference with the freedom of exchange on the part of government is, and hereafter will be, on its trial.

It has been said above that Political Economy is one of the hardest of the sciences. It is true that when any one of its laws is substantiated it becomes as plain as any law of Nature; but the difficulty first lies in proving it, and next in inducing people to accept the proof, and act upon it. Mr. Mill has said, with equal truth and clearness, that fallacies in which the wisest of our forefathers believed are now so utterly exploded, that the belief in such fallacies reminds one of those opinions of children, which are corrected by a word from grown-up persons. But he also observes that the acutest among us should not think, had he lived in the age when such an error was prevalent, that he would have escaped the delusion which occupied men's minds. People do not like to be disabused of a habit, especially of an habitual opinion with which they have been made familiar, and to which they have accommodated themselves. It is easy to illustrate this disposition by appealing to a fact in the history of Political Economy.

For many a century men believed that money—*i.e.*, pieces of the precious metals coined and circulated—was wealth; that a man was rich according to the number of these pieces which he possessed; and that similarly a state or government was rich proportionately to the treasure which it had accumulated. All the common phrases of language favoured this notion, as they had been derived from it. Persons were said to be worth so much money; objects of value were said to be worth so many pieces of such metals. A man with money in his pocket was seen to be able to command the industry of others at his discretion; poverty and riches, therefore, were identified with the absence or presence of these bits of gold and silver. Philosophers used the same language with ordinary people. Bacon saw poverty in a diminished stock of the precious metals; and Locke, commenting on the perishable nature of most possessions, observes that "money is a steady friend."

Now it very seldom happens that any statement, mischievous or erroneous though it be, is wholly destitute of truth. Mistakes, fallacies, delusions, are generally facts exaggerated, distorted, or misinterpreted. The popular notions about money rested on a single truth. There can be no doubt that, under ordinary circumstances, *there is nothing so saleable as money*—nothing which can be so easily available for supplying one's wants. In order that people may buy and sell, especially in small or retail trade, they must have some article of value with which to measure other objects, and which they will take when they sell; because they are under the impression that the possession of this article will give them very much the same command over such other objects at some future time, which it gives them at the moment of their taking it. Certain qualities possessed by the metals gold and silver have pointed out these objects as the most convenient measure of value, have made all men willing to take them, and have rendered them, from this point of view, peculiarly saleable, and therefore peculiarly convenient to those who wish to gain possession of whatever they may require or wish for.

Here, however, their utility, in the sense of wealth, stops. They are very useful because they are very saleable, but only because they are very saleable. Their possessor may anticipate their future utility in this direction, and therefore store or accumulate them. Circumstances may lead him to be very eager in accumulating them, and very loth to part from them; but the eagerness with which he gathers and treasures them, only shows how thoroughly he contemplates spending them, or selling them. No reasonable person would hoard money without the remotest purpose of using it. He knows that money is power, and he may defer the exercise of the power. But he never determines that he will not, under any circumstances, use the power which he possesses. A man who will not use his money is as ill off as a man who cannot use it. A man who has buried a hoard in the earth, who has imparted the secret of its place to no one, and who never uses nor will use what he has hoarded, is no better off than if he had made no hoard at all. For money to be of any use to its possessor, it must be used or got rid of.

What is true of an individual is still more clear in the case of a community. Here money is plainly a mere article of merchandise. In little acts of exchange—those, namely, of retail trade—money is necessary in order to bring buyers and sellers together; but in large transactions goods are really exchanged against goods. Though, for manifest reasons, the value of goods is expressed in money, little or no money actually passes between dealers. The trade of this country is represented by many millions of pounds in value; but by far the largest part of this trade is carried on without the intervention of a single piece of gold or silver. A community, therefore, never keeps any more money than it finds necessary; or, in other words, it always finds it expedient to get rid of all the money which it may possess, but which is in excess of its wants. It sells it, just as it sells cotton and woollen manufactures, hardware, or any other kind of produce; and it always has sold it, however much it has been hindered from doing so by government.

Our forefathers, however, were possessed of the idea that no nation could be rich which suffered money to go out of its custody. Hence the English monarchs appointed a great officer, called the King's Exchanger, who superintended, either in person or by deputy, all foreign commerce, in order to prevent money from leaving the kingdom, or to assist the entrance of money into it. In course of time, when it was found that certain kinds of trade could not be carried on unless permission to export money was given, precautions were taken that the goods which were bought with this money should be sold for more money, and that the country should thus be indirectly enriched. With the same object of underselling other countries, and thus of obtaining more of this coveted wealth, laws were enacted in order to keep down wages. To prevent any portion of the money which was held at home from leaving the country, Englishmen were not allowed to buy foreign goods, however cheap they might be. Laws were passed, giving, under the name of a bounty, premiums on those who could succeed in underselling their neighbours abroad; and other laws forbad the importation of food, lest a portion of the precious store of gold and silver should fall into the hands of foreigners. Trade was restricted, curtailed, hampered; a thousand jealousies were engendered, and made bitter, in order to effect that which could never be done, even if it were ever so much wished, and never should have been done, even if it had been possible. The worst parts of the commercial system which fifty years ago prevailed in this country, sprang entirely from the notion that money was wealth; and though we have slowly and with difficulty got rid of the delusion, with its consequences, other nations have so familiarised themselves with the restrictions which such a policy imposed, that they think their prosperity is held together by the chains in which they have fettered their trade.

Apart, however, from the difficulty which there is in combating and demolishing a prejudice, there are two causes which render the true solutions of social questions a hard task. In the first place, these questions are very complicated. Any common object of use and value contains collected in it a myriad of different agencies, each of which contributes something to the result. For example, a yard of calico represents an infinite number of industries, on each of which some influence may operate temporarily or permanently, but the force of which is very liable to miscalculation or misconception. The circumstances which set in motion, control, limit these several industries, relate to what economists call the production of wealth. The product, when it comes into the market, is worth something. This is called its value, or, interpreted in money, its price. Another set of causes or circumstances determines what share each of those agents who have contributed to its production shall have in the value of the article. A third set of facts, bearing on the means by which the market is opened to the sale of the article, have to be investigated. The second and third are concerned with the distribution of wealth and its exchange; and there are parts in the theory of all these operations which are still debated, and which never will be solved except by a careful induction from facts. In the course of these lessons I shall try to throw some light on the several subjects.

Another circumstance which makes the solution of these social questions difficult, is the power of compensation which industry exhibits. Labour may be hindered and weakened by bad laws, by a sterile soil, by an unfavourable climate, by a number of artificial and natural obstacles, and yet surmount the hindrances which are put in its way. Two things only it cannot overcome—want of freedom, by which I mean the power of making its own contract for its service, reaping its own reward for its toil, and want of security in that which it has gained. To take these away is to destroy every motive for the exertion by which labour gains its ends, and every motive for the accumulation of that by which labour is rendered continuous and effective. But if these two conditions of industry are granted, it has marvellous powers of overcoming other impediments. There can be no verdure where there is perpetual drought or perpetual frost; but if water can reach the soil, and sufficient warmth is imparted to it, few natural obstacles will be powerful enough to hinder vegetation and growth. And in this way the labour of man has often turned sandy wastes into fruitful cornfields; has conquered an ungenial climate, an ungrateful soil; and has even changed those adverse circumstances, which seemed to form a barrier to its activity, into means by which that activity may be developed. Nor is industry always checked by avarice or arbitrary legislation. It is, no doubt, crippled by injudicious laws, but it constantly evades their worst effects, and finds, as I said above, some compensation for them. Taxation, for example, may be excessive, or oppressive, or unfair; but if industry is only stout-hearted it will continually exert itself, and with success, to greater toil and new economies, wherewith to make up the loss which has been imposed on it.

Now this power of overcoming obstacles induces an obscurity over many social questions. Labour which thrives in spite of hindrances is frequently thought to thrive in consequence of such hindrances. Thus, for instance, no worse or more vicious system of finance could have been devised for any country than that which was imposed on this country up to the close of the great Continental war. During this epoch, however, of unwise taxation, the country made great progress; and one of the greatest difficulties which they had, who argued in favour of a more generous and freer system, was the fact that the progress of the people was notable. How, persons argued, can the mischief which you denounce and condemn be so great, if the phenomena of increasing prosperity are visible about us? We do well; why imperil our well-doing at the bidding of theorists, who cannot know that we shall do better?

If, however, the conclusions of Political Economy are arrived at with difficulty, and accepted generally only after a vigorous resistance, they are uniformly beneficent. There is, it may be confidently said, no science which has ever bestowed such great benefits on mankind. The reason is not far to seek. There is not a single economical law, which is capable of distinct demonstration, which is not fully in accordance with the laws of morality, which is at variance for the clearest and most intelligible justice. Men live together in order to confer mutual benefits, to prevent or redress wrongs, to further each other's happiness. Now it is true that Political Economy takes note of those services or labours only which are capable of being valued and paid for, and does not profess to discuss right and wrong, but only gain and loss. But these two notions differ only in form; they agree in fact. What the moralist denounces as a sin or a crime, the economist proves to be a weakness to society, a hindrance or a waste; and it is all the better for those who seek to inculcate what is just and right, that their conclusions should be strengthened by independent but corroborative evidence. Besides, though there are certain qualities and acts which are of so exalted and noble a nature, that they cannot be rewarded by any material recompense, just as they cannot be sufficiently praised and honoured, it is no loss, but rather a gain to those who bid men look beyond mere human judgments and human motives, when they find the economist allowing that certain services which man renders to man are of infinite benefit to society, are so important that society could hardly exist without them, but yet cannot be appraised by any material standard, and must be left to conscience, to benevolence, to charity, to an anxious love of well-doing, to some reward which man cannot give.

One of the best services which Political Economy tenders, is that of its teaching the inevitable consequence of breaking a natural law. The physician tells us that if people live in dirt, on unwholesome food, on impure water, if they lead intemperate or vicious lives, they must expect sickness, or at least an ill habit of body. Similarly, the economist teaches that if labour allows itself, by its own recklessness, to be perpetually without any resources except those which it gets from hand to mouth, it must accept the terms which hard employers can exact from the needy. Men who must sell in order to live, who cannot wait a day for the market to better itself, must acquiesce in the price which the market offers. So, again, a community which lives on the cheapest possible food, however thrifty and painstaking it is, is always within danger of famine, since, if its ordinary supply fails, it has no other resource to fall back on. The Belgian peasant is the thriftiest labourer in the world;

the Irish, before the famine of 1845, was the most reckless, according to common reports. Both lived on the cheapest kind of food, and both suffered the same extremities from the same cause. But we shall often have occasion to illustrate the position that Political Economy teaches the tendency of certain natural laws, and that serious inconvenience and loss follow the breach of these laws.

When people, then, speak of this science as harsh and stern and dismal, they are—unwittingly, no doubt, but surely—preferring ignorance to knowledge. All law is the will of God, and the will of God is never harsh, stern, or dismal, except to those who wilfully defy it. As well call the art of the physician stern or harsh, because it warns men that the laws of health cannot be broken with impunity, but must be obeyed, except to the manifest danger of those who violate them, and their probable detriment.

It was stated at the beginning of this paper that Political Economy is an inductive science, and that by this is meant that its conclusions are gathered from the observation of facts—that it is a science of experience, not of demonstration. This statement requires a little expansion and illustration.

Out of a few definitions and axioms, the geometrician builds up a series of proofs. So, again, a mathematician lays down a few simple rules in arithmetic, algebra, and the like, and from these educes a series of processes by which the most elaborate calculations can be developed. Similarly, the logician proposes a few laws of thought, and from them constructs or analyses complicated reasonings. It is not necessary in a paper like this to raise the question as to what is the origin of those principles from which sciences like the above-named have their commencement. It is sufficient to point to the fact that they deal with certain forms as laws of thought, which are apparently the constituents or conditions of the mind.

In the physical universe there are a vast mass of phenomena. In some of these phenomena man is able to lay down an hypothesis, and then proceed to verify or reject the hypothesis by experiment. For example, a chemist tells us that water is composed of two gases; and he can prove this incontestably, for he can exhibit the production of water, by employing certain agencies which operate on these two gases when they are brought together. In the same way, the electrician has been able not only to account for the phenomena of thunder and lightning, but to exhibit the spark and sound on a small scale. He is able to verify his hypothesis, and to establish a physical law.

There is another set of phenomena, the proof of which is due to the verification of hypothesis by observation. This is the way in which the laws of astronomical science have been generally discovered. The orbit of comets was, for example, first stated as an hypothesis. The discoverer then tried whether the actual course of the comet accorded with the place in which the hypothesis anticipated the body would be. In time the anticipation was satisfied. It is in this way that most astronomical discoveries have been made, though it must be allowed that the most brilliant and suggestive of all, the spectrum analysis, was indebted to the method of experiment for its verification.

Now Political Economy is an inductive science of observation. We can make no experiments on society; we cannot construct a state in which we can wholly control all the constituents which contribute to an economical problem. All we can do is to anticipate, watch, and verify our anticipation; or if we find the facts at variance with our theory, to account for the discrepancy, or discard our theory. Nothing has done, and nothing can do, more harm to this science than to lay down a few hard rules, and then to account for the facts by the rules. The proper thing to do is to search for the rule in the facts. For example, some very ingenious writers have laid down certain positions about rent, population, profit, capital, which are found to be at variance with the facts of society, with things as they really are. We shall have occasion to illustrate the errors which such unyielding and unverified hypotheses engender.

In concluding this prefatory lesson, I may observe that the study of Political Economy constitutes the key to much which is otherwise unintelligible in history. History proposes to deal with the events which have occurred in the social progress and decay of human societies. Part of its inquiries are the wars by which empires have been founded and lost; and, indeed, it is too often the case, that those who have busied themselves with the rise, growth, and downfall of communities, have laid too much stress on these continual and superficial occurrences, and have given little or no attention to the social condition of the nations whose history they profess to teach. But we may be certain of this, that the vicissitudes to which such nations have been subjected are all susceptible of an economical interpretation. An economist finds no great difficulty in explaining the brief duration of Oriental empires, in accounting for the short-lived brilliancy of ancient Greece, for the growth of the Roman power, for its utter downfall, and for the long duration of social barbarism which followed it. Nor does he find himself unable to anticipate the greater durability of modern societies, and the causes which give our civilisation its strength and coherence, while he is conscious of the hindrances which oppose its fuller development, and the difficulties which menace it.

In my next lesson I shall treat of the progress of modern society, and show how its economy has been constructed.

LESSONS IN GERMAN.—LXX.

§ 100.—THE ADVERBS.

(1.) Adverbs in German, as in other languages, serve to modify the signification of verbs, participles, adjectives, and often, also, that of one another; denoting, for the most part, certain limitations of time, place, degree, and manner. Hence they are usually classified according to their *meaning*.

(2.) They are indeclinable; and formed, either by derivation or composition, from almost every other part of speech: of some, however, the origin is wholly unknown.

Arranged according to derivation, adverbs are divisible into the following classes :—

§ 101.—ADVERBS FORMED FROM NOUNS.

Adverbs are formed from nouns by affixing the letter s. This termination s is nothing more than the sign of the genitive singular; which case, not only of nouns, but also of adjectives, participles, etc., is often made to perform the office of an adverb. Examples :—

Morgens, in the morning;	from	der Morgen, morning.
Tags, in the day;	,,	der Tag, day.
Theils, in part, or partly;	,,	der Theil, part.
Flugs, swiftly;	,,	der Flug, flight.
Durchgehends, generally;	,,	durchgehend, passing through.
Zusehends, visibly;	,,	zusehend, looking at.

§ 102.—ADVERBS FORMED FROM ADJECTIVES.

(1.) Adverbs are formed from adjectives by the addition of the suffixes lich, haft, and lings; which, except the last, are also regular *adjective* terminations. These endings are chiefly expressive of manner; and may be translated sometimes by a corresponding suffix (as the English *ly* or *ishly*), and sometimes by some equivalent phrase. Examples :—

Wahrlich, truly, verily;	from	wahr, true.
Boshaft, maliciously;	,,	böse, evil, wicked.
Weislich, wisely;	,,	weise, wise.
Freilich, sure, to be sure;	,,	frei, free, sure.
Blindlings, blindly;	,,	blind, blind.

(2.) The letter s, also, as above stated, added to adjectives, gives rise to a class of adverbs; thus,

Rechts, on the right;	from	recht, right.
Links, on the left;	,,	link, left.
Anders, otherwise;	,,	ander, other.
Bereits, already;	,,	bereit, ready.
Besonders, particularly;	,,	besonder, particular.
Stets, continually;	,,	stet, continual.

The letter s is, also, sometimes affixed to adverbs ending in mal; as, vormals, formerly; damals, at that time; vielmals, many times. For numeral adverbs ending in mal, lei, etc., see the section on Numerals.

(3.) Here note, also, that *almost all German adjectives, in the absolute form—that is, in the simple form without the terminations of declension—are employed as adverbs;* thus, er rennt schnell, he runs rapidly; er handelt ehrlich, he acts honestly.

§ 103.—ADVERBS FORMED FROM PRONOUNS.

(1.) These are, chiefly, da, *there* (from der, die, das, *this* or *that*);

wo, *where* (from wer, was, *who, what*); her, *hither*, and hin, *thither* (from some corresponding demonstrative pronoun no longer found).

(2.) The pronominal adverbs, in combination with other words, give rise to a number of compounds. Thus da and wo, united with prepositions, serve often instead of the dative and accusative (*neuter*) of the pronouns der, wer, and welcher respectively. It will be noticed, that when the other word begins with a vowel or with the letter n, da and wo are written dar and wor; that is, that r is inserted for the sake of euphony. The following are compounds of da and wo:—

Dabei, thereby, *i.e.*, by this or that.	Wobei, whereby, *i.e.*, by which.
Dafür, therefore, *i.e.*, for this or that.	Wofür, wherefore, *i.e.*, for which.
Damit, therewith, *i.e.*, with this or that.	Womit, wherewith, *i.e.*, with which.
Darin, therein, *i.e.*, in this or that.	Worin, wherein, *i.e.*, in which.
Darunter, thereunder or among, *i.e.*, under this or that.	Worunter, whereunder, among, *i.e.*, under which.
Darum, thereabout or therefore, *i.e.*, for this or that; therefore.	Worum, whereabout, *i.e.*, about or for which, wherefore; why.
Daran, thereon, *i.e.*, on this or that.	Woran, whereto, *i.e.*, to which.
Darauf, thereupon, *i.e.*, upon this or that.	Worauf, whereupon, *i.e.*, upon which.
Daraus, therefrom, *i.e.*, from this or that.	Woraus, wherefrom, *i.e.*, from which.
Davon, thereof, *i.e.*, of this or that.	Wovon, whereof, *i.e.*, of which.
Dazu, thereto, *i.e.*, to this or that.	Wozu, whereto, *i.e.*, to which.
Dadurch, there-through or thereby, *i.e.*, through or by this or that.	Wodurch, whereby, *i.e.*, by or through which.

(3.) In like manner her and hin appear, also combined with other words. Between these two particles a distinction exists, wherever they are used, whether alone or in composition with other words, which should be well understood and always remembered. They are, in signification, exact *opposites:* her indicating motion or direction *towards* the speaker; hin implying motion or direction *away from* the speaker. The following are examples:—

Herab, down hither, *i.e.*, where the speaker is.	Hinab, down thither, *i.e.*, away from the speaker.
Herauf, up hither.	Hinauf, up thither.
Heraus, out hither.	Hinaus, out thither.
Herein, in hither; into this place.	Hinein, into that place.
Hierher, or hieher, hither here; this way.	Hierhin, thither; this way forward.
Herüber, over hither.	Hinüber, over thither.
Herunter, under hither.	Hinunter, under there.
Daher, from there hither, *i.e.*, thence.	Dahin, from thither (to) there, *i.e.*, thither.
Woher, from which place hither, *i.e.*, whence.	Wohin, from which place thither, *i.e.*, whither.

(4.) We have no words in English corresponding exactly in use and force with her and hin; and therefore, though everywhere in German their force may be *felt*, it cannot always be expressed by single words, in translation. Hence they are often treated as expletives.

§ 104.—ADVERBS FORMED FROM VERBS.

(1.) Adverbs are formed from verbs by suffixing to the radical part the termination lich. All adverbs so formed, however, are equally employed as adjectives; thus,

Glaublich (from glaub + en, to believe), credibly.
Sterblich (from sterb + en, to die), mortally.
Kläglich (from klag + en, to lament), lamentably.
Merklich (from merk + en, to note, perceive), perceptibly.

§ 105.—ADVERBS FORMED BY COMPOSITION.

(1.) Besides the classes given above, a numerous list of adverbs in German is produced by the union of various parts of speech. Thus, the word Weise (*mode, manner*), combined with nouns, forms a class of adverbs employed chiefly in specifying things individually or separately; thus, schrittweise, step by step; theilweise, part by part; tropfenweise, drop by drop. Weise is also added to adjectives; as, diebischerweise, thievishly; glücklicherweise, fortunately.

(2.) Sometimes an adverb and a preposition are united; examples of which may be found under the head of adverbs formed from pronouns (§ 103).

(3.) Sometimes adverbs are formed by the union or the repetition of prepositions; as, durchaus, throughout, thoroughly; durch und durch, through and through.

(4.) Sometimes a noun and a pronoun joined together serve as an adverb; as, meinerseits, on my side; diesseits, on this side; allerdings, by all means.

(5.) Sometimes one adverb is formed from another by the addition of a suffix; as, genugsam, sufficiently; sometimes by the union of another adverb; as, nimmermehr, nevermore.

(6.) Sometimes the several words composing a phrase are, by being brought into union, made to perform the office of an adverb; thus, fürwahr (for für wahr), verily; sonst (for the obsolete so ne ist, *if it is not*), otherwise, else.

§ 106.—COMPARISON OF ADVERBS.

(1.) Many adverbs, chiefly, however, those expressive of manner, are susceptible of the degrees of comparison. The forms for these are the same in adverbs as in adjectives.

(2.) It must be observed, however, that when a *comparison*, strictly speaking, is intended, the form of the superlative produced by prefixing am (see *Obs.* § 38) should always be employed; as, er schreibt am schönsten, he writes the most beautiful (*of all*).

(3.) If, on the other hand, we purpose, not to compare individuals one with another, but merely to denote extreme excellence or eminence, there are three ways in which it may properly be done:—*First*, by using the simple or absolute form of the superlative; as, er grüßt freundlichst, he greets or salutes in a manner *very* friendly, *very* cordially. *Secondly*, by employing aufs (auf + das) with the accusative, or zum (zu + dem) with the dative, of the superlative; as, aufs freundlichste, in a manner very friendly; zum schönsten, in a manner very beautiful. *Lastly*, by adding to the simple form of the superlative the termination ens; as, bestens, the best or in the best manner; höchstens, at the highest or at the most.

§ 107.—THE PREPOSITION.

(1.) The prepositions in German—that is, the words employed merely to denote the *relations* of things—are commonly classified according to the cases with which they are construed. Some of them are construed with the genitive only; some with the dative only; some with the accusative only; and some either with the dative or accusative, according to circumstances.

(2.) They may also, on a different principle, be divided into two general classes: the *primitive* and the *derivative*. The primitive prepositions always govern either the dative or the accusative; the derivative prepositions are found, for the most part, in connection with the genitive only.

§ 108.—TABLE OF THE PREPOSITIONS.

(1.) PREPOSITIONS CONSTRUED WITH THE GENITIVE.

Anstatt, or statt.	Oberhalb.
Außerhalb.	Troß.
Diesseit, or diesseits.	Um -willen.
Halb, halben, or halber.	Unfern.
Innerhalb.	Ungeachtet.
Jenseit, or jenseits.	Unterhalb.
Kraft.	Unweit.
Längs.	Vermittelst, or mittelst.
Laut.	Vermöge.
	Während.
	Wegen.
	Zufolge.

(2.) PREPOSITIONS CONSTRUED WITH THE DATIVE.

Aus	Nebst
Außer.	Ob.
Bei.	Sammt.
Binnen.	Seit.
Entgegen.	Von.
Gegenüber.	Zu.
Gemäß.	Zuwider
Mit.	
Nach.	
Nächst.	

(3.) PREPOSITIONS CONSTRUED WITH THE ACCUSATIVE.

Durch.	Ohne.
Für.	Sonder.
Gegen, or gen.	Um.
	Wider.

(4.) PREPOSITIONS CONSTRUED WITH THE DATIVE OR ACCUSATIVE.

An.	Ueber.
Auf.	Unter.
Hinter.	Vor.
In.	Zwischen.
Neben.	

KEY TO EXERCISES IN LESSONS IN GERMAN.

Exercise 181 (Vol. III., page 379).

1. Ich wünsche Ihnen einen guten Abend. 2. Ich habe das Vergnügen, Ihnen einen guten Morgen zu wünschen. 3. In der Fremde gedenken wir oft mit Liebe unserer Freunde in der Heimath. 4. Ich gedenke nächsten Monat nach dem Festlande zu gehen. 5. Gedenken Sie lange dort zu bleiben? 6. Nein, ich gedenke nicht lange dort zu bleiben, ich werde bald zurückkehren. 7. Er versuchte seinen Freund bei der Erlernung der deutschen Sprache einzuholen, aber er konnte es nicht, denn sein Freund war zu weit vorgerückt. 8. Gedenken Sie, Ihren Bruder auf seiner Reise einzuholen? 9. Ich holte meinen Bruder nach einer dreitägigen Reise ein. 10. Vor sechs Monaten war ich im Begriffe, nach Amerika zu gehen; nun aber bin ich sehr froh, daß ich in der Heimath geblieben bin.

Exercise 182 (Vol. III., page 379).

1. When Rudolph of Hapsburg had become emperor of Germany, the internal dissensions and the so-called club-law ceased in this empire. 2. After they had killed a few stags, they desisted from hunting. 3. It ceases raining, and we now can continue our journey. 4. My brother is at home; he has already been a week in bed. 5. In Germany there are other manners and customs than in America. 6. The imperial diets were held at Ratisbon in later years. 7. The high-school at Breslau is among the best in Germany. 8. They were just dining as we arrived there. 9. They were not accustomed to take their supper until they had done all their day's work. 10. They took their dinner in summer during fine weather under a linden-tree, which stood in the yard. 11. When the cholera raged in Paris, thousands upon thousands died of it. 12. The soldiers take the field. 13. In the last storm several ships sank. 14. The beggar goes from door to door, and from village to village. 15. This redounds to my honour, to his disgrace. 16. You might do it for my gratification. 17. The enemy steers with all sails towards the east. 18. That is too good for him. 19. I am only too certain that it will happen so. 20. That may be done too when we have first regulated our own affairs. 21. Friend, life is an earnest business; suffer its hardships: thus only will the voyage be easy to you. 22. Finally, thou landest, after all, safely on shore in thy harbour; it is called the grave. 23. He has ruined his own and his friends' fortune. 24. He has ruined his health by these labours. 25. Nelson destroyed the French fleet. 26. If he is not careful, his whole business may be ruined in a short time.

PLANE TRIGONOMETRY.—V.

SOLUTION OF OBLIQUE-ANGLED PLANE TRIANGLES.

XXI. *Solution of Oblique-angled Plane Triangles.*—It has been already explained (Section X.) that any plane triangle can be computed when three out of its six "elements" are given, provided that at least one side be given. By aid of the formulæ developed in the last section, we proceed to show this in the three following cases, which include all that can be presented; viz.:—

1. Where three sides are given.
2. Where two sides and one angle are given.
3. Where one side and two angles are given.

1. *Given the three sides a, b, c.*—Find A, B, and C. The simplest way to effect this is by (76),

$$\text{Tan. } \tfrac{1}{2}\text{A} = \frac{\sqrt{(s-b)\,(s-c)}}{s\,(s-a)};$$

$$\therefore \text{log. tan. } \tfrac{1}{2}\text{A} = 10 + \frac{\text{log.}(s-b) + \text{log.}(s-c) - \left(\text{log.}s + \text{log.}(s-a)\right)}{2};$$

whence, by the table of logarithmic sines, tangents, etc., in Galbraith and Haughton's mathematical tables, $\frac{1}{2}$ A, and therefore A, can be found. Similarly, by (76),

$$\text{Log. tan. } \tfrac{1}{2}\text{B} = 10 + \frac{\text{log.}(s-a) + \text{log.}(s-c) - \left(\text{log.}s + \text{log.}(s-b)\right)}{2}.$$

A and B being now known, C of course is known also.

Familiarity with the use of logarithms is necessarily assumed in the student, who will remember that, as 10 is added to all logarithms of trigonometrical ratios (to avoid the necessity of entering negative indices in the tables, which would otherwise arise from the fact that many of the ratios are less than unity), it is also necessary to deduct 10 from them before using them in calculations, or (what is the same thing) to add 10 to the other side of any equation in which they may appear. This has been done above. The use of logarithms is fully explained in our "Lessons in Logarithms" in the Popular Educator.

Exercise 4.

1. Given $a = 26$, $b = 31$, $c = 43$. Find the angles.
2. Given $a = 16{\cdot}22$, $b = 15{\cdot}32$, $c = 21{\cdot}56$. Find the angles.
3. Given $a = 1110$, $b = 1342$, $c = 1500$. Find the angles.
4. Given $a = 1{\cdot}32$, $b = 1$, $c = 0{\cdot}75$. Find the angles.

2. This case appears in two forms—

First, *given two sides, a and b, and the included angle* C. Find A, B, and c.

$$\tfrac{1}{2}(\text{A}+\text{B}) = \tfrac{1}{2}(180° - \text{C}) = 90° - \tfrac{1}{2}\text{C}.$$

Again, from (67), $\text{tan. } \tfrac{1}{2}(\text{A}-\text{B}) = \dfrac{\text{tan. } \frac{1}{2}(\text{A}+\text{B}) \times (a-b)}{a+b}$;

$$\therefore \text{log. tan. } \tfrac{1}{2}(\text{A}-\text{B}) = \text{log. tan. } \tfrac{1}{2}(90° - \tfrac{1}{2}\text{C}) + \text{log. }(a-b) - \text{log. }(a+b).$$

There being a logarithmic ratio on each side of this equation, of like sign, there is no occasion to allow for the *added tens*, which balance each other.

We have now obtained $\frac{1}{2}$ (A + B) and $\frac{1}{2}$ (A − B), the sum and difference of which, by the well-known rule, give the values of A and B respectively.

$$\text{By (65), we have } c = \frac{a \,.\, \text{sin. C}}{\text{sin. A}};$$

$$\therefore \text{log. } c = \text{log. } a + \text{log. sin. C} - \text{log. sin. A}.$$

Here again, owing to difference of sign, the "added tens" balance each other.

Secondly, *given two sides, a and b, and an angle*, A, *not included between them.* (This is called "the ambiguous case.") Find B, C, and c.

$$\text{We find B readily from (65); viz., } \frac{\text{sin. B}}{\text{sin. A}} = \frac{b}{a};$$

$$\text{whence log. sin. B} = \text{log. sin. A} + \text{log. } b - \text{log. } a;$$

$$\text{and C} = 180° - (\text{A}+\text{B}),$$

c is found from (65), as in the last example.

Now since sin. B is also sin. (180° − B), the above equation for log. sin. B always admits of two values of B (except when B = 90°), one greater and the other less than a right angle; and other data have to be considered in determining which is the correct one; thus—

(α) If the given angle A is a right angle, or greater than a right angle, B must be less than 90°, and no doubt arises.

(β) Again, if A, though less than a right angle, together with the *greater* value of B, be not less than 180°, it is clear the *less* value of B must be adopted. For instance, if A = 80° and B = 70° or 110° (*i.e.*, 180° − 70°), it is plain that 110° is an inadmissible value for B; consequently, B = 70° and C = 30°.

(γ) But if A, together with the greater of the two values of B, be less than 180°, it is plain that the data given apply to *two* triangles. Thus, if A = 80° and B = 85° or 95°, we may have either

$$\text{A} = 80°;\ \text{B} = 85°;\ \text{C} = 15°;$$
$$\text{or A} = 80°;\ \text{B} = 95°;\ \text{C} = 5°;$$

these alternative values being quite consistent with the fact that a and b are fixed values, as appears by Fig. 14, where both the triangles ABC and AB′C correspond with the data given.

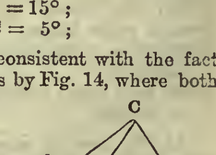


Fig. 14.

It appears, however, by inspection of Fig. 14, that the ambiguity can *never* arise when a is greater than b, since then one of the two equal lines which may still be drawn from C to AB (or AB produced) will fall *to the left of* A, an impossible position for a side of a triangle in which A is an angle. This is a re-statement of (β) in a more convenient form.

We may thus sum up:—*The ambiguity can only occur when the given angle is acute, and when the side opposite to it is less than the other given side.*

When these conditions are fulfilled, both values of B must be worked out, causing two values of C and two of c.

Exercise 5.

1. Given $a = 218$, $b = 156$, and C = 38° 21′ 20″. Find A, B, and c.
2. Given $a = 53{\cdot}24$, $b = 31{\cdot}27$, and C = 126° 36′ 6″. Find A, B, and c.
3. Given $b = 173$, $c = 123$, and A = 22° 13′ 30″. Find B, C, and a.
4. Given $b = 156$, $a = 130$, A = 42° 25′. Find B, C, and a (give both solutions).

5. Given $a = 53$, $c = 47$, $C = 30° 42' 30''$. Find A, B, and b (assume A to be acute).
6. Given $a = 217$, $b = 199$, and $B = 62° 24' 20''$. Find A (obtuse), C, and c.
7. Given $a = 100$, $c = 62$, and $C = 38° 19'$. Find A, B, and b.

3. *Given one side, a, and two angles,* A *and* B. Find C, b, and c.

$$180° - (A + B) = C.$$

$$\text{By (65), } \frac{b}{a} = \frac{\text{sin. B}}{\text{sin. A}};$$

$$\therefore \text{log. } b = \text{log. } a + \text{log. sin. B} - \text{log. sin. A}.$$

$$\text{Similarly, log. } c = \text{log. } a + \text{log. sin. C} - \text{log. sin. A}.$$

EXERCISE 6.

1. Given $a = 217$, $B = 56° 21' 30''$, $C = 62° 41' 20''$. Find A, b, and c.
2. Given $a = 1000$, $B = 120° 15' 15''$, $C = 36° 52'$. Find A, b, and c.

XXII. *To find the Area of a Triangle.*—There are two useful formulæ for finding the area—one in terms of any two sides and included angle, the other in terms of the three sides.

$$1. \text{ Area} = \tfrac{1}{2} bc \text{ sin. A}.$$

If A is a right angle, area evidently = half the rectangle

Fig. 16.

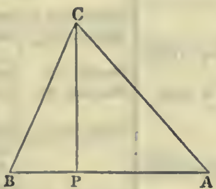


Fig. 15.

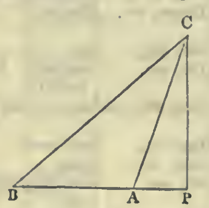


Fig. 17.

under the adjacent sides, which agrees with the statement, since sin. $90° = 1$.

If A is acute, as in Fig. 15, drop C P perpendicular to A B, or A B produced (Fig. 16). Then, by Euclid II. 1,

$$\text{Area} = \tfrac{1}{2} \text{ AB} \times \text{CP}.$$

$$\text{But AB} = c, \text{ and since } \frac{\text{CP}}{b} = \text{sin. A, CP} = b \text{ sin. A};$$

$$\text{therefore area} = \tfrac{1}{2} bc \text{ sin. A}.$$

If A be obtuse (Fig. 17), drop C P as before, on B A produced; then area $= \frac{1}{2}$ A B $\times$ C P,

But A B $= c$ and C P $=$ C A sin. C A P, and sin. C A P $=$ supplement of A.

$$\therefore \text{Area } \tfrac{1}{2} bc \text{ sin. A} \qquad (77)$$

$$\text{Or, log. 2 area} = \text{log. } b + \text{log. } c \times \text{log. sin. A} - 10.$$

2. Substituting in (77) the value of sin. A given in (73), we get

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)} \qquad (78)$$

$$\text{Or log. area} = \frac{\text{log. } s + \text{log. }(s-a) + \text{log. }(s-b) + \text{log. }(s-c)}{2};$$

but it is often easier to work out (77) arithmetically than to employ logarithms.

EXERCISE 7.

1. Given $b = 35$ feet, $c = 117$ feet, and $A = 27°$. Find the area.
2. Given $a = 1000$ yards, $b = 2{\cdot}5$ miles, and $C = 42°$. Find the area.
3. Given $b = 2{\cdot}314$, $c = 1{\cdot}527$, and $A = 49° 6' 20''$. Find the area.
4. Given $a = 287{\cdot}1$, $c = 310{\cdot}25$, and $B = 114° 23' 32''$. Find the area.
5. Given $a = 49$, $b = 98$, $c = 53$. Find the area without employing logarithms.
6. Given $a = 603$, $b = 507$, $c = 721$. Find the area.
7. Given $a = 0{\cdot}45$, $b = 0{\cdot}34$, $c = 0{\cdot}23$. Find the area.
8. Given $a = 2{\cdot}05$, $b = 1{\cdot}67$, $c = 2{\cdot}7$. Find the area.

We have now concluded our investigation of theoretic Trigonometry, or rather of such parts of the theory as will enable us to apply our knowledge largely in practice. There are formulæ for other ratios or values, such as for the radius of the circle inscribed in, or circumscribed about, a given triangle, the area of the circumscribed circle in terms of the sides, the area of any polygon inscribed in a circle (whence the area of the circle itself may be obtained approximately), and the like; but these, although useful, are not needed to enable us merely to solve "heights and distances," upon which the practical art of surveying mainly depends. A complete survey of a coast or country may be made, and heights and distances accurately calculated, without a single actual measurement being taken, except one at starting called the *base-line.* (It is usual, however, to check a result here and there by actual measurement.) By choosing or marking spots or objects at convenient distances apart, the whole district is divided into triangles, and it is obvious that a knowledge of one side of the first triangle calculated (the base-line before mentioned), an instrument for measuring angles, and a level, are all that are required to enable it to be completely surveyed.

A few cases will be given in the next lesson as illustrations of the commonest practical uses of Trigonometry, and the Key to Exercises 2 to 7 inclusive.

TERMS USED IN COMMERCE.—VII.

PAR OF EXCHANGE.—The comparative intrinsic value of the specie of different countries according to their fixed standards of weight and purity.

PARTNERSHIP.—The combination of two or more individuals for the purposes of business in common, each deriving a share of the profits, or bearing a corresponding share of the losses arising from it.

PASS BOOK.—A book passing between bankers and their customers, which records all payments and receipts.

PASSPORT.—A document granted by a consul, giving a description of the owner, and entitling him to pass through or to reside for a time in the country for which it is given. In maritime law, a document carried in time of war by a vessel to prove her nationality.

PATENT—LETTERS PATENT.—A privilege granted under the Crown seal, conveying to the persons specified the sole right to make use of some new invention or discovery therein stated.

PENALTY.—A sum to be forfeited for the non-completion of a contract or for a part of it.

PER CENT.—*"By the Hundred."* Thus 5 per cent. would be five out of every hundred.

PERMIT.—A licence from the Excise authorities permitting the removal of goods upon which duty has been paid.

PILOT.—A person duly qualified and authorised to conduct ships through rivers, into or out of port, or through certain channels or roads.

PLANT.—A trade term comprehending fixed machinery, implements, or other requisites for carrying on a business.

POLICY OF INSURANCE.—A document by which insurance companies and underwriters secure to the parties contracting with them for life, fire, marine, or accident insurance, an indemnity against loss from the risk incurred. It is a document of considerable importance; stating the names of the insurers and of the insured, the amount and exact nature of the indemnity, and of the risk incurred.

POST, TO (*Book-keeping*).—To transfer an entry from one book to another.

POSTDATE.—To date a letter or document of any description later than the day on which it is written.

POST OBIT BOND.—A bond, the main condition of which is that it only becomes payable after the death of some person whose name is therein specified.

PRÉCIS-WRITING.—Writing the contents of a document in as short and condensed a style as possible.

PREMIUM.—An additional sum beyond a standard or fixed price.

PREMIUM (INSURANCE).—The per-centage or sum paid by the insured for the indemnification granted by the insurer.

PRESENTMENT OF A BILL.—The act of demanding, or presenting for, acceptance or payment.

PRICE CURRENT.—A list or enumeration of various articles of commerce, with the market price of each.

PRIMAGE, OR HAT MONEY.—A customary per-centage paid by shippers, in addition to the freight of goods, and considered to be for the master of the vessel, for his care and trouble in taking charge of such goods while on board.

PRIME COST.—The first cost, before charges begin to accrue.

PRINCIPAL signifies the responsible person. It also applies to the partners in any establishment, who are spoken of as the principals. In Banking, the sum on which the interest arises.

PRIVATEER.—A private ship fitted out for warlike purposes under a license from the Government. (See *Letters of Marque.*)

PROCEEDS.—The actual result or sum produced by any sale.

PROCTOR.—An officer in the admiralty and ecclesiastical courts, corresponding with an attorney in common law or a solicitor in equity.

LESSONS IN FRENCH.—LXXXIX.

§ 146.—FRENCH HOMONYMS AND PARONYMS (*continued*).

French Words.	Meaning in English.
Général, *adj.*	*general.*
Général, *nm.*	*general.*
Générale, *adj., f.*	*general.*
Générale, *nf.*	*general's wife; fire-drum, general.*
Germain, *adj.*	*german, first cousin; brother, sister of the whole blood* (law).
Germain, *nm.*	*German.*
Gland, *nm.*	*acorn.*
Glande, *nf.*	(anat.) *gland.*
Grâce, *nf.*	*grace, gracefulness.*
Grasse, *adj. f.*	*fat.*
Graisse, *nf.*	*grease, fat.*
Grèce, *nf.*	*Greece.*
Grave, *adj.*	*grave, weighty; heavy; solemn.*
Grave, *nm.*	*gravity; heavy body* (nat. phil.).
Gré, *nm.*	*will.*
Grès, *nm.*	*sandstone.*
Grêle, *adj.*	*slender, slim, lank; shrill.*
Grêle, *nf.*	*hail; hail-storm; tumour of the eyelids.*
Gril, *nm.*	*gridiron.*
Grille, *nf.*	*grate; grating.*
Gris, *adj.*	*grey.*
Grosse, *nf.*	*gross (twelve dozens).*
Grosse, *adj. f.*	*stout, big.*
Guère, *adv.*	*scarcely.*
Guerre, *nf.*	*war.*
H.	
Haine, *nf.*	see Aine.
Haire, *nf.*	see Air.
Hâle, *nm.*	*heat of the sun.*
Halle, *nf.*	*market, market-place.*
Haleine, *nf.*	see Alène.
Hallier, *nm.*	see Allié.
Hanche, *nf.*	see Anche.
Hart, *nf.*	see Are.
Haut, *nm., adj*	see Aulx.
Haute, *adj. f.*	*high.*
Hôte, *nm.*	*host, guest; landlord, innkeeper.*
Hotte, *nf.*	*basket (carried on the back); basket-funnel.*
Hautesse, *nf.*	*highness.*
Hôtesse, *nf.*	*host, guest; landlady, innkeeper.*
Hauteur, *nf.*	see Auteur.
Héraut, *nm.*	*herald.*
Héros, *nm.*	*hero.*
Hère, *nm.*	see Air.
Hêtre, *nm.*	see Être.

French Words.	Meaning in English.
Heur, *nm.*	*luck.*
Heure, *nf.*	*hour, time, o'clock.*
Heurt, *nm.*	*knock, shock, collision.*
Hocher, *v.*	*to shake.*
Hochet, *nm.*	*rattle (for children); toy; plaything.*
Horion, *nm.*	*blow, thump.*
Orion, *nm.*	(astron.) *Orion.*
Hors, *prep.*	*except; out.*
Or, *conj.*	*now.*
Or, *nm.*	*gold.*
Hospice, *nm.*	see Auspice.
Hôtel, *nm.*	see Autel.
Houe, *nf.*	see Août.
Houx, *nm.*	see Août.
Hun, *nm.*	*Hun.*
Un, *art., adj. m.*	*a, an; one.*
Hune, *nf.*	(nav.) *top.*
Une, *art., adj. f.*	*a, an; one.*
Hutte, *nf.*	*hut, cabin.*
Ut, *nm.*	(mus.) *ut, C.*
I.	
Immortelle, *adj. f.*	*immortal.*
Immortelle, *nf.*	*everlasting flower.*
Impériale, *adj. f.*	*imperial.*
Impériale, *nf.*	*roof, outside (of a coach); imperial (beard on the lower lip); (cards), all-fours.*
Insigne, *adj.*	*signal, notorious.*
Insigne, *nm.*	*badge; insignia.*
Interne, *adj.*	*internal, interior.*
Interne, *nmf.*	*(in schools) boarder; house-surgeon.*
Issu,-e, *pp.*	*born, descended, sprung.*
Issue, *nf.*	*issue; egress; outlet; end, event.*
J.	
Jais, *nm.*	see Geai.
Jars, *nm.*	*gander.*
Jarre, *nf.*	*jar, pot, pitcher.*
Jet, *nm.*	see Geai.
Jeune, *adj.*	*young.*
Jeûne, *nm.*	*fasting.*
Jouer, *v.*	*to play; to gamble.*
Jouet, *nm.*	*toy, plaything.*

French Words.	Meaning in English.
Jumelle, *nf., adj.*	*twin.*
Jumelle, *nf.*	*opera-glass.*
Jumelles, *nf. pl.*	(carp.) *checks, side-beams;* (her.) *gemel;* (nav.) *fishes of masts, yards.*
L.	
La, *art., pron., f.*	*the; her.*
La, *nm.*	(mus.) *la, A.*
Là, *adv.*	*there.*
Lacs, *nm.*	*string; gin (snare); love-knot; springe.*
Lacs, *nm., pl.*	*lakes.*
Las, *interj.*	*alas!*
Las, *adj.*	*tired.*
Lac, *nm.*	*lake.*
Laque, *nf.*	*lac, lake, gum-lake.*
Laque, *nm.*	*lacquer.*
Lai, *adj.*	*lay.*
Lai, *nm.*	*layman; lay (little poem).*
Laid, *adj., nm.*	*ugly; what is ugly.*
Laie, *nf.*	*wild sow.*
Lait, *nm.*	*milk.*
Lé, *nm.*	*breadth of linen, cloth, etc.*
Legs, *nm.*	*legacy.*
Les, *art. pron. pl.*	*the; them.*
Lez, *prep.*	*near.*
Lard, *nm.*	*bacon.*
Lares, *nm. pl., adj.*	(antiq.) *Lares; household gods, home.*
Le, *art., pron.*	*the; him, it.*
Lé, *nm.*	*breadth of cloth, linen, etc.*
Lest, *nm.*	(nav.) *ballast.*
Leste, *adj.*	*quick; nimble.*
Lice, *nf.*	*lists; field; arena; warp.*
Lice, *nf.*	*bitch, hound.*
Lis, *nm.*	*lily.*
Lisse, *adj.*	*smooth; polished.*
Lisse, *nf.*	*warp;* (nav.) *sheer-rails, drift-rails.*
Lieu, *nm.*	*place, spot.*
Lieue, *nf.*	*league* = 2½ *miles English.*
Lire, *v.*	*to read.*
Lyre, *nf.*	*lyre;* (astron.) *Lyra.*
Livrée, *nf.*	*livery.*
Livrer, *v.*	*to deliver; to betray.*
Livret, *nm.*	*little book.*
Loch, *nm.*	(nav.) *log.*
Looch or lok, *nm.*	(med.) *loch.*
Loque, *nf.*	*rag.*
Louer, *v.*	*to hire, to let; to rent.*
Louer, *v.*	*to praise.*
Lut, *nm.*	(chem.) *luting.*
Luth, *nm.*	(mus.) *lute.*
Lutte, *nf.*	*struggle.*
M.	
Ma, *adj.*	*my.*
Mat, *adj.*	*unpolished.*
Mat, *nm.*	(at chess) *mate, check-mate.*
Mât, *nm.*	(nav.) *mast.*

French Words.	Meaning in English.
Mai, *nm.*	*May.*
Maie, *nf.*	(nav.) *trough to drain newly tarred cordage; kneading-trough.*
Mais, *conj.*	*but.*
Maïs, *nm.*	*maize, Indian corn.*
Mes, *adj.*	*my.*
Mets, *nm.*	*dish (food).*
Mail, *nm*	*mallet; mall (game; place).*
Maille, *nf.*	*mesh; mail; haw (eyes of animals); an obsolete French coin.*
Maire, *nm.*	*mayor (of a town).*
Mer, *nf.*	*sea.*
Mère, *nf.*	*mother.*
Mal, *adv., nm.*	*badly; evil.*
Mâle, *nm., adj.*	*male; manly.*
Malle, *nf.*	*trunk.*
Mânes, *nm. pl.*	*manes, shade, ghost.*
Manne, *nf.*	*manna.*
Mante, *nf.*	*mantle (woman's).*
Menthe, *nf.*	*mint (plant).*
Marc, *nm.*	*(weight) mark; residuum (of anything strained, boiled, squeezed, etc.).*
Mare, *nf.*	*pool, pond; trough (used by cider brewers).*
Mars, *nm.*	*March; Mars.*
Marche, *nf.*	*march, walk; steps (of stairs); move (at chess)*
Marché, *nm.*	*market, market-place.*
Mari, *nm.*	*husband.*
Marie, *nf.*	*Mary.*
Marri, *adj.*	*sorry, vexed.*
Marin, *adj.*	*marine.*
Marin, *nm.*	*mariner; seaman; sailor.*
Marine, *adj. f.*	*marine.*
Marine, *nf.*	*navy; sea-service.*
Martyr, *nm.*	*martyr.*
Martyre, *nm.*	*martyrdom.*
Martyre, *nf.*	*martyr (female).*
Massif, *adj.*	*massive, bulky; solid (of metals).*
Massif, *nm.*	*group (of trees); (masonry) solid mass; (carp.) dead wood; block.*
Ménager, *v.*	*to spare; to husband.*
Ménager, *adj.*	*sparing, thrifty.*
Menu, *adj.*	*small, slender, thin.*
Menu, *nm.*	*minute detail, particulars; bill of fare.*
Menu, *adv.*	*minutely, in small pieces.*
Mépris, *nm.*	*contempt.*
Meprise, *nf.*	*error, mistake.*
Mil, *adj.*	*one thousand (Christian era).*
Mil, *nm.*	(bot.) *millet.*
Mille, *adj.*	*one thousand.*
Mille, *nm.*	*mile.*
Mine, *nf.*	*look, aspect, mien, appearance.*
Mine, *nf.*	*mine (of metals); mine (milit.).*
Mine, *nf.*	*an obsolete measure = 75 quarts English; mina* (Greek antiq.).

*

French Words.	Meaning in English.
Mire, nf.	(artil.) sight, aim; mark.
Myrrhe, nf.	myrrh.
Mise, nf.	laying, placing; circulation of coin; capital supplied by partners.
Mise, nf.	dressing, way of dressing; bidding (at auctions); stake (in gambling).
Moi, pron.	me.
Mois, nm.	month.
Mollet, adj.	soft, softish.
Mollet, nm.	calf of the leg.
Mon, adj.	my.
Mont, nm.	mountain.
Montre, nf.	sample, show, parade; show glass, shop window.
Montre, nf.	watch.
Moral, adj.	moral.
Moral, nm.	mental faculties, mind; spirit.
Morale, adj. f.	moral.
Morale, nf.	ethics, morals, morality; rebuke, lecture; moral (of fables, etc.).
More (or Maure), nm.	Moor.
Mors, nm.	horse bit.
Mort, nf.	death.
Mort, nm., pp.	dead man; dead.
Mou, adj.	soft, mellow, weak.
Mou, nm.	lights (of some animals)
Moue, nf.	pouting; wry face.
Moût, nm.	must (unfermented wine).
Mousse, adj.	blunt.
Mousse, nf.	moss, froth, foam.
Mousse, nm.	cabin-boy, apprentice sailor.
Mur, nm.	wall.
Mûr, adj.	ripe.
Mûre, nf.	mulberry.
Mure, adj. f.	ripe.
N.	
Naturel, adj.	natural.
Naturel, nm.	native.
Naturel, nm.	naturalness; character, disposition.
Nécessaire, adj.	necessary, indispensable.
Nécessaire, nm.	necessaries; dressing-case; work-box.
Nef, nf.	nave (of a church); ship (ant.).
Nèfle, nf.	medlar (bot.).
Neuf, numeral	nine.
Neuf, adj.	new, newly bought, newly made.
Ni, conj.	neither, nor.
Nid, nm.	nest.
Nom, nm.	name.
Non, adv.	no.

French Words.	Meaning in English.
None, nf.	(Rom. antiq.) the 4th part of the day, 3 o'clock p.m.; (Cath. relig.) none.
Nones, nf. p.	(Roman calend.) 7th day of March, May, July, and October; the 5th of the other months.
Nonne, also nonnain, nf.	nun.
Nouveau, adj	new, fresh.
Nouveau, nm.	something new, news.
Nouvelle, adj. f.	new, fresh.
Nouvelle, nf.	news, novelet.
Noyé, nm.	drowned man.
Noyer, v.	to drown.
Noyer, nm.	walnut-tree.
Nue, adj. f.	bare, nude, naked.
Nue, nf.	cloud.
O.	
Officier, v.	to officiate.
Officier, nm.	officer.
Oing, nm.	cart-grease.
Oint, nm.	anointed.
Or, conj.	see Hors.
Or, nm.	see Hors.
Oratoire, adj.	oratorical.
Oratoire, nm.	oratory (apartment for private devotion); Oratory (a religious order).
Orion, nm.	see Horion.
Os, nm.	see Aulx.
Ou, conj.	see Août.
Où, adv.	see Août.
Oubli, nm.	oblivion, neglect, forgetfulness.
Oublie, nf.	a kind of very thin pastry.
Oui, adv.	yes.
Ouï, pp.	heard.
Ouïe, pp. f.	heard.
Ouïe, nf.	ear; sense of hearing; hole (of violins, guitars, etc.).
Ouïes, nf. p.	holes (of violins, guitars, etc.); gills (of fishes).
Outre, nf.	leather bottle.
Outre, conj.	besides.
P.	
Pain, nm.	bread; loaf.
Pin, nm.	pine-tree.
Pair, adj.	even (of numbers); such; like, alike.
Pair, nm.	Peer; equal; mate; par.
Paire, nf.	a pair, two.
Père, nm.	father.
Pers, adj.	bluish.
Paix, nf.	peace.
Paye, nf.	pay, salary, wages.

French Words.	Meaning in English.
Pal, nm.	pale (punishment); pale (her.).
Pâle, nf.	sluice, flood-gate; blade, paddle-board (of an oar); (Cath. religion) square paste-board covered with muslin to cover the chalice with.
Pâle, adj.	pallid, ghastly, pale, wan.
Palais, nm.	palace; palate (of the mouth).
Palet, nm.	quoit.
Pan, nm.	skirt; flap (of a coat); large piece of wall; side; (carp.) cant.
Paon, nm.	peacock.
Par, prep.	by.
Part, nm.	newly-born child (law term).
Part, nf.	share, part, side, portion.
Parallèle, adj.	parallel.
Parallèle, nm.	parallel, circle of latitude; comparison.
Parallèle, nf.	parallel line; (fort.) trench, parallel.
Parc, nm.	park.
Parque, nf.	Fate, Fatal sister.
Parce que, conj.	because.
Par ce que,	by what; by which; by that which.
Parquer, v.	to pen, to fold (cattle); to enclose; (artil.) to park.
Parquet, nm.	wood floor.
Parti, nm.	party, side, part, cause; resolution; (milit.) detachment.
Partie, nf.	part; match; line of business; (com.) parcel; (play) game; party; contracting party.
Pas, nm.	step, pace, footstep, stride, gait; threshold; precedence.
Pas, adv.	not, no, none.
Pât, nm.	food (of falcons).
Pat, nm.	stalemate (chess).
Pâte, nf.	paste.
Patte, nf.	paw (of animals); flap (of pockets); foot (of birds); leg (of insects)
Pâté, nm.	pie.
Pâtée, nf.	paste (for poultry); mess (for dogs, cats).
Paume, nf.	palm (of the hand); tennis (game).
Pomme, nf.	apple; ball, knob; head (of cabbages, lettuces, etc.; of a walking-stick).
Pause, nf.	pause; rest, stop.
Pose, nf.	laying; laying down; posture, attitude; hanging of bells; stationing (of sentries)
Peau, nf.	skin.
Pot, nm.	jar, pot.
Pêche, nf.	peach.
Pêche, nf.	fishing.
Péché, nm.	sin.
Pécher, v.	to sin.
Pêcher, nm.	peach-tree.
Pêcher, v.	to fish.

French Words.	Meaning in English.
Pécheur, nm.	sinner.
Pêcheur, nm.	fisherman.
Peine, nf.	pain, trouble, difficulty.
Pêne, nm.	bolt (of a lock).
Pendant, adj., pp.	hanging.
Pendant, nm.	counterpart, fellow; thing hanging; (horl.) pendant; frog (of a sword-belt).
Pendant, prep	during.
Panser, v.	to groom (a horse); to dress (wounds).
Penser, v.	to think; to believe; to suppose.
Perche, nf.	perch (fish).
Perche, nf.	pole, perch; perch (measure); (hunt.) horns.
Personnel, adj	personal; selfish.
Personnel, nm.	personal character, disposition (ant.); personnel (all the persons employed in a public or private establishment), staff.
Phare, nm.	see Fard.
Philtre, nm.	see Filtre.
Pic, nm.	pick, pick-axe; (nav.) gaff; peak (of a mountain).
Pique, nm.	spade (at cards).
Pique, nf.	pike (long lance).
Pie, nf.	magpie.
Pie, adj.	pious, charitable; piebald (of horses).
Pis, nm.	udder, dug (of a cow).
Pis, adv.	worse, worst.
Pieu, nm.	stake, pile (of wood).
Pieux, adj.	pious.
Pinçon, nm.	pinch (the mark left on the skin by a severe pinch).
Pinson, nm.	chaffinch (orni.).
Piquer, v.	to prick; to goad; to sting.
Piquet, nm.	picket (of soldiers); piquet (card game); picket, stake, peg.
Placer, v.	to place.
Placer, nm.	gold-digging.
Placet, nm.	petition.
Plaid, nm.	plea, pleading (of a barrister); plaid (Scotch garment).
Plaie, nf.	sore, wound; evil, plague.
Plain, adj.	flat, even, plain.
Plein, adj.	full.
Plaine, adj. f.	flat, even, plain.
Plaine, nf.	plain.
Pleine, adj. f.	full.
Plainte, nf.	complaint.
Plinthe, nf.	plinth (arch.).
Plan, adj.	even, plain, level, flat.
Plan, nm.	plan, plane, draught, design, model, scheme, project, ground, perspective.
Plant, nm.	plant, young plant, sapling; plantation.

French Words.	Meaning in English.
Plane, *adj.*	*even, plane, level, flat.*
Plane, *nm.*	*plane-tree, platane.*
Plane, *nf.*	*drawing-knife; spoke-shave.*
Plat, *adj.*	*flat.*
Plat, *nm.*	*dish; mess (of sailors; the flat side of anything; sheet (of glass).*
Pli, *nm.*	*fold, crease.*
Plie, *nf.*	*plaice.*
Plié, *pp.*	*folded.*
Plié, *nm.*	*bend (of the knee in dancing).*
Plier, *v.*	*to fold.*
Plu, *pp.*	*pleased.*
Plu, *pp.*	*rained.*
Plus, *adv.*	*more.*
Plumer, *v.*	*to pluck; to plume; to fleece.*
Plumet, *nm.*	*plume of feathers; plume.*
Poêle, *nm.*	*pall; canopy (at catholic marriages); stove.*
Poêle, *nf.*	*frying-pan.*
Poil, *nm.*	*hair.*
Poids, *nm.*	*weight.*
Pois, *nm.*	*pen; pea.*
Poix, *nf.*	*shoemaker's wax.*
Poing, *nm.*	*fist.*
Point, *nm.*	*point; dot; full stop; speck; break of day; stitch; moment; difficulty.*
Point, *adv.*	*no, not, none.*
Poison, *nm.*	*poison.*
Poisson, *nm.*	*fish.*
Poli, *adj.*	*polite, civil, polished.*
Poli, *nm.*	*polish.*
Pompe, *nf.*	*pomp, splendour*
Pompe, *nf.*	*pump.*
Porc, *nm.*	*pork, porker, hog, pig.*
Pore, *nm.*	*pore.*
Port, *nm.*	*seaport, haven, harbour.*
Port, *nm.*	*postage, carriage; aspect, presence; gait, attitude;* (nav.) *burden; compass (of the voice).*
Pou, *nm.*	*louse.*
Pouls, *nm.*	*pulse.*
Pout-de-soie, *also* Pou-de-soie, *nm.*	*paduasoy (silk).*
Pouce, *nm.*	*thumb; inch.*
Pousse, *nf.*	*shoot, sprout; heaves.*
Puce, *nf.*	*flea.*
Prémices, *nf. pl.*	*first-fruits.*
Prémisses, *nf. pl.*	(log.) *premises.*
Près, *prep.*	*near.*
Prés, *nm. pl.*	*meadows, grass-fields.*
Prêt, *adj.*	*ready.*
Prêt, *nm.*	*loan.*
Préteur, *nm.*	*pretor* (antiq.).
Prêteur, *nm.*	*lender.*
Prix, *nm.*	*price.*
Prix, *nm.*	*prize.*
Prise, *nf.*	*taking, capturing; capture, prize; hold, purchase;* (plur.) *struggle*
Prise, *nf.*	(med.) *dose; pinch (of snuff).*
Puis, *adv.*	*then, next, after, afterwards.*
Puits, *nm.*	*well.*
Puisant, *pp.*	*drawing; deriving.*
Puissant, *adj.*	*powerful.*
Pyrique, *adj.*	*pyrotechnic.*
Pyrrhique, *nm.*	*Pyrrhic* (poet.).
Pyrrhique, *adj.*	*Pyrrhic.*
Pyrrhique, *nf.*	*Pyrrhic* (milit. dance).
Q.	
Quand, *adv.*	see Camp.
Quant à, *conj.*	see Camp.
Quart, *n., adj.*	see Car.
Quarte, *n., adj.*	see Carte.
Quartier, *n.*	see Cartier.
Quoi, *pron.*	see Coi.
Quoique, *conj.*	*although, though.*
Quoi que,	*whatever thing.*
R.	
Raie, *nf.*	*line; stroke, streak, stripe; parting (of hair).*
Raie, *nf.*	(icht.) *skate.*
Rais, *nm.*	*spoke (of a wheel);* (ant.) *beam, ray of light;* (her.) *beam.*
Rets, *nm.*	*snare, net, netting.*
Rainette, *nf.*	*tree-frog.*
Rainette, or Reinette, *nf.*	*pippin* (apple).
Raiponce, *nf.*	(bot.) *rampion, rampion bell-flower.*
Réponse, *nf.*	*answer, reply, response*
Raisonner, *v.*	*to reason.*
Résonner, *v.*	*to resound.*
Resonner, *v.*	*to ring a bell again.*
Rame, *nf.*	*stick, prop (for peas).*
Rame, *nf.*	*oar.*
Rame, *nf.*	*ream (of paper).*
Ras, *adj.*	*close-shaved; shorn; short-haired.*
Ras, *nm.*	*short-nap cloth;* ras de carène, *shipwright's floating stage;* ras de marée, *race, bore.*
Rat, *nm.*	*rat.*
Rate, *nf.*	(anat.) *milt, spleen.*
Rate, *nf.*	*she-rat.*
Rauque, *adj.*	*hoarse.*
Roc, *nm.*	*rock.*
Reconnaissance, *nf.*	*recognition, acknowledgment.*
Reconnaissance, *nf.*	*reconnoitring party, reconnoitring, reconnoissance.*
Reconnaissance, *nf.*	*pawn-ticket.*
Reformer, *v.*	*to form again.*
Réformer, *v.*	*to improve, to mend, to reform.*
Régal, *nm.*	*feast, entertainment, treat.*
Régale, *nm.*	*organ-stop; organ-pipe.*
Régale, *nf.*	*the king's right to receive the revenue of a vacant bishopric.*
Régale, *adj.*	eau régale, *aqua regis.*
Réglement, *nm.*	*regulation, bye-laws, laws.*
Réglément, *adv.*	*regularly.*
Rein, *nm.*	*kidney.*
Rien, *nm.*	*nothing.*
Reine, *nf.*	*queen.*
Rêne, *nf.*	*bridle, rein.*
Renne, *nm.*	*rein-deer.*
Remoudre, *v.*	*to grind again (corn, barley, etc.).*
Rémoudre, *v.*	*to grind again (knives, scissors, etc.).*
Repaire, *nm.*	*den; haunt (of wild beasts);* (hunt.) *dung (of hares, wolves, etc.).*
Repère, *nm.*	*bench-mark; datum.*
Repartir, *v.*	*to reply, to answer, to retort.*
Repartir, *v.*	*to set out again.*
Répartir, *v.*	*to divide, to distribute, according to a certain prorata.*
Reprouver, *v.*	*to prove again.*
Réprouver, *v.*	*to reprobate, to disapprove.*
Ressort, *nm.*	*spring; elasticity.*
Ressort, *nm.*	*extent of the jurisdiction of a court of justice.*
Ris, *nm.*	*laugh, laughter; smile.*
Ris, *nm.*	*sweet-bread (of the calf).*
Ris, *nm.*	*reef (of sails).*
Riz, *nm.*	*rice.*
Romain, *nm., adj.*	*Roman.*
Roman, *nm.*	*novel, romance.*
Roman, *adj.*	*Romance* (languages); *Romanish; Romanic.*
Romance, *nf.*	*ballad.*
Rond, *adj.*	*round.*
Rond, *nm.*	*a circle.*
Ronde, *adj. f.*	*round.*
Ronde, *nf.*	*patrol; table song, roundelay;* (mus.) *semibreve; round-hand* (writing).
Rose, *nf.*	*rose.*
Rosse, *nf.*	*jade, sorry horse.*
Rosse, *nf.*	(icht.) *roach.*
Roue, *nf.*	*wheel.*
Roux, *adj.*	*red-haired; reddish.*
Roux, *nm.*	*russet; reddish colour;* (cook.) *brown butter sauce.*
Roué, *nm.*	*roué, rake, profligate.*
Rouet, *nm.*	*spinning-wheel.*
Ru, *nm.*	*channel (of a small stream).*
Rue, *nf.*	(bot.) *rue.*
Rue, *nf.*	*street.*
Ruse, *nf.*	*ruse.*
Russe, *n., adj.*	*Russian.*
S.	
Sa, *adj.*	see Ça.
Sas, *nm.*	see Ça.
Sain, *adj.*	see Ceint.
Saine, *adj.*	see Cène.
Sale, *adj.*	*dirty.*
Salle, *nf.*	*large hall.*
Saleur, *nm.*	*salter, curer.*
Saloir, *nm.*	*salting-tub; salt-box.*
Sang, *nm.*	see Cent.
Sans, *prep.*	see Cent.
Satire, *nf.*	*satire, lampoon.*
Satyre, *nm.*	*(Greek poet.) satyre.*
Saule, *nm.*	*willow; weeping willow.*
Sol, *nm.*	*formerly used instead of* sou, *which see.*
Sol, *nm.*	*ground, piece of territory; soil.*
Sol, *nm.*	(mus.) *fifth note of the gamut, sol, G.*
Sole, *nf.*	(icht.) *sole; sole (of animals' feet);* (agri.) *break.*
Saur, *adj.*	*(of herrings) red; (of horses) sorrel; yellowish brown.*
Sort, *nm.*	*fate.*
Saut, *nm.*	*leap, jump.*
Sceau, *nm.*	*seal, impression of a seal.*
Seau, *nm.*	*pail, bucket.*
Sot, *nm.*	*fool, simpleton.*
Scène, *nf.*	see Cène.
Schah, *nm.*	see Chat.
Scie, *nf.*	see Ci.
Scythe, *nm.*	*Scythian.*
Site, *nm.*	*site.*
Se, *pron.*	see Ce.
Séant,	see Céans.
Sèche, *adj.*	*dry, barren.*
Sèche, or Seiche, *nf.*	*cuttle-fish.*
Sein, *nm.*	see Ceint.
Seine, *nf.*	see Cène.
Seing, *nm.*	see Ceint.
Sel, *nm.*	see Celle.
Selle, *nf.*	see Celle.
Sellier, *nm.*	see Cellier.
Sensé, *adj.*	see Censé.
Sensible, *adj.*	see Censé.
Serein, *adj.*	*serene, placid.*
Serein, *nm.*	*night dew, evening damp.*
Serin, *nm.*	*canary-bird.*
Serf, *nm.*	see Cerf.
Serment, *nm.*	*oath.*
Serrement, *nm.*	*squeeze, squeezing, clasping.*
Serrément, *adv.*	*niggardly.*
Serre, *nf.*	see Cerf.
Session, *nf.*	see Cession.
Si, *conj.*	see Ci.
Signe, *nm.*	see Cygne.
Sinistre, *adj.*	*sinister, inauspicious.*
Sinistre, *nm.*	*accident, disaster; fire, conflagration.*

LESSONS IN ETHNOLOGY.—IV.

ASIATIC PORTION OF THE ARYAN RACE.

THE leading tribes comprehended under this section of the great Aryan race are the Brahmans and the Iranians or Persians. Both of these have had their early history wonderfully cleared up of late, by investigations into the Vedas, or oldest of the Brahmanic sacred writings, and into the Zendavesta, or Parsee scriptures. In connection with the Vedic inquiries, the name of Professor Max Müller of Oxford deserves most honourable mention; whilst a small and unpretending volume, published at Bombay in 1862, by Dr. Martin Haug, of the Sanscrit College at Poona, and entitled "Essays on the Sacred Language, Writings, and Religion of the Parsees," has quite revolutionised our ideas of early Persian history.

The old Aryan tribe from which sprang the ancestors of the leading European nations, as well as those of the Brahmans and Parsees, seems to have had its place somewhere north of the Hindoo Koosh range of mountains, in the region which used to be called in maps of Asia "Independent Tartary," but which is now more accurately termed "Independent Turkestan." When those Aryans who were destined ultimately to people Europe left their primitive abode in Central Asia, the rest of the tribe lingered for some time in the old settlement; and when at length they did move, they journeyed not westward but southward, went through or around, first, the Hindoo Koosh, and next the stupendous Himalaya Mountains; and ended by leading a wandering shepherd life in the Punjaub. At that time their worship was a simple one, being, in the main, the adoration of the elements in Nature. They found the north of India, as is believed, inhabited by Turanians, against whom, however, they managed to hold their own. The date of their immigration into India was a very remote one, being possibly as far back as 1700 B.C. After many years, a portion of the shepherds becoming tired of the pastoral life, began to cultivate patches of land, and probably became what we should now call wealthier than the rest of the tribe. The shepherds felt no scruple in helping themselves to a share of the farm produce, raised and stored up through the industry of their agricultural brethren; and a quarrel, which deepened into a feud between the two, was the result. The agriculturists ultimately left the Punjaub in disgust, and returned to the region beyond the Hindoo Koosh, where for a long period they resided in Bactria, a province of which the capital in subsequent times was at the place now called Balkh. The oddest thing about this political separation was the religious schism which accompanied it. The agriculturists who had hitherto been of the same faith as the shepherds, took up the notion that the gods they had been accustomed to worship, or some of them at least, instead of protecting them, had helped their plundering co-religionists; and they cast off allegiance to the spiritual authority which had been exercised so unfairly. They considered those beings demons instead of gods, while the other party, of course, continued to pay them divine honours. The shepherds of the Punjaub became the Brahmans of India, while the agriculturists who had emigrated to Central Asia were the progenitors of the old Persians. The gulf between the two factions widened with the lapse of years. The Brahmans, influenced seemingly by the Turanians, among whom they had settled, fell into idolatry, while the Iranians in Bactria abstained from this form of superstition; and, finally, about the time perhaps of Moses, 1500 B.C., there arose in the Bactrian settlement a very remarkable man—Zarathustra Spitama by name, the same whom the Greeks call Zoroaster—who remodelled and fixed the faith of his people, preached the doctrines embodied in the older parts of the Zendavesta, and made the Parsee religion very much what it is to-day. He believed in the unity of God. In accounting for the prevalence of evil in the world, he assumed the existence of two principles—one good, and the other bad, ultimately elevated by his followers into two great supernatural beings in perpetual antagonism. The old elemental worship still remains in the adoration of the sun and fire. Cyrus, Darius Hystaspes, and Xerxes were of the Parsee race and faith. Yet more interesting, some of the most enterprising natives of Bombay are Parsees. Sir Jamsetjee Jeejheebhoy was one. Some may be seen in the streets of London, having come here to establish mercantile houses. It is the Parsees whom Moore makes his heroes in the well-known poem, "Lalla Rookh." In Fig. 4 an excellent representation is afforded of the physical appearance presented by this interesting race. The evidence of language shows the Affghans (who speak the Pushtoo tongue), the Koords, the Ossetians of the Caucasus, and the Armenians to belong to the Iranian race.

Fig. 4.—PARSEE LADY.

We must now follow the fortunes of the Punjaub shepherds. They became, as already mentioned, the Indian Brahmans. Time was when it was supposed that all the Hindoos belonged to a single family of mankind, and that the Brahmanic one; but this notion has been quite abandoned during recent years. The languages of Southern India—as we shall afterwards have occasion more particularly to remark—though modified by Sanscrit, the Brahmanic language, are still essentially distinct from it, and are, in fact, Turanian. Even the tongues spoken in Central and Northern India, which were once regarded as offshoots of Sanscrit, are now held to be of a Turanian origin, though changed by a great infusion of Sanscrit words. All that is known of early Indian history goes to confirm the conclusions to which an examination of the languages naturally leads. Though, as before mentioned, the Brahmans entered India at a remote period of antiquity, yet for a long time they never passed beyond the Punjaub, and centuries elapsed before they reached the Vindhyan mountains in the middle of India. Either that elevated range, or the Nerbudda river just south of it, for a long time constituted their southern boundary; so much so that Hindostan, which etymologically means "the place of the Hindoos," properly signifies not the whole of India, but only that portion of it which is north of the Nerbudda.

Fig. 5.—BEDOUIN OF SINAI.

The Indian Brahmans are, as a rule, fairer than the Turanian inhabitants of India, though there are dark individuals amongst them too. Having for 3,000 years been the pre-eminently-educated Hindoo caste, intellect has become so nearly universal among them, that the Brahman boys are the best scholars in every Indian school. The Brahmanic religion is now totally different from what it was at first, having largely borrowed from the Turanian faith, which it has failed to displace. Booddhism is of Indian origin, though it is now all but extinct in that country; its great seat being China. Thus of the leading religions now in the world, Brahmanism, Zoroastrianism, and Booddhism originated with the Aryans.

THE SYRO-ARABIAN RACE.

As before mentioned, instead of the appellation Syro-Arabian, some use the term Shemitic, or Semitic, in speaking of this family of mankind. Its exact limits have not yet been settled beyond dispute. Using language as our guide, and omitting for the present tongues doubtfully Semitic, the forms of speech now under consideration fall naturally under three divisions—the Northern, or Aramaic; the Middle, or Hebraic; and the Southern, or Arabic.

Much light has been thrown on the first-mentioned of these divisions, the North Semitic one, by the examination of the cuneiform inscriptions found in the territories successively ruled by the old Asiatic empires. Cuneiform means *wedge-shaped*, the first part of the word being derived from the Latin *cuneus*, a wedge. The characters called *cuneiform* are also often described as arrow-headed. London readers, at least, will at once recognise them as those singular lines, thick at one end, covering men, lions, bulls, etc., in the Ninevite sculptures in the British Museum, and the copies of them at the Crystal Palace. It required a great deal of ingenuity and perseverance before the arrow-headed writing was deciphered, and when the feat was at least, to a certain limited extent, accomplished, it was found that the Persian writing on the rock of Behistun, at Persepolis, and other places ruled by the Zoroastrians, was, as might have been anticipated, in a language allied to Zend; that of Nineveh, and Babylon, on the contrary, is held to be in the main Semitic. The other ancient dialects belonging to this division of tongues are the Chaldee and the Syriac; the former spoken of old in the eastern, and the latter in the western part of the Aramæan area. The term *Chaldee* is not a good one, for it is supposed that the Chaldees of Scripture were Aryans. The so-called Chaldee and Syriac are believed to be so closely allied, that some deny their separate existence as dialects. The Jews, in a measure, lost their Hebrew, and acquired East Aramæan during their residence in Babylon; and parts of the books of Ezra and Daniel are written in it. Words and phrases belonging to it occur in various parts of our English version of the Bible, as in Gen. xxxi. 47; Mark v. 41; vii. 34; xv. 34. In the first of these passages, Jegar-sahadutha is Aramæan, and Galeed is Hebrew. Both signify "the heap of witness;" or, more accurately, the Aramæan phrase means the "heap of witness," and the Hebrew equivalent, the "witness-heap." One finding the two so different would naturally suppose that Hebrew and Aramæan had no close affinity, but the inference would be erroneous. The words in the passage in Genesis happen to be exceptionally unlike; the comparison of a multitude of others would conduct to a conclusion just the opposite of that suggested by this single case. The Arabic has long extinguished the Aramæan or Syriac itself, but it still lingers among the Nestorians of the Upper Tigris near Lakes Ooroomiah and Van.

The second division of the Syro-Arabian race is that speaking the Hebraic branch of the Semitic tongues. With the very limited space at our command, we can do no more than mention the Jews, in some respects the most interesting of all nations; but, happily, their history is so well known that it is unnecessary to enter on it here. Latham thus describes the physical characteristics which distinguish the Jews from the Arabs, to whom they are closely allied:—"Physical conformation, differing from that of the Arab in (*a*) greater massiveness of frame; (*b*) thicker lips; (*c*) nose more frequently aquiline; (*d*) cranium (skull) of greater capacity."

Samaritan is a mixture of Hebrew and Aramæan. The evidence of language proves the remarkably interesting fact that the Phœnician tongue, the one spoken first in Tyre and Sidon, and subsequently in Carthage, in connection with which it obtained the name of Punic, was almost identical with Hebrew. A recent writer, Farrar, thus neatly sums up the evidence on the subject in his "Families of Speech," a work well worth the reader's attention:—"We know that Carthage itself means in Hebrew, 'Newtown;' that Byrsa, its citadel, is the Hebrew *bozra* (a fortress); that *bal* in such names as Hasdrubal and Hannibal is simply *Baal;* that Barca, the family name of Hannibal, is the same as *barak* (lightning); that *suffetes*, which Livy tells us was the name of the Carthaginian magistrates, is the Hebrew *shophetim*, or 'judges;' that Lilybæum, the name they gave to the western angle of Sicily, means 'towards Libya'—*li* being simply the Hebrew preposition. Finally, not to dwell on other proofs, Plautus wrote a play called 'Pœnulus' (the little Carthaginian); and in that play a Punic scene is introduced, which, so far as it has been yet deciphered, is most distinctly Hebraic in its character. St. Augustine, who was himself a Carthaginian, says that Hebrew and Carthaginian differed but little."

The Arabic, or southern division of the Syro-Arabian race, is the last to which we shall turn our attention. The French Baron Larrey thought the Arabs, physically and mentally considered, the most perfect of mankind; maintaining that they had more convolutions in the brain, and a finer organisation of the physical parts ministering to intellect, than other people. This opinion has not been perfectly confirmed. Latham thus describes the physical characteristics of the Arab race:—"Face, oval; forehead, vaulted; nose, straight, or aquiline; lips, thin, even when thick, not projecting; hair, wavy, or curled; complexion, various shades of brown; limbs, spare." The Bedouins constitute but a limited part of the Arab race. A very large section of the Arabs live like other people in towns, of which there are many in the Arabian peninsula itself. The Arabs are formidable in war, especially when they fight from behind stone walls. It was among them, as is well known, that the Mohammedan faith arose. During the brief period that they gave their attention to science, they achieved some intellectual reputation, and have left their memorial behind them in such words as *zenith*, *nadir*, or the star *Aldebaran*. Fig. 5 affords a characteristic representation of a Bedouin of Sinai.

The Arabic division of the Semitic tongues is again separated into two—the Northern, or proper Arabic; and the Southern, or Himyaritic. With the last is conjoined at least one, and probably two, of the Abyssinian tongues. The old Gheez, now extinct, was Semitic; so was the language of Tigré. The modern Amharic, that of Theodore's court, is more mixed. Apparently the old Himyaritic Arabs must have overflowed into Abyssinia.

It is believed that the Berber or Amazirgh language, that spread here and there through the Barbary States, is also Semitic.

The Coptic language was once ranked as undoubtedly Semitic, but further researches into the subject have thrown considerable doubt on the correctness of this classification. We shall return to the subject of the Abyssinian, the Egyptian, and the Berber tongues in a subsequent paper.

Throughout a great portion of the world's history the relations between the Aryans and the Syro-Arabians have been the reverse of friendly. Of the great empires of antiquity, the Assyrian and the Babylonian monarchies were Semitic. When Cyrus took Babylon, the sceptre of the world passed into Aryan hands, which have retained it ever since. The death-struggle between the Romans and the Carthaginians was a contest between the Aryans and the Syro-Arabians; so also was the decisive battle at Poictiers between Charles Martel and the Arab Moslem Abderrahman. The Aryans are now much more numerous than the Syro-Arabians, if, indeed, they have not been so from the earliest times, so that the issue of any future struggle of the same nature cannot be doubtful.

The faith now professed by the most civilised nations of the world came to them by means of the Jews, a Semitic race. In the same Syro-Arabian family of mankind arose Mohammedanism, which is a development in some respects of Judaism, in others of Christianity. Thus the Syro-Arabians have played a great part in the drama of human history. If they have, as a rule, failed in achieving empire by the sword, they have become the religious teachers of the leading nations in the world, thus gaining a great moral triumph with which the victories of the soldier are not for a moment to be compared.

LESSONS IN GREEK.—XLIX.

FORMATION OF WORDS (*continued*).

Patronymics, or nouns denoting descent from a father (πατηρ), that is, an ancestor, are formed mostly by the suffix δης for the masculine, and merely ς for the feminine. This suffix is added immediately to the stem in α; as—

MASCULINE.	FEMININE.	NOMINATIVE.
βορεαδης,	βορεᾶς,	βορεᾶς, *the north wind.*
Αινειαδης,		Αινειάς, *Æneas.*

To consonantal stems the suffix is appended by means of the vowel ι; as, Κεκροπίδης (masc.), Κεκροπις (fem.), from Κεκροψ, *Cecrops.*

Stems in ευ and ο of the third declension also take the connecting vowel ι, before which the υ or ευ disappears :—

Πηλειδης, from Πηλευς. Λητοιδης, from Λητω.

The ο of the second declension is replaced by ι; as—

MASCULINE.	FEMININE.	NOMINATIVE.
Ταυταλιδης,	Ταυταλις, from original,	Ταυταλος.
Κρονιδης,	„ „	Κρονος.

Only ιο (nom. ιος) is changed into ια; as—

MASCULINE.	FEMININE.	NOMINATIVE.
Θεστιαδης,	Θεστιας, from original,	Θεστιος.
Μενοιτιαδης,	„ „	Μενοιτιος.

A less frequent suffix for patronymics is ιων; as Κρονιων, son of Κρονος.

Gentilia, or nouns denoting the *gens* or race, the country or the tribe, whence a person is sprung, have the suffixes—

1. ευ (nom. ευς); as Μεγαρευς, from the noun-stem Μεγαρο, nom. τα Μεγαρα, *Megara;* Ερετριευς, from the noun-stem Ερετριο, nom. Ερετρια. Feminine *gentilia* end in δ (nom. ς); as Μεγαριδ, nom. Μεγαρις, *a woman of Megara;* Σικελιωτιδ, nom. Σικελιῶτις, *a woman of Sicily.*
2. τα (nom. της); as Τεγεατης (Τεγεα), Αιγινητης (Αιγινη), Ηπειρωτης (Ηπειρος), Σικελιωτης (Σικελια).

The most important suffixes for the formation of adjectives are these :—

1. ιο (nom. ιος) expresses in the most general way the idea involved in the noun from which the adjective comes; as ουρανιος, *heavenly* (from the noun ουρανος, *heaven*). By appending ιο you also form adjectives from adjectives as stems, as ελευθεριος, *liberal*, from ελευθερ (ελευθερος, *free*); also gentile adjectives from names of places—thus, from Μιλητος comes Μιλησιος, and from Αθηναι comes Αθηναιος.
2. κο (nom. κος), which is generally appended to the stem by means of ι, and in words derived from verbal stems signifies fitness; as from αρχ (αρχω) comes αρχικος, *fit for governing.* From nouns as stems are formed adjectives which denote the peculiar quality of the noun; as βασιλικος, *kingly* (βασιλευς, *a king*).
3. ινος, 4. εος, ους, indicate the stuff or substance of which a thing is made; as λιθινος, *stony*, from λιθος, *a stone;* χρυσεος, χρυσους, *golden*, from χρυσος, *gold.*
5. εις (fem. εσσα, neut. εν) denotes fulness; as χαριεις, *full of grace or beauty* (from χαρις, *grace, beauty*); ὑληεις, *full of wood* (from ὑλη, *a wood or forest*).

VERBS.

Verbs are in various ways formed from nouns as stems. In the ensuing list the verbs are arranged according to their terminations, as they appear in the present tense :—

1. οω; as μισθοω, *I hire* (from μισθος, *wages, reward*); χρυσοω, *I gild* (χρυσος, *gold*).
2. αω; as τιμαω, *I honour* (τιμη, *honour*); αιτιαομαι, *I accuse* (αιτια, *cause, blame*).
3. εω; as αριθμεω, *I number* (αριθμος, *number*); ευτυχεω, *I am fortunate* (ευτυχης, *fortunate*).
4. ευω; as βασιλευω, *I am a king* (βασιλευς, *a king*); βουλευω, *I counsel* (βουλη, *counsel*).
5. ιζω; as ελπιζω, *I hope* (ελπις, *hope*); Ἑλληνιζω, *I speak Greek* (Ἑλλην, *a Greek*).
6. αζω; as δικαζω, *I judge* (δικη, *justice*); εργαζομαι, *I labour* (εργον, *labour*).
7. αινω; as σημαινω, *I signify* (σημα, *a sign*); λευκαινω, *I whiten* (λευκος, *white*).
8. υνω; as ἡδυνω, *I sweeten* (ἡδυς, *sweet*); λαμπρυνω, *I adorn* (λαμπρος, *brilliant*).

From the same noun as a stem may be derived several verbs, having different terminations and different meanings; thus, δουλο-, δουλος, *a slave;* δουλοω, *I enslave;* δουλευω, *I am a slave;* πολεμυ-, πολεμος, *war;* πολεμεω and πολεμιζω, *I carry on war;* πολεμοω, *to set in hostilities.*

Verbs may also be formed from verbs. There are three classes of verbs which set forth the idea conveyed by the primitive verb under certain modifications; these are called *frequentative, inchoative,* and *desiderative.* The frequentative are those verbs which denote a repetition of the act; the inchoative those which denote the commencement of the act; and the desiderative are those which express a desire towards that which the primitive declares.

1. *Frequentatives.*—Frequentatives are formed partly from the unchanged stem by means of the terminations αζω, ιζω, υζω, partly by the conversion of the stem-vowel into ο with the termination εω, or by the lengthening of ο into ω, the termination αω being added: for example, στεναζω, *I groan frequently* (from στενειν, *to groan*); αιτιζω, *I ask often, I beg* (from αιτεῖν, *to ask*).

2. *Inchoatives.*—Inchoatives are formed by the addition of the termination σκω; as, μεθυσκω, *I am addicted to drunkenness* (from μεθυειν, *to use strong drink*); ἡβασκω, *I become an adult* (from ἡβαν, *to be an adult*).

3. *Desideratives.*—Desideratives are generally formed from the first future of the primitive verb by the addition of the termination of ειω; as, γελασειω, *I desire to laugh* (from γελαν, *to laugh*); πολεμησειω, *I wish to be in war* (from πολεμειν, *to make war*). Desideratives are formed also from verbal substantives by means of the terminations ιαω and αω; as, κλαυσιαω, *I wish to weep* (from κλαυσις, *weeping*); στρατηγιαω, *I wish to be a general* (from στρατηγος, *a general*); θαναταω, *I desire death* (from θανατος, *death*).

COMBINATION.

Besides primitive and derivative words, the Greek language has compound words. Compound words are such as are made up of two words or more, and are designed to express complex ideas. To the multitude of compounds which the Greek possesses that language at once owes its richness and its exactitude, so that by means of a compound possessing two or three components it expresses that for the full utterance of which several words would be required in English: for example, ὑπεκφευγω (ὑπο, *from*, εκ, *out of*, and φευγω, *I flee*) signifies *I flee home out of a place away from some one;* and προκαταλαμβανω (προ, *before*, κατα, *down*, and λαμβανω, *I take*) signifies *I take something before some one else.* The subject is very pregnant, and here can be only looked at superficially.

A noun which in combination takes the first place appears in its stem-form; as—

αστυ-γειτων,	χορο-διδασκαλος,	σακεσ-παλος,
city-neighbour,	*choir-teacher,*	*shield-maker,*
neighbouring city,	*teacher of dancing,*	*warrior,*

where αστυ, χορο (χορος), and σακες (σακος, *a shield*) are in the stem-form.

Consonantal stems are in general united with the second compound by the connecting vowel ο; as, ανδριαντ-ο-ποιος, *image-maker;* πατροκτονος, *father-slayer.*

This connecting ο is found, also, after short vowels; as φυσιολογος, *nature-investigator;* ιχθυοφαγος, *fish-eater;* and is the regular representative of an α in the stem, as ἡμεροδρομος, *day-runner;* χωρογραφος, *place-describer*, where the first components are ἡμερα, *a day*, and χωρα, *a place* or *country.*

The ο disappears before a vowel; as, χορ(ο)ηγος, *a choir-leader;* πατραδελφος, *father's brother.* Yet it remains in words which originally began with the aspirate which is called the digamma, equivalent to our *v*, as εαρ (in Latin *ver*), *spring;* also in εικοσι (Doric Fικοτι, Latin *viginti*), thus, δημιοεργος (Homeric), δημιουργος (Attic), *hand-worker.*

The termination of a word is often in combination somewhat changed, especially if the compound is an adjective; thus τιμη becomes τιμος, and πραγμα, πραγμων: for example, φιλο-τιμος, *honour-loving;* πολυ-πραγμων, *much-doing* (*a busy-body*).

The termination ης (masculine and feminine) and the termination ες (neuter) deserve attention: they are appended—

(1) To many adjectives formed immediately from verbal stems; as, αβλαβης, *uninjured*; αυταρκης, *self-sufficient.*

(2) To adjectives whose second component has arisen from a substantive in ες (nominative ος); as, δεκαετης, *ten-year-old*; κακοηθης, *bad-mannered.*

Without changing its nature a verb cannot be combined with any word except a preposition. If another word is united with a verbal stem, the two unite to form a noun; thus, out of λιθος, *a stone*, and βαλλω, *I throw*, is formed λιθοβολος, *a stone-thrower.* Hence a verb may be formed, as λιθοβολεω, *I throw stones.* So from ναυς and μαχομαι we have ναυμαχος, *a sea-fighter*, and thence ναυμαχεω, *I fight by sea*; also from ευ and εργ come ευεργετης, *a benefactor*, and ευεργετεω, *I act as a benefactor.*

A substantive with an abstract signification may unite with a preposition only by retaining its own termination; thus βουλη, *a determination*, becomes προβουλη, *a pre-ordination*; in every other combination an abstract noun must assume a derivation-ending; thus λιθος and βολη (βαλλω) give rise to λιθοβολια, *stone-throwing*; ναυς and μαχη give rise to ναυμαχια, *a sea-fight*; and ευ and πραξις give rise to ευπραξια, *a good condition* (*well-being, weal*).

In regard to signification, compounds may be divided into three classes, *determinatives*, *attributives*, and *objectives.* The determinatives are those compounds in which the secondary component determines the exact meaning of the primary, and in these the second word is the primary or chief word. These compounds are the least numerous; as ὁμοδουλος, *a fellow-slave*; ακροπολις, *the lofty city* (acropolis).

Attributive Compounds.

The attributives are those in which also the second word is determined by the first, but the idea formed by the two is *attributed* as a quality to another word; thus ὁμοτροπος signifies not *the same kind* (τροπος), but *being of the same kind, having the same disposition*; and μακροχειρ is not *a long hand*, but *having a long hand* or *being long-handed.*

Objective Compounds.

The objectives are those in which one element is governed by the other, the latter being *the object* to the former; thus δεισιδαιμων, *superstitious, god-fearing*, where, as in *god-fearing*, δαιμων is governed by δεισι, and the word is equivalent to τους δαιμονας δεδιως, *fearing the divinities.* So ἡνιοχος, *rein-holding*, is the same as τα ἡνια εχων. In the same manner consider λογογραφος, *speech-writer* (historian or *fabulist*); αξιολογος, *worthy of record*; and χειροποιητος, *hand-made*—that is, *made by the hand*, χερσι ποιητος. Sometimes the first component is the object, sometimes the second. Especially common are compounds with the prefix αν (ανευ, Latin *sine*, without), which before consonants becomes α, and which, on account of its negative or privative force, is termed *alpha privative*; as, αγραφος, *unwritten*; αμητωρ, *motherless* (or in form more exactly, *unmotherly*).

The prefix ευ, *well*, and the prefix δυς, *hardly, with difficulty*, form many compounds: for example, ευτοκος, *easily-bearing*; δυσαρεστος, *displeased.*

VERBAL ADJECTIVES.

Verbal adjectives have two endings, one in τος, the other in τεος. Those in τος resemble in signification the Latin participle in *-tus*, as ποιητος (*factus*), that is, *made*; so γραπτος (*scriptus*), *written.* Many, and perhaps the greater number of them, more nearly approach the Latin adjectives in *-bilis*, as θαυμαστος (*mirabilis*), *admirable*; or they express a simple possibility, as ορατος, *visible, an object that may be seen*; ακουστος, *audible.*

Verbal adjectives in τεος have the same force as the Latin participles in *-dus*, and denote duty or necessity, as δοτεος (*dandus*), *must be given.* The adjectives in τεος, like the participle in *-dus*, has three genders, so as to agree with any noun that may be joined with it; they may also be used in the neuter in a general way, as signifying necessity; thus, ανηρ λυτεος εστιν (Lat. *vir solvendus est*), *the man must be set free*; τιμητεα στιν ἡ αρετη (Lat. *virtus honoranda est*), *virtue must be honoured*; γραπτεον εστιν (Lat. *scribendum est*), *it is necessary to write.*

Both these adjectives are formed from the verbal stem. An easy practical way to form them is to change the termination of the first aorist passive, θεις, into τος or τεος; as—

λυω,	λυθεις,	λυτος,	λυτεος.
τιμαω,	τιμηθεις,	τιμητος,	τιμητεος.

LESSONS IN LOGARITHMS.—IV.

TABLES OF LOGARITHMS.

THE following tables will be found very useful, not only to students who are endeavouring to make themselves acquainted with logarithms, but also to persons who are desirous of abridging calculations of any description, especially those connected with the mathematical and philosophical sciences. The first table, called *Table of Logarithms*, contains the *mantissæ of the logarithms* of all numbers from 1 to 10,000, according to the *common system*, of which the base is 10. The decimal part of a logarithm is called its *mantissa*, and the integral part is called its *index* or *characteristic.* Thus in the logarithms 0·477121, 1·041393, and 3·005609, the decimal parts ·477121, ·041393, and ·005609 are the mantissæ; and the integral parts, 0, 1, and 3, are the indices or characteristics.

The mantissæ of the logarithms in the first table extend only to four decimal places; but these are reckoned sufficient for ordinary purposes. If, however, a greater degree of accuracy be required than can be obtained from this table, recourse must be had to more extensive tables. Let us now proceed to explain our own tables contained in this and the following lesson.

In the first vertical column of the table are contained the first two figures of any given number, whose logarithm is required, within the range above mentioned. In the next ten vertical columns is contained the third figure of any such number; these ten columns are headed *Third Figure.* In the next nine vertical columns is contained the fourth figure of any such number; and these nine columns are headed *Fourth Figure.*

If the logarithm of a number be required which consists of one figure only, as of the *nine digits*, seek for that figure with a cipher annexed to it in the first column of the table; and when it is found, then you will find the mantissa of its logarithm in the same horizontal line in the adjoining column on the right, under the figure marked 0 at the top. To this mantissa prefix the index in the manner described in the preceding lessons, and you will have the required logarithm. Example: Required the logarithm of the number 4. Here, looking for 40 in the first column of the table, you find in the same horizontal line, in the adjoining column on the right, and under 0 at the top, the mantissa ·6021; to this mantissa prefix 0, which is the index for units, and you have 0·6021 for the logarithm of the number 4. If the logarithm of the number 40 were required, the mantissa would be the same, but the index would be 1 and the logarithm 1·6021. If the logarithm of 400 were required, the mantissa would still be the same; but the index would be 2, and the logarithm 2·6021; and so on.

If the logarithm of a number be required which consists of two figures only, as of all numbers between 10 and 99, seek for that number in the first column of the table; and when you have found it, the mantissa of its logarithm you will find in the same horizontal line in the adjoining column on the right, under the figure marked 0 at the top. To this mantissa prefix the index as before, and you will have the complete logarithm. Thus: Required the logarithm of the number 78. Here, looking for 78 in the first column of the table, you find in the same horizontal line, in the adjoining column on the right, and under 0 at the top, the mantissa ·8921; to this mantissa prefix 1, which is the index for tens, or for a number consisting of two integer figures, and you have 1·8921 for the logarithm of the number 78. If the logarithm of the number 7·8 were required, the mantissa would be the same, but the index would be 0, and the logarithm 0·8921. If the logarithm of the number ·78 were required, the mantissa would still be the same; but the index would be $\bar{1}$, and the logarithm $\bar{1}$·8921; and so on.

If the logarithm of a number be required which consists of three figures, as of all numbers between 100 and 999, seek for the first two figures of the number as in the preceding case, that is, in the first column of the table; and when these are found, you will then find the mantissa of its logarithm in the same horizontal line in one of the ten adjoining columns on the right, under the *third figure of the number* at the top. To this prefix the proper index, and you will have the logarithm required. Thus let the logarithm of 476 be required. Here, looking for 47 in the first column of the table, you find in one of the ten adjoining columns on the right, and under 6 at the top, the mantissa ·6776; to this prefix 2, which is the index for hundreds, or for a number consisting of three integer figures, and you have 2·6776 for the logarithm of the number 476. If the logarithms of the numbers 47·6, 4·76, ·476, or ·0476 were required, the operation for finding the mantissa of each would be the same, and they would be, on the principles now fully explained to our students, 1·6776, 0·6776, $\bar{1}$·6776, and $\bar{2}$·6776 respectively.

If the logarithm of a number be required which consists of four figures, as of all numbers between 1000 and 9999, seek for the mantissa corresponding to the first three figures, as in the preceding case, and in the same horizontal line in one of the nine columns, headed *Fourth Figure*, you will find, under the fourth figure at the top, a number which is *to be added* to the mantissa, in order to make it the complete mantissa required; to this prefix the index as before, and you will have the logarithm sought. For example, let it be required to find the logarithm of the number 5768. Here, looking for the mantissa of the first three figures, 576, as in the preceding case, you find ·7604; and in the same horizontal line with it, under the *fourth figure*, 8, you find the number 6, which is to be added to ·7604; this being done, you have ·7610 for the complete mantissa; prefixing the index 3, according to previous directions, you have 3·7610 for the complete logarithm required. If the logarithms of 57680, ·576·8, 5·768, or ·005768 were required, the operation for finding the mantissæ would still be the same; but the indices, according to the previous rules, would be different, the logarithms being respectively 4·7610, 2·7610, 0·7610, and $\bar{3}$·7610.

TABLE OF LOGARITHMS.

	THIRD FIGURE										FOURTH FIGURE.								
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4

LESSONS IN FRENCH.—XC.

§ 146.—FRENCH HOMONYMS AND PARONYMS (*continued*).

French Words.	Meaning in English.	French Words.	Meaning in English.
Sire, *nm.*	*see* Cire.	Souffler, *v.*	*to blow, to blow out; to breathe, to inflate, to prompt; to huff (at draughts).*
Six, *adj.*	*see* Ci.		
Soc, *nm.*	*plough-share.*		
Socque, *nm.*	*clog, galoche, patten.*	Soufflet, *nm.*	*bellows, pair of bellows; head of a carriage.*
Soi, *pron.*	*one's self.*		
Soie, *nf.*	*silk; hair (of dogs); bristle (of elephants, hogs, etc.); tongue (of knives, etc.).*	Soufflet, *nm.*	*box on the ear, slap in the face; affront, mortification, humiliation.*
Soit, *adv., conj.*	*be it so, let it be so; well and good, I grant it; either, or, whether.*	Strass, *nm.*	*strass, paste (of jewels).*
		Strasse, *nf.*	*floss-silk.*
		Succin, *nm.*	*yellow amber.*
Sommer, *v.*	*to summon, to call upon.*	Succinct, *adj.*	*succinct, concise, brief.*
Sommet, *nm.*	*top, apex, summit, pinnacle, acme.*	Sur, *adj.*	*sour, tart, sharp (to the taste).*
		Sûr, *adj.*	*sure, certain.*
Son, *adj.*	*his, her.*	Sur, *prep.*	*on, upon, over, above, in, about.*
Son, *nm.*	*bran.*		
Son, *nm.*	*sound, noise.*		
Sonner, *v.*	*to sound; to produce a sound; to ring a bell; to strike (of clocks); to toll.*	T.	
		Tache, *nf.*	*spot, stain, blot.*
		Tâche, *nf.*	*task, task-work; job.*
Sonnet, *nm.*	*sonnet.*		
		Tacher, *v.*	*to stain, to spot, to blot, to blemish.*
Sou, *nm.*	*French coin = about a half-penny.*	Tâcher, *v.*	*to try, to endeavour, to strive.*
Soûl, *or* Saoul, *adj.*	*glutted, surfeited; tipsy, drunk.*		
Soûl, *or* Saoul, *nm.*	*one's fill, one's belly-full.*	Taie, *nf.*	*pillow-case; (med.) film, speck.*
Sous, *prep.*	*under, beneath, in, with.*	Têt, *nm.*	*fragment of broken glass; (chem.) test (vessel); skull; shell (of shell-fishes).*
Sous, *nm.*	*plural of* sou, *which see.*		

*

French Words.	Meaning in English.
Taille, *nf.*	*cutting, cut, edge of a sword; pruning;* (surg.) *cystotome.*
Taille, *nf.*	*size, stature, waist, figure.*
Taille, *nf.*	*tally-stick;* (feudal law) *villain tax;* (at cards) *deal;* (mus.) *tenor.*
Ter, *adv.*	*third house of the same number.*
Terre, *nf.*	*earth; the earth; land, estate.*
Tain, *nm.*	*foil, tinfoil.*
Teint, *nm.*	*complexion.*
Thym, *nm.*	(bot.) *thyme.*
Tan, *nm.*	*tan; tanner's bark.*
Tant, *adv.*	*so much, so many.*
Taon, *nm.*	(ent.) *ox-fly.*
Temps, *nm.*	*time.*
Tante, *nf.*	*aunt.*
Tente, *nf.*	*tent, pavilion.*
Tard, *adv.*	*late.*
Tare, *nf.*	(com.) *tare, waste; defect, blemish; fault;* (vet.) *curb.*
Taré, *adj.*	(com.) *spoiled, damaged; of a bad character.*
Taux, *nm.*	*rate, price; assessment.*
Tôt, *adv.*	*soon.*
Tendre, *adj.*	*tender.*
Tendre, *v.*	*to stretch, to bend, to strain, to set; to tend.*
Ténu, *adj.*	*tenuous.*
Tenu, *pp.*	*held, kept, bound.*
Tenue, *nm.*	*session, holding* (*of assemblies*)*; attitude, dress, carriage, deportment, bearing, address* (*of persons*)*; appearance* (*of troops*).
Terme, *nm.*	*term, end, termination, time, word, expression.*
Terme, *nm.*	*quarter's rent, quarter-day.*
Thermes, *nm. pl.*	*thermal baths;* (antiq.) *thermæ.*
Thon, *nm.*	*tunny-fish.*
Ton, *adj.*	*thy.*
Ton, *nm.*	*tone, voice, accent, manner.*
Tic, *nm.*	*knack, habit;* (med.) *tic.*
Tique, *nf.*	(ent.) *tick.*
Tirant, *nm.*	*string* (*of purses*)*; boot-strap; cramp-iron; ship's draught; sea-gauge.*
Tyran, *nm.*	*tyrant.*
Tirer, *v.*	*to draw, to pull.*
Tiret, *nm.*	*dash, hyphen; slip of parchment.*
Toi, *pron.*	*thee, thou.*
Toit, *nm.*	*roof.*
Tore, *nm.*	(arch.) *torus, tore.*
Tort, *nm.*	*wrong, injury, harm.*
Tournoi, *nm.*	*tournament.*
Tournois, *adj.*	*of Tours;* livre tournois, *one-franc piece coined at Tours.*
Toue, *nf.*	*ferry-boat.*
Tout, *adj.*	*all, every, whole.*
Toux, *nf.*	*cough.*

French Words.	Meaning in English.
Trait, *nm.*	*arrow, dart, shaft, bolt, thunder-bolt; stroke, hit; trait; trace* (*of horses*)*; ray* (*of light*).
Trait, *nm.*	*leash* (*of dogs*)*; turn* (*of the scale*)*; gulp, draught; dash, stroke of the pen;* (paint.) *touch; kerf* (*of a saw*)*; feature* (*of the face*).
Traite, *nf.*	(com.) *bill of exchange, draft; stage, journey; trading; slave-trade.*
Traité, *nm.*	*treatise.*
Traité, *nm.*	*treaty.*
Tranchant, *adj.*	*sharp, cutting; peremptory, decisive.*
Tranchant, *nm.*	*edge* (*of cutting instruments*)*; web* (*of coulters*).
Tranche, *nf.*	*slice; steak; rasher; edge* (*of books*)*; period, set* (*of figures*).
Tranchée, *nf.*	*trench; drain; throes, pains; gripes, griping; cut, cutting, excavation.*
Trancher, *v.*	*to cut, to cut off; to decide, to settle.*
Tranchet, *nm.*	*shoemaker's knife; paring knife.*
Transparent, *adj.*	*transparent.*
Transparent, *nm.*	(paint.) *transparency; lines* (*for writing straight*).
Tribu, *nf.*	*tribe.*
Tribut, *nm.*	*tribute.*
Trop, *adv.*	*too much, too many.*
Trot, *nm.*	*trot* (*of horses*).
U.	
Un, *art., adj.*	*see* Hun.
Une, *art., adj.*	*see* Hune.
Ut, *nm.*	*see* Hutte.
V.	
Vain, *adj.*	*vain.*
Vin, *nm.*	*wine.*
Vingt, *adj.*	*twenty.*
Vaine, *adj.*	*vain.*
Veine, *nf.*	*vein;* (geol.) *seam; under-ground spring of water.*
Van, *nm.*	(agri.) *fan.*
Vent, *nm.*	*wind; gale; flatulence;* (hunt.) *scent; vanity, emptiness;* (artil.) *windage.*
Veau, *nm.*	*calf, veal.*
Vos, *adj.*	*your.*
Veille, *nf.*	*watching, watch; sitting up; eve; vigil; day before; point, verge.*
Veillée, *nf.*	*sitting up and working in company; night attendance upon the sick.*
Vieille, *adj., nf.*	*old; old woman.*
Vielle, *nf.*	*hurdy-gurdy.*
Vénéneux, *adj.*	*poisonous* (*of plants, minerals, etc.*).
Venimeux, *adj.*	*venomous* (*of animals*).

French Words.	Meaning in English.
Ver, *nm.*	*worm.*
Verre, *nm.*	*glass; drinking-glass.*
Vers, *nm.*	*plural of* Ver, *which see above.*
Vers, *nm.*	*line* (*of poetry*)*, verse.*
Vers, *prep.*	*towards, about, to.*
Vert, *adj.*	*green; sharp; harsh; tart* (*to the taste*)*; raw* (*of hides*)*; hale, vigorous, robust* (*of old age*).
Vert, *nm.*	*green, green colour; grass, green meat.*
Verdeur, *nf.*	*greenness, viridity; vigour, strength; sap; tartness* (*of wines*)*; acrimony.*
Verdure, *nf.*	*verdure, greenness; green; greens; pot-herbs.*
Versant, *adj.*	*liable to be overturned* (*of carriages*).
Versant, *nm.*	*declivity; slope, side* (*of mountains, etc.*).
Verseau, *nm.*	(astron.) *Aquarius.*
Verso, *nm.*	*back* (*of a page of a book*)*;* (print.) *reverse, even page.*
Verser, *v.*	*to pour; to pour out; to shed; to deposit* (*money*)*; to overturn, to upset* (*of carriages*)*; to be laid* (*of corn*).
Verset, *nm.*	*verse* (*of the Bible*).
Vice, *nm.*	*vice, fault, defect, blemish.*
Vice, *Latin prefix*	*vice;* vice-amiral, *vice-admiral.*
Vis, *nf.*	*screw.*

French Words.	Meaning in English.
Vil, *adj.*	*vile, base, mean, despicable, low, wretched, villainous.*
Ville, *nf.*	*town, city.*
Viol, *nm.*	*violation* (*of the person*)*, rape.*
Viole, *nf.*	(mus.) *tenor violin; viol.*
Violer, *v.*	*to violate; to break, to infringe, to transgress.*
Violet, *adj., nm.*	*violet-coloured; violet colour.*
Voie, *nf.*	*way, road, track, path;* (nav.) *leak; width between the wheels of carriages.*
Voix, *nf.*	*voice; vote, suffrage; singer.*
Voir, *v.*	*to see.*
Voire, *adv.*	*indeed, and, even.*
Vol, *nm.*	*flight, flying; soaring.*
Vol, *nm.*	*theft, robbery, robbing, larceny.*
Vole, *nf.*	*vole* (*at cards*).
Voler, *v.*	*to fly, to fly about; to fly, to fly at, to chase* (*of birds*).
Voler, *v.*	*to rob, to steal.*
Volet, *nm.*	*window-shutter; dove-cot; ledge* (*of pigeon-house*)*;* (bot.) *water-lily.*
Voleter, *v.*	*to flutter.*
Volter, *v.*	(fenc.) *to make a volt.*
Votre, *adj.*	*your.*
Votre, *pron.*	*yours.*

§ 147.—Anglo-French Homonyms and Paronyms.

(1.) Anglo-French Homonyms, as given in the following list, are words which, having the same spelling in English and in French, and the same or a different derivation, have different significations.

(2.) Anglo-French Paronyms, as given in the following list, are words which, having slightly different spellings in English and in French, and the same or a different derivation, have different or the same significations.

Note.—Only those Anglo-French homonyms have been given in the following list, which have entirely different significations, or only vary in the meaning of some of their acceptations.

English Words.	French Equivalents.	French Words.	English Equivalents.
Abatement,	*diminution; rabais, réduction.*	**Abattement,**	*faintness, prostration, despondency.*
to **Abuse,**	*dire des sottises à; injurier.*	**Abuser,**	*to deceive, to make ill-use; to misuse.*
Abuse, *n.*	*injures, invectives.*	**Abus,** *nm.*	*ill-use, misuse* (*of things*)*; grievance.*
Abusive,	*injurieux, insultant.*	**Abusif,**	*improper, against right.*
Academy,	*académie; pension, école.*	**Académie,**	*academy* (*society of learned men*)*; one of the divisions of the French university; riding-school;* (paint.) *academical figure.*
Ache, *n.*	*mal, douleur.*	**Ache,** *nm.*	*smallage, wild celery.*
to **Achieve,**	*accomplir, exécuter.*	**Achever,**	*to finish, to complete.*
Achievement.	*exploit, fait d'armes; œuvre, production.*	**Achèvement,**	*completion, finishing.*
to **Act,**	*agir; représenter; jouir; feindre.*	**Acte,** *nm.*	*act, deed, action.*
Actual,	*réel, effectif, véritable.*	**Actuel,**	*present.*

English Words.	French Equivalents.	French Words.	English Equivalents.
Actually,	réellement, effectivement, véritablement.	**Actuellement,**	now, at this moment.
Addresser, n.	pétitionnaire.	**Adresser,** v.	to direct, to address.
to Advise,	conseiller, donner avis de.	**Aviser,** v.	to apprise, to espy; to consider.
Agreement,	accord; rapport; convention; bonne intelligence; conformité.	**Agrément,**	approbation, consent; agreeableness, pleasingness; pleasure; gracefulness; amusement; (mus.) grace.
Altered,	changé.	**Altéré,**	thirsty.
Amends,	dédommagement, réparation.	**Amende,**	fine, penalty.
Ampliation,	ajournement d'un jugement criminel.	**Ampliation,**	duplicate, copy of orders, sentences passed by law courts, of title-deeds, etc.
Amuser, n.	amuseur.	**Amuser,** v.	to amuse.
Apprehender, n.	celui qui opère une arrestation; penseur.	**Appréhender,** v.	to arrest, to take into custody; to fear, to apprehend.
Arm, n.	bras.	**Arme,** nf.	weapon.
As, conj.	comme, que, car.	**As,** nm.	ace (cards, dice).
to Attend,	accompagner; écouter; servir, soigner; s'occuper de; faire attention.	**Attendre,**	to await; to wait for.
Attendant, n.	assistant; serviteur; compagnon; suivant; personne de la suite.	**Attendant,** pp.	waiting for; awaiting.
Attirer, n.	celui, celle qui habille, qui pare.	**Attirer,** v.	to attract.
to Avert,	détourner; éviter; éloigner.	**Avertir,** v.	to warn, to caution.
Axe,	hache.	**Axe,**	axis; axle, axle-tree; (artil.) trunnion.
Bachelor,	célibataire, garçon; bachelier.	**Bachelier,**	bachelor of a university, graduate.
Back,	dos.	**Bac,**	ferry-boat.
Bag,	sac.	**Bague,**	ring (for the finger).
Bail,	caution; cautionnement.	**Bail,**	lease.
Bailer or **Bailor,**	déposant.	**Bailleur,** **Bâilleur,**	lessor. yawner, gaper.
Balance,	équilibre; contrepoids.	**Balance,**	balance (scales), pair of scales; balance (of account); balance-sheet; (astron.) Libra.
Balancer, n.	peseur; celui qui balance.	**Balancer,** v.	to balance; to swing; to hesitate; to counterbalance; to square accounts.
Ballot,	boule; bulletin (scrutin).	**Ballot,**	bale, package.
Beck,	signe de la main, de la tête.	**Bec,**	beak; bill; nib; rostrum; gas-burner; snout; spout; socket.
Billet,	bûche; (her.) billette; billet; billet de logement.	**Billet,**	note, letter; bill, handbill; label; promissory note; billet (quartering of soldiers).
to Bless,	bénir.	**Blesser,**	to wound.
Bond,	lien, engagement; assemblage; obligation; bon; entrepôt.	**Bond,**	leap, bound, jump.
Bonnet,	chapeau (de femme); bonnette (nav., fort.).	**Bonnet,**	cap (head-gear).
Bribe,	présent (pour corrompre); prix, appât.	**Bribe,**	great lump of bread; pl., scraps, pieces of meat; odd ends.
Bride,	fiancée, mariée.	**Bride,**	bridle, rein.
Brig,	brick (nav.).	**Brique,**	brick (for building).
But, conj.	mais.	**But,** nm.	aim; end; mark.
Calmer, n.	celui qui calme, qui apaise.	**Calmer,** v.	to calm, to appease.
Campaign,	(milit.) campagne.	**Campagne,**	country-fields; country-seat; estate; campaign; (nav.) cruise, voyage.
Cane,	canne; jonc.	**Cane,** nf.	duck.

English Words.	French Equivalents.	French Words.	English Equivalents.
Canon,	chanoine; canon (law of the church); (print.) canon.	**Canon,**	cannon, gun, artillery; (church) canon law; barrel (of a musket, etc.); (print.) canon; catalogue of saints.
Cap,	bonnet; casquette; barrette; chapeau (de cloche, de sonnette); (nav.) chouquet; (horl.) recouvrement.	**Cap,**	headland, cape, promontory; (nav.) head.
Capon,	chapon.	**Capon,**	mean fellow; coward; cheat; sneak; (nav.) cat-tackle.
Car, n.	char; chariot; nacelle (de ballon).	**Car,**	as, for.
Carrier, n.	porteur; voiturier.	**Carrier,** nm.	quarry-man.
Case,	étui; enveloppe; caisse; (print.) casse; (of a watch) boîte; cas; état; cause.	**Case,**	division, compartment; hut; pigeon-hole; point (at backgammon); berth (nav.).
Cask,	tonneau, baril, barrique.	**Casque,**	helmet; helmet-shell (conch.).
Casket,	cassette.	**Casquette,**	cap (man's).
Cassine,	(bot.) viorne luisante.	**Cassine,**	(milit.) little isolated house that can serve as a post; hut, hovel; (bot.) cassine.
Cassis,	(conch.) casque.	**Cassis,**	black currant; black-currant tree; black-currant ratafia; gutter; drain.
Causer, n.	cause (person).	**Causer,** v.	to talk, to converse, to chat; to cause.
Caution,	avis; précaution; garantie.	**Caution,**	surety, security; bail, pledge; bailer.
Cave,	antre, caverne.	**Cave,**	cellar, wine-cellar; stake (gambling).
Chagrin,	dépit, vexation.	**Chagrin,**	grief.
Chair,	chaise, siège; (professorship) chaire; (of a chairman) fauteuil; (railways) coussinet.	**Chair,**	flesh, meat; (of persons) skin.
Chandelier,	candélabre.	**Chandelier,**	candlestick.
Char,	ouvrage fait à la journée; (icht.) ombre.	**Char,**	car, chariot.
Charger, n.	grand plat; cheval de bataille; coursier.	**Charger,** v.	to load; to exaggerate; to lay it on.
Chariot, n.	coupé; char, char de guerre (des anciens).	**Chariot,** nm.	waggon, cart, wait.
Chat, n.	causerie; conversation.	**Chat,** nm.	cat.
Chine,	échine; (cook.) échinée.	**Chine,**	China (country).

RECREATIVE SCIENCE.—XX.

ROSE'S KALOTROPE—PILKINGTON'S SIMPLE FORM OF THE KALOTROPE AND PHOTODROME—KING'S OXY-HYDROGEN COLOUR TOP MOVEMENT.

In explaining the principle of the kalotrope, Mr. Rose very properly observes that formerly disc-action did not seem to be clearly understood. Take up Brewster or Lardner, who copies him verbatim. See the latter's "Handbook of Philosophy," Optics, p. 269. After alluding to the figures being stationary, when the slots and pictures are equal in number, he says:—"If the figures were eleven in number in place of twelve, they would all appear to move in one direction; and if they were thirteen, they would appear to move in the opposite direction."

Certainly they would; but why not use a general expression, that the relations of motion are disturbed when the slots and figures are unequal in number? As to their going this way or that, it depends altogether whether you turn the disc to the right hand or to the left.

At pages 269, 270, there is a laboured statement to prove that with twelve slots you must have thirteen horses, or they cannot leap over a gate. Surely it is very evident that eleven motions, properly arranged, would answer quite as well as thirteen, if you place your horses' heads in the right direction, and turn your disc suitably.

*

Then comes a remarkable statement, page 270:—"It is obvious that if, instead of a mirror, another person whirls round in an opposite direction, and with the same velocity, a similar disc, the effect will be the same."

No motive effects can be more dissimilar; the second disc multiplies the figures, and makes anamorphoses (shapeless forms) of them. The last sentence convinces one that neither Sir D. Brewster nor Dr. Lardner have devoted much thought to the subject, otherwise they would have seen that, merely for the purpose of dispensing with the mirror, there is a much more satisfactory way of using the second disc.

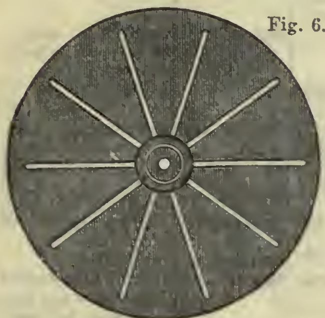


Fig. 6.

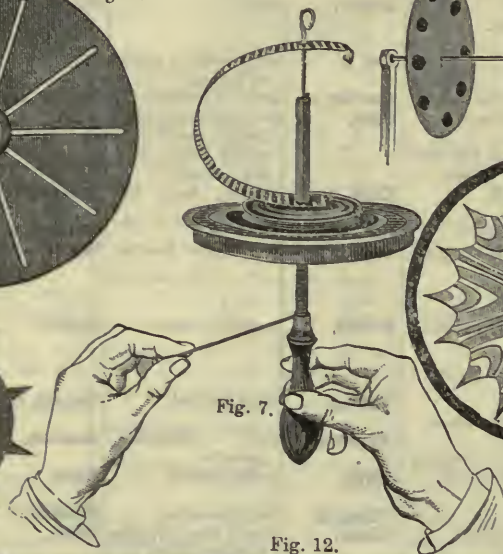


Fig. 7.

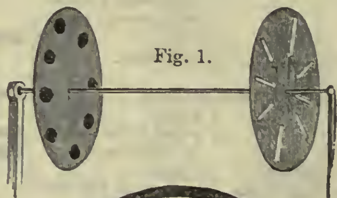


Fig. 1.

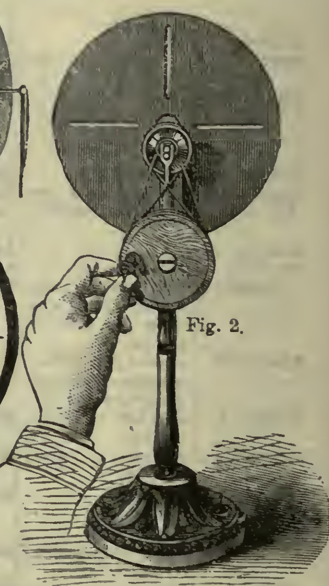


Fig. 2.

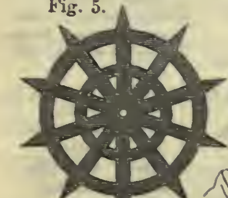
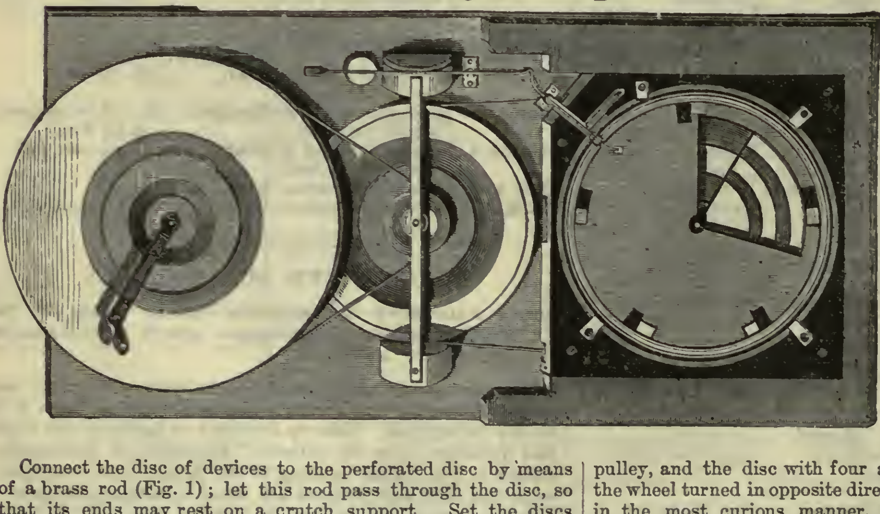


Fig. 5.

Fig. 4.

Fig. 12.



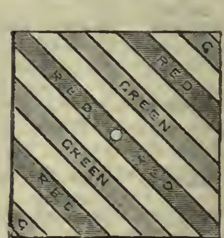


Fig. 3.

Connect the disc of devices to the perforated disc by means of a brass rod (Fig. 1); let this rod pass through the disc, so that its ends may rest on a crutch support. Set the discs revolving in *the same direction*, and, looking through the slots, you will see the figures in motion precisely the same as in the mirror. How this very obvious contrivance did not occur to them, it is difficult to say.

The apparatus so clearly described by Mr. Rose has been constructed in a very cheap form by the Rev. Mr. Pilkington (Fig. 2). On a turned wooden pillar and stand is fixed an elbow-shaped iron, carrying the axles, one of which work inside the other. Each axle carries a pulley, round which the two bands or strings are placed; the strings pass round the grooved wheel and handle for giving motion to the two discs, which move in opposite directions, and at unequal velocities, by crossing one of the pulley bands. The diameter of the small pulley attached to the device, the axle of which works inside the other, is half an inch; whilst that of the larger pulley—which, of course, moves slower, and carries the perforated disc, having, say, four slots or openings—is one inch and three quarters. When the wheel is turned, the bands, one of which is crossed, cause the two pulleys, one bearing the device and the other the perforated disc, to go round in opposite directions; and, on looking through the slots, the operator sees the curious changes that occur: for instance, a piece of cartridge paper, six inches square, is painted with diagonal lines, as shown in Fig. 3, so as to have alternately green, white, red, white, green, white, red, and so on. When this is attached to the axle of the small pulley, and the disc with four apertures to the larger one, and the wheel turned in opposite directions, the diagonal lines change in the most curions manner, and produce the symmetrical pattern shown in Fig. 4, the letters of which, corresponding with the first letter of each colour, show the manner in which the pattern is tinted with them.

The supporting pillar of this cheap form of the kalotrope stands twelve inches high, and screws or drops into a turned wooden foot, four inches in diameter, and an inch thick, which should be loaded with lead to make it stand quite steady. The turning wheel works on a screw, which attaches it to the pillar, and is three inches in diameter, having two grooves sunk three-eighths of an inch, in which the two bands—elastic letter bands—work. The elbow piece of brass is screwed in above the driving-wheel, and projects horizontally one inch and a quarter, and is the same in height, with a crutch at the top to carry the two axles, working one within the other, of which one end rests on the end of the crutch and the other on the top of the wooden pillar, cut out in a fork to receive it.

Each axle carries a rough brass pulley, one inch and three-quarters in diameter, so that either exactly equal motions in opposite directions may be obtained, or unequal ones, by using one of the little pulleys attached to the axle carrying the device.

It may be put together for a few shillings, and will not only show the pretty effects of Mr. Rose's kalotrope, but also those of his more elaborate contrivance, called the photodrome, or *light-runner*, in which a device, moving round very fast, actually appears to *stand still*.

This curious effect is well shown by attaching the blackened cardboard device, cut out with two circles and *ten* radii (Fig. 5) to one of the axles; and the perforated disc (Fig. 6), with *ten* slots, to the other axle of the same sized pulley with the crossed band; on turning the handle the device appears to *stand still*, although it is moving round at least 100 times in a minute.

Fig. 11.

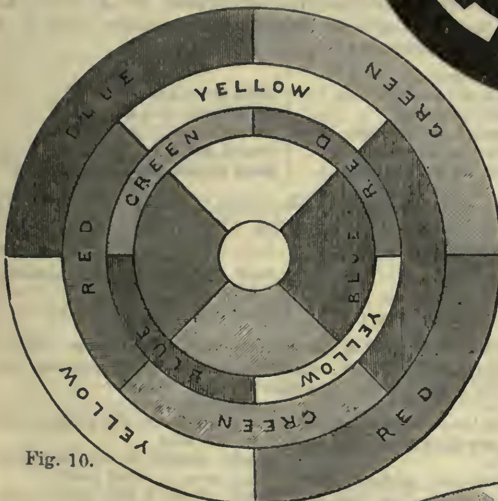


Fig. 10.

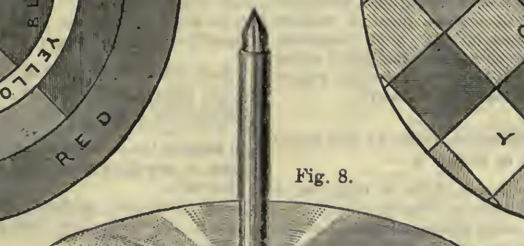


Fig. 8.

Fig. 9.

With the ordinary colour top it is, of course, necessary to wind on the string each time before spinning it, and thus the effects cannot be made continuous. In order to surmount this objection, Mr. Pilkington has arranged a very cheap and effective top, which may be kept spinning as long as the operator wishes to observe any particular coloured disc; it can also be used with bent wires, or slips of cardboard, in order to create those figures of vases, tumblers, bottles or goblets, already alluded to in our last paper.

The top (Fig. 7) is made of a circular piece of boxwood, four inches in diameter and half an inch thick; through the centre of which is passed a hollow brass tube, having a bore of an eighth of an inch; on the upper face is arranged the coloured disc, painted according to the taste of the operator; and if variety of effect is desired, a loop of cardboard, also coloured, is fixed in a semi-circular form, as shown in Fig. 7. In order to give it a rotatory motion, the lower part of the tube is placed on a spindle let into an ebony handle; the tube drops into the hollow of the brass ring, and is thereby kept in its place when the string, which is tied to and wound round it, is pulled out. Every time the string is pulled out, the boxwood circle rotates, and by the momentum the string is again wound, to be once more pulled out, and so on, as long as may be desired. The whole affair can be constructed for half-a-crown, and will afford much amusement to young persons who can paint a great variety of discs.

As a contrast to this inexpensive arrangement, is the more refined colour top, constructed by Mr. Pichler, which costs one guinea, and is most beautifully made. It consists of a circular brass plate, through which is passed or fixed a steel axle, as shown in Fig. 8. The spindle assumes the appearance of an inverted cup at the lower part of the upper face, and it is turned by rolling the spindle between the palms of the hands. With practice it is surprising what a velocity may be imparted; and as the brass circle is heavy, and the power accumulates in it like a fly-wheel, it will continue rotating for a very considerable period. The designs are all most carefully drawn and painted; thus, by placing Fig. 9, which is painted in squares of green, yellow, blue, violet, red, orange, on the brass circle, and rotating the top with the palms of the hands, the whole changes to circular figures showing red, green, yellow, or blue in the outer circle, then four sections of yellow, red, green, or blue, crossed by a narrow circular band, presenting the same colours in varied compartments (Fig. 10), and by merely touching or raising the edge of the painted disc, the arrangement of colour changes immediately; the movement of a corner causing a wave of changing colour to pass over the disc. It is very amusing to observe the change of the squares to circles concentric with each other.

By placing the perforated black card (Fig. 11) on the first flange, or inverted cup-like figure at the bottom of the top spindle, and looking through it at various coloured discs, while the top is rotating, the shadows cast by the upper and perforated disc on the lower coloured one produce a remarkable appearance, and make it appear as if a number of rings were standing up above the lower disc, some of which are blue, others red or yellow, according to the manner in which they are painted. Perhaps the most complete and handsomest apparatus for showing coloured circles, with or without perforated discs above them, is that made by Elliott, in which a small fly-wheel is connected by an elastic band with a pulley working on a nicely poised axle. The velocity can be changed at pleasure, the whole being worked on a mahogany stand in the horizontal position; and as the coloured discs are very beautifully lithographed and painted, this apparatus rises above the mere toy, and becomes a most interesting addition to the apparatus required to illustrate the laws of colour.

The effects of the colour top had not been displayed on the screen by the oxy-hydrogen light, until Mr. King contrived a very simple apparatus which could be placed in the oxy-hydrogen lantern.

It consists (Fig. 12) of a rotating circular piece of glass, which is painted like the discs of the colour top, with the columns in concentric rings, but in unequal proportions. An opaque disc, with the usual section left open, is made constantly to shift its position at the will of the operator, so that sometimes an excess of red and yellow with white and colourless rings are disclosed, forming orange and white rings, then blue or yellow, producing green or white, or other coloured rings, and so on, according to the particular colour painted on the revolving glass disc. The opaque one revolves with the former, and is made to change its position by a simple lever arrangement.

LESSONS IN ITALIAN.—XL.

ADJECTIVES.

Rule 17.—The adjective, in Italian, agrees in gender and number with the substantive to which it refers; as—

Il chirurgo del Signor Anna è stato un bravo uomo, *Mr. Anna's surgeon has been an excellent man.*
Tutti i giorni non possono essere fecondi di brillanti avvenimenti, *every day cannot produce brilliant events.*
Io non feci parola di quella mia ridicola avventura, *I did not speak of my ridiculous adventure.*
Dio ti benedica amorosa fanciulla! *God bless you, loving child!*
Oh che belle parabole! *oh, what fine parables!*

Rule 18.—Two or more substantives of different genders require the adjective in the plural masculine:—

Un uomo, e una donna piccoli, *a little man and woman.*
Un ragazzo, e una ragazza cattivi, *a naughty boy and girl.*
Il padre, e la madre sono caritatevoli, *the father and mother are charitable.*
Le mie case, ed i luoghi pubblichi di Roma son pieni d' antiche immagini de' miei maggiori, *my houses and the public places of Rome are filled with ancient statues of my ancestors.*

Rule 19.—When two or more adjectives refer to the same substantive, they may either precede or follow it:—

Avendo seco Tancredi varie e diverse novità pensate, *Tancred having revolved in his mind different thoughts.*
Ed al nostro amore daremo piacevole, ed interno compimento, *and we shall give to our affection agreeable and internal satisfaction.*
Una donna dotta e religiosa, *a learned and religious woman.*
Un uomo sobrio, onesto, ed industrioso, *a sober, honest, and industrious man.*
È una damigella saggia, leggiadra, e graziosa, *she is a wise, pretty, and graceful young lady.*

Rule 20.—When an adjective refers to several nouns of inanimate objects, without being separated by a verb, it agrees with the noun next to it:—

Égli avéa la mano e il cappello rosso, *he had a red hand and hat.*
Ecco l' affetto e la pietà materna, *behold the maternal tenderness and piety.*
Rifiutano l' occasione d' acquistare onori, e gloria nuova, *they refuse an opportunity of gaining new honours and glory.*

Rule 21.—Italian adjectives are generally placed either before or after their substantives:—

Un nobile aspetto, *or* un aspetto nobile, *a noble face.*
Un buon amico, *or* un amico buono, *a good friend.*
La nuova sposa, *or* la sposa nuova (*the new spouse*), *the bride.*
Égli avesse la barba grande, *he had a (great) long beard.*

Rule 22.—Italian adjectives are placed after the nouns, when they express—

1. NATIONALITY.

Un principe Italiano, *an Italian prince.*
Una dama Francese, *a French lady.*
La lingua Spagnuola, *the Spanish language.*
La politica Romana, *the Roman politics.*

2. THE SHAPE OR FORM.

Una tavola quadrata, *a square table.*
Una forma ovale, *an oval form.*
Un teatro largo, *a wide theatre.*
Una chiesa lunga, *a long church.*
Un sigillo rotondo, *a round seal.*

3. THE STATE OF THE ELEMENTS.

Un tempo freddo, *cold weather.*
Una terra arida, *dry ground.*
Un vento caldo, *a warm wind.*
Un aria salubre, *a wholesome air.*
Un fuoco intenso, *an intense fire.*

4. COLOURS.

Un abito turchino, *a blue coat.*
Una sedia indorata, *a gilt chair.*
Un vino bianco, *a white vine.*
Un fior giallo, *a yellow flower.*

5. TASTE.

Un frutto dolce, *a sweet fruit.*
Un' erba amara, *a bitter herb.*
Un sidro agro, *sour cider.*
Un vino cotto, *burnt wine.*

The following adjectives have different meanings, according as they are placed before or after the substantive; as—

Una certa notizia, *a certain piece of news.*
Una notizia certa, *a certain report.*
Un galant' uomo, *a brave and honest man.*
Un uomo galante, *a gallant man.*
Un gentiluomo, *a nobleman.*
Un uomo gentile, *a genteel man.*
Il pover uomo, *a man without genius.*
È un uomo povero, *he is a poor man.*

Rule 23.—The adjectives *bello*, *buono*, *santo* lose their last syllable before masculine nouns beginning with a consonant; but *grande* loses it before masculine and feminine nouns:—

SINGULAR.	PLURAL.
Bel giardino, *fine garden.*	Belli, bei, be' giardini, *fine gardens.*
Buon libro, *good book.*	Buoni libri, *good books.*
San Pietro, *Saint Peter.*	Santi Pietri, *the Saint Peters'.*
Bel ragazzo, *fine boy.*	Belli ragazzi, *fine boys.*
Gran birbone, *great rascal.*	Gran birboni, *great rascals.*
Gran regina, *great queen.*	Gran regine, *great queens.*

Rule 24.—The same adjectives, *bello*, *buono*, *grande*, *santo*, do not lose their last syllable before nouns beginning with an *s* followed by a consonant:—

SINGULAR.	PLURAL.
Bello sposo, *fine husband.*	Begli sposi, *fine husbands.*
Buono stato, *good state.*	Buoni stati, *good states.*
Grande strepito, *great noise.*	Grandi strepiti, *great noises.*
Grande spada, *a long sword.*	Grandi spade, *long swords.*
Santo Steffano, *Saint Stephen.*	Santi Steffani, *the Saint Stephens'.*

Rule 25.—The adjectives *bello*, *buono*, *grande*, *santo*, lose their final vowel before words beginning with a vowel, and take an apostrophe in its place:—

Bell' occhio, *fine eye.*
Buon' aspetto, *good face.*
Grand' impero, *great empire.*
Sant' Antonio, *or* San' Antonio, *Saint Anthony.*
Gran' ingegno, *great genius.*

Rule 26.—Adjectives of dimension—alto, *high*; largo, *wide*; lungo, *long*; grosso, *thick*; profondo, *deep*—do not require the preposition *di* before the numerals:—

Un tappeto lungo sei iardi e largo due, *a carpet six yards long and two wide.*
Questa fossa era profonda nove piedi, *this ditch was nine feet deep.*
Un muro grosso due piedi, *a wall two feet thick.*
Questa camera è alta sei piedi, *this room is six feet high.*
Quell' albero è alto dieci piedi, *this tree is ten feet high.*

COMPARATIVES AND SUPERLATIVES.

COMPARATIVES.

Rule 27.—When, in a comparison, *than* is followed by an article, or a possessive pronoun, it is expressed by the definite articles *del*, *dello*, *della*, *degli*, *delle*; as—

La rosa è più bella della viola, *the rose is more beautiful than the violet.*
Il maestro è meno dotto dello scolare, *the master is less learned than the scholar.*
Questo libro è migliore del vostro, *this book is better than yours.*
La Germania è più grande, e più potente dell' Italia, *Germany is larger and more powerful than Italy.*
Questa camera è più bella della mia, *this room is prettier than mine.*

Rule 28.—When *than* is followed by an article, or a possessive pronoun, it is translated only by *di*:—

Cesare è stato più felice di Pompeo, *Cæsar was more fortunate than Pompey.*
Giorgio è più astuto di Pietro, *George is more cunning than Peter.*
Vostro padre è più dotto di me, *your father is more learned than I.*
Égli è più sciocco di voi, *he is more silly than you.*
Sono meno esperto di lui, *I am less experienced than he.*

Rule 29.—When a comparison is made between two adjectives, substantives, or adverbs, following one another, *than* is expressed by *che*; and if there is a verb after *than*, this conjunction is rendered by *che non*:—

È meglio tardi che mai, *it is better late than never.*
Spende più che non guadagna, *he spends more than he gains.*
Io scrivo più che non parlo, *I write more than I speak.*
È più prudente che dotto, *he is more prudent than learned.*
Vostra zia ha più talento che grazia, *your aunt has more talent than grace.*

Rule 30.—When *as much as, so as*, are employed in a comparison, they must be rendered by *quanto* :—

Ho quanto danaro desidero, *I have as much money as I desire.*
Égli è ricco quanto suo fratello, *he is as rich as his brother.*
Siamo ingannati quanto voi, *we are deceived as much as you.*
Eravamo afflitti quanto esso, *we were as much grieved as he.*
Ella ha spirito quanto sua madre, *she has as much wit as her mother.*

SUPERLATIVES.

Rule 31.—The relative or absolute superlatives are placed either before or after their substantives :—

Ella è la più bella donna d' Inghilterra, *she is the finest woman in England.*
Vostro umilissimo servitore, *your most humble servant.*
Ieri era un tempo freddissimo, *yesterday was very cold weather.*
Ebenchè, potessino far le guerre più lunghe, *and though they could carry on the longest wars.*
Égli è il più dotto precettore di Cambrigge, *he is the most learned instructor in Cambridge.*

NUMERALS.

THE CARDINAL NUMBERS.

Rule 32.—The cardinal numbers are placed either before or after their substantives; as illustrated in the accompanying examples :—

Il pranzo ci è costato cinque franchi per uno, *our dinner has cost us five francs each.*
Égli giungerà in Parigi fra quindici giorni, *he will arrive in Paris in a fortnight.*
E questo castello posto propinquo a Firenze ad otto miglia, *and this castle stands eight miles from Florence.*
Cappelli ventuno, calze trentuna, *twenty-one hats, thirty-one stockings.*
Nel detto anno 1328, si commenciò, è fu due anni seguenti grande caro di grano, in Firenze, che di soldi 17 lo stojo, il detto anno valse soldi 38, *in the same year, 1328, and the two following years, there was such a scarcity of corn, that a bushel, which before was sold for 17 pence, was the same year sold for 38.*

THE ORDINAL NUMBERS.

Rule 33.—The ordinal numbers are placed before their nouns, and agree with them in gender and number, and take an article :—

Il quarto volume, *the fourth volume.*
L' ottavo meraviglia del mondo, *the eighth wonder of the world.*
Il settimo angelo, *the seventh angel.*
Il ventesimo sospiro, *the twentieth sigh.*
Il decimoquarto secolo, *the fourteenth century.*

Rule 34.—The ordinal numbers employed for quotations are generally put after their nouns, without an article, as in these examples :—

Storia d' Italia, libro settimo, *the History of Italy, book the seventh.*
Giornata nona, novella ottava, *the Ninth Day, novel the eighth.*
Storia d' America, epoca quinta, *the History of America, fifth epoch.*
Nuova grammatica Italiana, capo decimo, *a New Italian Grammar, chapter the tenth.*
Il nano di una principessa, lettera seconda, *the Dwarf of a Princess, letter the second.*

Rule 35.—The ordinal numbers are used without an article in speaking of emperors, kings, popes, and other dignitaries; as in the following examples :—

L' imperador Carlo quinto era sovrano delle Spagne, *the emperor Charles the Fifth was sovereign of Spain.*
Ferdinando quarto, re di Nápoli, *Ferdinand the fourth, king of Naples.*
Vita di Carlo duodecimo, *Life of Charles the Twelfth.*
La cattività del pontefice Pio sesto, *the captivity of the pontiff, Pius the Sixth.*
Il secolo di Luigi decimoquarto, *the age of Louis the Fourteenth.*

PERSONAL PRONOUNS.

Rule 36.—When the personal pronouns *io, tu, noi, voi*, are the subjects of a discourse, they may be left out; but *egli, ella, eglino, elleno, esso, essa, essi, esse*, must be expressed, in order to distinguish the gender; as—

Mangio una pernice, *I am eating a partridge.*
Parli da sciocco, *thou speakest like a fool.*
Spendevamo assai, *we expended much.*
Non ragionerete mai, *you will never reason.*
Égli affettò troppa indifferenza, *he affected too much indifference.*
Elleno compierono il voto, *they performed the vow.*

EXAMPLES TO ILLUSTRATE THE POSITION OF PERSONAL PRONOUNS.

Pensate a me, *think of me.*
Pensa per te, *think for thyself.*
È malcontento di se, *he is not satisfied with himself.*
Andate con lui, *go with him.*
Parlate a lei or ad essa, *speak to her.*
Égli parla di noi, *he speaks of us.*
Ciò dipende da voi, *that depends upon you.*
Voi insegnate loro, *you teach them.*
Io lo vedo, *I see it.*
Tu la conosci, *thou knowest her.*
Voi l' amate, *you love her.*
Io le aspetto, *I expect them.*
Voi ne riderete, *you will laugh at it.*
Io glielo dirò, *I will tell it to him.*
Voi gliela darete, *you will give it to her.*
Io glieli manderò, *I shall send them to him.*
Voi gliene comprerete, *you shall buy some for him.*
Tu me lo dai, *thou givest it to me.*
Io te la do, *I give it to thee.*
Égli se li farà dare, *he will have them given to him.*
Domandagli, *ask him.*
Divertiamoci, *let us amuse ourselves.*
Domandateglielo, *ask it of him.*
Non glielo domandate, *do not ask it of him.*
Non me ne date, *do not give me some.*
Non lo facciamo, *let us not do it.*
Ciò mi place, *that pleases me.*
Dio ti vede, *God sees you.*
Égli si lusinga, *he flatters himself.*
Io vi amo, *I love you.*
Respondetemi, *answer me.*
Prometto loro, *I promise them.*
Ne parlerò loro, *I will speak to them about it.*
Datene loro, *give them some.*
Eccomi, *here I am.*

ITALIAN FORMS OF ADDRESSING PERSONS.

The Italians, in speaking or writing to persons of both sexes, whom they wish to treat with great respect, make use of the title Vossignoria,* or Vostra Signoria, *your lordship* or *ladyship.* As this flattering title is in the third person of the feminine gender, it requires the verb in the third person, and agrees with the adjective or past participle.

To avoid the repetition, or better to avoid the word *vossignoria*, the Italians make use of *ella*, as it is seen in the following illustration :—

Singular (for both Genders).

Nom.	Vossignoria, V. S., *or* ella, *you* (*Sir* or *Madam*).
Gen.	Di vossignoria, V. S., *or* di lei, *of you.*
Dat.	A vossignoria, V. S., *or* a lei *or* le, *to you.*
Acc.	Vossignoria, V. S., *or* lei *or* la, *you.*
Abl.	Da vossignoria, V. S., *or* da lei, *from you.*

Plural.

	MASCULINE.	FEMININE.
Nom.	Lor signori;	Lor signore, *you.*
Gen.	Di lor signori;	Di lor signore, *of you.*
Dat.	A lor signori;	A lor signore, *to you.*
Acc.	Lor signori;	Lor signore, *you.*
Abl.	Da lor signori;	Da lor signore, *from you.*

MASCULINE AND FEMININE.

Nom.	Le signorie loro, *or* elleno, *you.*
Gen.	Delle signorie loro, *or* di loro, *of you.*
Dat.	Alle signorie loro, *or* a loro, *to you.*
Acc.	Le signorie loro, *or* loro, le, *you.*
Abl.	Dalle signorie loro, *or* da loro, *from you.*

EXAMPLES.

Ella mi disse che era soddisfatta, *you told me that you were satisfied.*
Come sta V. S. or ella? *how do you do, Sir,* or *Madam?*
Io ringrazio V. S. or lei, or lo la ringrazio, *I thank you, Sir,* or *Madam.*
Come stanno le V. S., or lor signori, or elleno? *how do you do, gentlemen,* or *ladies?*
Sono lor signori stati in campagna? *have you been in the country, gentlemen?*
Dove è il suo fratello, or dove è il fratello di V. S.? *where is your brother, Sir,* or *Madam?*
Ho veduto le sue sorelle, *I saw your sisters, Sir,* or *Madam.*
Hanno le vostre signorie ricevuto il loro denaro? *have you received your money, gentlemen,* or *ladies?*

Masters speaking to their servants, or other persons of the lower orders; parents to their children; husbands to their wives; brothers, sisters, cousins, intimate friends, to each other—all make use of the second person singular. Poets, and people in a passion, do not fail to employ it.

* This word is seldom used in polite society.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XIV.—BYZANTINE COMMERCE (*continued*).

LATER MARITIME TRADE.

THE decay of the Byzantine trade is to be traced in part to the struggle for empire between the Mohammedans and the Greeks. The government of Constantinople could not safely spare vessels of war to convey merchandise across the sea. The neutral states shrewdly took advantage of this condition of things, and the Mediterranean trade quickly passed over to Italy. The vessels of the empire were confined exclusively to the waters of the Black Sea.

The policy pursued by the Greeks in commercial affairs aided very much in driving traffic out of their own hands. Justinian increased his revenues by the short-sighted policy of granting monopolies, and by reserving to the state the sale of important articles. As a government can never be so good a trader as an individual, whose fortune depends upon his enterprise, thrift, and skill, Justinian's policy led to the decline both of manufactures and commerce, which yearly went further westwards.

Venice stood at the head of the Italian cities. Its merchantmen visited the Levant as early as the ninth century. At first they sought permission from the Byzantine court; but in the time of the first crusade their services were of so much importance that they were welcomed to Constantinople, obtained after a time the control of the entire Greek navy, entered into alliances with noble families, and became possessors of great property.

Such prosperity was not lasting, for it involved the Venetians in the wars of the Greeks. In 1172 the Emperor Manuel Comnenus required them to assist in attacking the King of the Two Sicilies, and upon their hesitating, he treacherously pretended to continue on friendly terms with them till an opportunity occurred of seizing their vessels and cargoes, and imprisoning the owners. Although he afterwards set the merchants at liberty, they never regained their property. Comnenus delayed the restitution from time to time, and his successors refused it altogether.

As soon as the Venetians lost influence at the Byzantine court, the merchants of Genoa, Pisa, and Amalfi sought their own profit in intercourse with Constantinople, and the emperor assigned to these traders a portion of the city, in which to erect their dwellings, stores, and churches. States which at sea treated each other's vessels as pirates, and were envious of each other's prosperity, could, however, no more agree at Constantinople than in Italy. The Genoese and Pisans fought, whenever they met, as fiercely as they did at home.

During the time of the fifth crusade (1198—1204), domestic contentions in Constantinople placed a usurper on the throne. The rightful heir applied for help to the crusaders, who, in conjunction with the Venetians, took Constantinople in 1203, and made the heir to the throne their creature. Another revolution took place in three months; the usual scenes of pillage and murder ensued, the city was partly destroyed, and Baldwin of Flanders was made emperor. The Venetians re-established themselves in the capital, took possession of the sea-coast, and monopolised the commerce, till they were in turn driven from their vantage-ground by the Genoese and Greeks, about 1261. The Indian trade was carried on by the Venetians, while they held Constantinople, and by the Genoese who succeeded them. More than once, however, a papal interdict denounced all intercourse with the Arabs—except that of war—and prohibited supplying them with weapons, iron, and timber. This interference on the part of the Church obstructed the direct trade through Egypt, and made it necessary to seek some other route. Taria (*Azof*) and Feodosia (*Kaffa*) were founded as starting-points for a caravan route through Bokhara, and Samarcand, and Balkh. Bokhara and Samarcand are parts of the province sometimes known as Western Turkestan, to distinguish it from the eastern or Chinese province of the same name. Great Bucharia, Iagatai, Turan, and Mawar-al-Nahr, are also names which have been given to it at various times. It corresponds to the Sogdiana and Bactria of the ancients. The only variation from the route that had once before existed, was in the region between the Crimea and the Caspian. The caravans reached the Volga, and the merchandise was sent up the river to Astrakhan, carried overland to the Tanais or Don, and thence down the latter river to Azof. The Pisans also shared in this trade, having their depôts at Kaffa.

The revolution that terminated the Venetian hold upon Constantinople also brought the Græco-Latin empire to an end. Michael Palæologus, the new ruler, had been assisted by the Genoese in ascending the throne, and he rewarded them with privileges which gradually enabled them to drive out their rivals, the Venetians and Pisans, and to dispossess them of the trade both in the city and the Black Sea.

The Genoese, now in the ascendant, signed a commercial treaty with the Khan of Tauris, or the Crimea. The Venetians, regardless of their religious scruples, or of the papal interdict, made a successful effort to enter into a similar treaty with the Arabs in order to obtain the produce of India through Syria and Egypt. The interdict was not removed till 1345; but from this time, till the Portuguese doubled the Cape of Good Hope, the wares of India found their way unimpeded through Egypt to Venice, their chief emporium.

During the hostile rivalry of the Venetians and Genoese for Byzantine trade, many of the German towns formerly supplied through the Italian marts, found it more advantageous to open direct communication with Constantinople, in order to obtain Indian produce. The Danube, as far as Servia, became the means of transport, and thus in the twelfth century a chain of commercial stations linked the Bosphorus with the German Ocean. Vienna, Ratisbon, Ulm, Augsburg, and Nuremberg were the leading towns in South or High Germany engaged in this through trade.

The Greeks highly valued the trade with Russia, whence were obtained furs, and slaves, grain, dried and salt fish, hides, iron, timber and pitch, honey and wax. Sclavonic merchants took the most active part in this commerce, as intermediate agents between the *boyards*, or Russian nobles, and the Greek government. Travelling did not suit the indolent Greeks. They found it easier to apportion a suburb of their city to these traders, and to bribe them into taking up residence, by furnishing them monthly with supplies of bread, fish, meat, wine, and oil, than to take an active part in the trade themselves. By a selfish policy, however, which defeated and ruined the trade, they levied imposts upon goods arriving in Constantinople, and drove away the Russian merchants during the winter, in order that Constantinople might always remain an emporium, and that the Venetians, Genoese, and Pisanese living in the city should not become direct customers of the northern traders. The Russians from Novgorod and Tschornigov used to meet at Kiev and repair to Constantinople together; but from the obstacles put in the way of their residence, they arranged to meet the Venetians at the mouth of the Dnieper, where Russian interchange was from this time effected without passing through Constantinople. Fish and grain were the sole Russian commodities which then reached that city. Of the magnitude of the fish trade we may gain an idea from the fact that in the thirteenth century not fewer than 1,600 vessels were employed in it.

Despite the false economy of the Byzantine government, trade had wonderfully enriched Constantinople. When taken by the Crusaders and Venetians, it was, in the words of Hallam, "decked with the accumulated wealth of ages, and resplendent with the monuments of Roman empire and of Grecian art." The severity of ancient taste, which had existed through nine centuries, was seen sliding into the more various and brilliant combinations of Eastern fancy. In the libraries were gathered the remains of Grecian learning, which the chiefs of the crusaders were no more able than their soldiery to appreciate. "Four horses, that breathe in the brass of Lysippus, were removed to the square of St. Mark at Venice, and we have to deplore the fate of many pieces of sculpture wantonly destroyed or coined into brass money." Thus the Greeks threw away their noble commerce. Timid and self-indulgent, they declined the labour and risk of national enterprise, and over-reached themselves by endeavouring to wring their profits out of more adventurous races. From the time of the crusades Byzantine commerce ceased to be worthy of mention.

CHAPTER XV.—COMMERCE OF THE ARABS.

THE conquest of Western Asia by the Arabs creates in commercial history an epoch better defined even than that which followed the destruction of the Roman empire. These remarkable people, whose country had been the highway of traffic from time immemorial, can scarcely be said to have had a national existence till, as Mohammedans, they burst forth from their deserts with the battle-cry of "The Koran; Tribute, or the Sword!" and subdued the nations from the Indus to the Pyrenees. Inspired by the precepts of their religion, they encouraged trade and the arts, as works pleasing to God.

Ancient writings are full of reference to Arab trade. A company of Midianite merchants going down into Egypt bought Joseph of his brethren. When the Jews despoiled the Midianites, they took golden collars off the camels, as well as ornaments of gold from the merchants; whence we may infer the lucrative character of the trade that was carried on. From the prophet Ezekiel we learn that Edom had the control of the trade with Phœnicia, giving emeralds, purple, broidered work, bezoar, and precious stones, for Phœnician wares. Predatory Arabs appear to have infested Egypt, and to have kept possession of Thebes for several centuries before the time of Sesostris. Gerrha, on the Persian Gulf, was for ages a commercial link between Babylon and India. Some modern historians think that Ophir, whence Solomon obtained gold, silver, gems, and sandal-wood, was in Arabia. The early intercourse of the Phœnicians with India was carried on by caravans across the desert. Herodotus says of Arabia that it was the only place where frankincense and myrrh were to be found. Arab commerce in the middle ages attained great magnitude. The possession of Persia gave the Arabs the command of the Indian market, and they held indirect intercourse with China. Along the African coast they planted trading stations communicating with Egypt. They possessed also, for a time, the entire maritime commerce of the Mediterranean. Before the conversion of the Arabs to Mohammedanism, they had regarded Mecca as their capital. It afterwards assumed additional importance as a sacred shrine for pilgrimages. The ancient caravan routes were revived. Medina, Kufa, Borsippa, Bassorah, Damascus, Bagdad, Mosul, and Madain, the last-named situated opposite the ancient city of Seleucia, on the Tigris, were also caravan stations, and acquired thereby fame and opulence.

The capital of the caliphate, and the centre of the routes traversed by the caravans, was Bagdad, which in commercial activity eclipsed its splendid predecessor, Babylon. Pilgrims visited it from Arabia, Turkey, Egypt, Persia, and the west coast of Africa. Most of them combined profit with devotion; some were hired as guards; some came as proxies for true believers, who, in lieu of pilgrimage in person, preferred to employ the services of professional pilgrims. Commerce was attracted to every spot where the Arabs settled. When they conquered a state, they appointed a governor and a cadi or judge, and established mosques and schools. Highways were constructed, and kept in good condition. Wells were opened along every route which led to the Holy City. Caravanserais, or halting-places for the night, were placed at convenient intervals, landmarks were set up to indicate distances, and posts were established where fresh horses and camels could be obtained. These matters became a part of the state administration. Great advantages arose from the magnitude of the Arab empire, and the policy pursued by its government. A common language was spoken throughout their possessions in Europe, Asia, and Africa, and thus social intercourse was promoted. Princes and the wealthy sent their sons to Bagdad for mental culture. Traders could journey throughout the whole extent of the Arab empire, secure of a caravanserai, and of being not only understood but welcomed in every town. Trade was not impeded by restrictions imposed by rival states.

The social life of the Arabs offered a marked contrast to that of the European nations. While civilisation was barely kept alive in Germany, Gaul, and Britain by the monks, and while the inhabitants of these countries generally were in a state of rude poverty, treasures of gold and silver, works of art, and splendid palaces abounded in the cities of the Arabs, thus realising in a great degree the marvels of Arabian fiction. The caliphs patronised letters. The writings of the Greek philosophers were translated, and eagerly read. Astronomy and chemistry were studied, and, above all, it is to the Arabs we owe our numerical system and the science of algebra. Spain was never so flourishing under the Romans as under the Moors. Everywhere arose peopled towns and magnificent palaces; and, by skilful irrigation, the land was made to blossom like a garden. Geographical knowledge was greatly increased by the enterprise of Arab traders. Caravans penetrated through Tartary into Siberia. Arabs settled in India, where various native princes embraced the Mohammedan faith. Trade extended still further east, and merchants soon reached the Indian Archipelago and China. Westward, caravans reached the Niger, and the trade of the east coast of Africa extended as far as Madagascar.

With the increase of wealth the caliphs sank into voluptuous indulgence, and their empire fell into decay.

The commercial prosperity of the Arab empire surpassed that of the ancients, both in its extent and in its diffusion, but declined as rapidly as it had grown. The policy of the Arabs was to multiply trade-marts, while that pursued by the commercial nations of earlier times had been to concentrate the wealth of the world in a few great cities. The wide-spread prosperity arising from trade gave an impulse to agriculture and to other branches of industry, which in their turn multiplied commodities for exchange. The wealthy prided themselves upon the cultivation of beautiful gardens, and even the lower classes exhibited taste in producing the refinements of life.

Silk stuffs were among the choicest articles of manufacture. A thousand silk tapestries, embroidered with needlework of gold thread, are described as belonging to the Caliph Mostansir. These tapestries represented the kings and heroes of the caliphate, whose names and deeds, together with the name of the dynasty to which they belonged, were embroidered by the side of their respective portraits. Besides historical incidents, figures of towns, roads, rivers, and seas were worked upon carpets, in gold, silver, and silk thread of many colours, upon a ground of blue silk. These carpets were very costly; one alone is said to have been worth 22,000 deniers.

Another result of Arabian commerce was a love of travel. Merchants sent their sons in company with the caravans, as a necessary part of education, and made them visit distant cities, in order to obtain instruction from teachers eminent in science and art. A higher degree of civilisation was thus attained than ever before existed. The glories of Bagdad, the capital, especially attracted foreigners and strangers from all parts of the empire; its visitors equalled in number the pilgrims to Mecca. Agriculture and manufactures supplied commodities for internal trade, as distinguished from the carrying trade. Yemen, in Arabia, excelled in weaving; and Sana, the chief town of that district, produced dates and flour. The balsams of Mecca were exchanged for the textiles of Persia and India. Coffee was a product of Arabia, and called *cahoch* (pronounced by the Turks *cahveh*), a name derived from its original use, as a stimulant to induce wakefulness.*

We proceed to notice the most important trading districts of the Arab empire. The ancient prosperity of the district of Babylonia was revived, as we have seen, in that of Bagdad and its neighbourhood. Damascus, the chief town of the province of Syria, and one of the oldest cities in the world, was situated on the line of route taken by the pilgrims, and consequently shared in the profits of the traffic with them. Damascus was always celebrated for its cutlery, and particularly for its sword-blades. The beautiful traceries wrought upon them gave rise to the term "damascening," as applied to steel; while "damasks," as applied to textile fabrics, indicate a raised pattern, peculiar and greatly prized. The district of Armenia, and especially Trebizond, on the Black Sea, were famous for the purple tapestry.

In the bazaars of Teheran, through which city a caravan route led into Tartary, were elegant household furniture, linen, cotton, and camels' hair fabrics, combs, and miscellaneous goods. During the period of Saracenic supremacy, the internal trade of Persia had its chief seat at Ispahan, the capital. Textile manufactures of remarkable softness, both in linen and wool, were produced in this city, the linen being as fine as silk, and the wool the produce of a superior breed of sheep, peculiar to the fertile region in which they were bred.

* It is interesting to trace the growth of this beverage in public favour. Coffee-houses, the first opened, were established at Constantinople in 1552, at Marseilles in 1671; Paris, 1672; Hamburg and Nuremberg, 1696; London, 1652, in St. Michael's Alley, Cornhill, by Pasqua Rosee, at the sign named after his own head. The coffee plant was introduced into Batavia, 1690; Amsterdam, 1710; Surinam, 1718; Hindostan, 1719; Cayenne and Martinique, 1722; and Jamaica, 1732.

Part of the Aral-Caspian depression was peopled with traders, who acted as the intermediate merchants between the Russians and the Arabs, the latter supplying linen, silk, and cotton manufactures, in exchange for furs, honey, and wax from the north. The route taken by the traders extended from Khorassan to the mouth of the Volga, diverging thence northward to Kazan, and westward to the Don.

Gold and slaves were obtained from the region of the Niger, as also were wild beasts, upon the taming of which the Arabs exercised all their skill.

Political relations were formed between the Arabs and the Chinese. Three caravan routes connected Bagdad with Canton. Two of these routes were by way of Mongolia, the towns of Independent Tartary being the principal depôts; the third passed through Bactria, by way of Balkh and Khoten, both important trading towns. Khoten also received the name of Kin-sa-tan-na, or "Bosom of the Earth." Its manufactures were numerous, the sciences and arts were assiduously cultivated, and the neighbourhood was strikingly beautiful.

A caravan trade extended from Khorassan, through Affghanistan and Bactria, to India, passing four large towns in its route, Nisapur, Meru, Herat, and Balkh. Meru produced textile fabrics, and was the centre of the silk trade. Herat manufactured carpets and sword-blades, and saffron and asafœtida were extensively cultivated. In the midst was a magnificent mosque, while at the foot and at the summit of a hill respectively stood a Christian church, and a temple to the sun for the use of the fire-worshippers. Balkh, from its antiquity, was called the mother of cities. Precious stones were found abundantly in its vicinity. One of its caravan routes led to Moultan.

CHAPTER XVI.—COMMERCE OF THE ARABS (*continued*).

THE ARABS IN EUROPE AND AFRICA.—MARITIME COMMERCE.

SPAIN fell under the Saracen yoke, A.D. 712, at a period when the conquerors were quite as barbarous as the Visigoths whom they supplanted, and much fiercer. The mandates of religion, and the natural aptitude of the Arab for civilisation, brought about a rapid advancement. Part of the peninsula was conquered by arms, and other parts were acquired by treaty. The Saracens, as lords of the soil, claimed the sole ownership of every conquered district; but where treaties were entered into, they allowed the original inhabitants to retain the rights of property. Natives, however, were jealously excluded from military service. An Eastern army was distributed over the principal Iberian provinces. Cordova maintained the legion of the caliphs; Seville was occupied by the troops of Emissa; Algesiras and Medina-Sidonia by soldiers from Palestine; Granada by a thousand horsemen chosen from the highest Arab families. The Moors invaded France, and advanced as far as Tours, near which they were defeated, with terrible slaughter, by Charles Martel, A.D. 720. Yet the Pyrenees proved an obstacle which the Arabs could never permanently surmount. The hardy mountain races would not submit to foreign rule, but, during the four centuries of Moorish domination, waged an offensive as well as defensive warfare against the Saracens, and at length, as will be seen hereafter, completely turned the balance against them. During the fifteenth century, the Moors were finally driven from Spain. The history of these centuries is the counterpart of that of the great Eastern monarchies. Wisdom and bravery produced in one age fruit which folly and effeminacy forfeited in the next. Under the hand of industry, the land became one large garden; even the most sterile parts were fertilised by means of canals and aqueducts, and commerce aided the growth of wealth. In less than half a century, the ruthless invaders had become a polished people. The Emirs of Spain at first owed allegiance to the Caliph of Damascus. When the Damascene dynasty was changed, Abderrahman, a fugitive from the ancient royal house, arrived in Spain, where he became the sovereign of an independent Moorish kingdom. The wealth which had been paid as tribute to Damascus now remained in Spain, and contributed a further impulse to progress. Writers give the annual revenues of Abderrahman at 10,000 ounces of gold, 10,000 lbs. of silver, 10,000 mules, 1,000 suits of armour, 1,000 helmets, and 1,000 lances. Abderrahman III. enjoyed still greater revenues. His reign was the zenith of Moorish prosperity. Without bearing heavily upon his subjects, he collected the annual amount of five and a half millions sterling. His grand vizier on one occasion made him an offering which shows the profusion of Moorish wealth. It consisted of 400 lbs. of pure gold, 420,000 deniers in silver bars, 400 lbs. of aloe-wood, 500 ozs. of amber, 300 ozs. of camphor, 30 pieces of embroidered cloth of gold, 10 marten skin mantles, 100 fur mantles of other kinds, 4 dozen horse cloths of gold and silk, 4,000 lbs. of wrought Spanish silk, 30 Persian carpets, 800 sets of steel harness, 1,000 shields, 100,000 arrows, 115 Arab steeds, and 20 mules with costly coverings.

Genius and learning followed in the train of prosperity, and set their seal upon the manners and customs of the age. Oriental fancy revelled in the harmony of gold and colour, as seen in the fretwork tracery of the courts of the Alhambra. Mosques and palaces were numerous in every province; their grandeur and beauty, as exhibited even in their ruins, are objects of wonder to the modern traveller. At Cordova the mosque built by the first king Abderrahman was 600 feet long by 250 feet wide. The roof was supported by marble columns, 1,093 in number, dividing the central space into twenty-nine compartments. Between 7,000 and 8,000 lamps, consuming daily 20,000 pounds of oil, illuminated this splendid edifice. The Palace of Zehra was even a still greater triumph of architecture. It occupied twenty-five years in building, and cost three and a quarter millions sterling. A whole town was afterwards built out of its remains. Cordova, the Moorish capital, was celebrated for its silversmiths' and filigree work, as well as for Cordovan leather. There were in this city 600 mosques and nearly 1,000 baths; and its industry employed 200,000 families, each occupying a separate dwelling-house. There were 16,000 looms for silk-weaving, and 130,000 weavers in Seville alone. 400,000 inhabitants are reported to have quitted the city when the Moors surrendered it. The villages along the course of the Guadalquivir were scarcely a quarter of a league apart. Industry in every form was vigorously pursued. No degradation was felt to attach to labour. It was not considered servile, as with the Greeks and Romans. The Arabs, as conquerors, were far more lenient towards those whom they subdued than were the victors of older times, and they have the credit of always maintaining treaties inviolate. Old silver mines, thought to be exhausted, were made to yield afresh by skilful working; and the Spanish mines from this time furnished the chief supplies of precious metals till the discovery of America. Rubies were sought in Beja and Malaga, and coral and pearl fisheries were prosecuted on the coast. In the weaving and dyeing of silk and wool, and in metal-work especially, the Moors attained great eminence. Other produce of their labour and skill was exported to Constantinople, in the form of raw silk, oil, sugar, quicksilver, bar-iron, dye-stuffs, amber, loadstone, antimony, rock-crystal, sulphur, and myrrh.

The productions of the country were so abundant and various that the exports exceeded the imports, and the exchange or balance of trade was always in favour of the Moors. But long continued success inspired them with false confidence; they grew vain, and lost the fervour of religious zeal. Absorbed in pleasure, or covetous of power, they disregarded the intrepid mountaineers who had never been subdued, and who were destined at last to win back the peninsula from its enervated invaders.

TERMS USED IN COMMERCE.—VIII.

PROCURATION.—The representative power derived under the authority of another, either by letter or power of attorney.

PRODUCE.—The raw productions of a country; a term more frequently applied to those of foreign growth, such as tea, cotton, sugar, spices, drugs, and dyes.

PRO FORMÂ.—Two Latin words, signifying *for the sake of form*. It is customary for merchants and others to make up *pro formâ* invoices and account sales previous to entering into an adventure, in order that they may form correct opinions as to its probable result. These accounts are made up in the exact form that they would assume if the transaction were carried out, so that no item of charge on purchase or sale may be lost sight of—the selling prices being, of course, estimated according to the expectations of the parties.

PROMISSORY NOTE.—A written promise by one person to pay another a specified sum of money at a stated period. It is subject to the same laws, and may be transferred by indorsement in the same way as a bill of exchange.

PROMPT.—The term of credit or period fixed upon by contract for payment of the purchase money for produce.

PROOF IN BANKRUPTCY.—The requisite proof, by affidavit or oath, of the correctness of any claim made upon a bankrupt's estate.

PRO RATÂ.—A Latin term signifying *proportionably*.

PROTEST OF A BILL.—A declaration made by a notary or other person of the presentation of a bill (either for acceptance or for payment), of the reply received, and of the refusal to accept or pay.

PROTEST (SHIP'S).—A declaration, made by the master and crew upon oath, of the particular circumstances under which any injury to a ship or cause of damage to her cargo has arisen.

PROXY.—Authority placed in the hands of a deputy, as a substitute for its personal exercise.

QUARANTINE.—A regulation in force at certain ports, cutting off and interdicting for definite periods all communication between ships and the shore, on their arrival from places commonly affected with contagious diseases.

QUID PRO QUO.—A Latin phrase, signifying *one thing for another*. The mutual consideration in contracts.

QUOTATIONS.—Stated prices. It is usual to quote the prices of certain articles, inclusive of the charges incurred in their delivery on board ship, which are termed *quotations f. o. b.* (free on board).

RATE OF EXCHANGE.—The actual price at which bills on a foreign country can be bought.

REAL PROPERTY.—Property that cannot be moved, such as land, houses, etc.

REBATE.—A return of discount by bankers and others upon bills taken up by the discounter previous to their arriving at maturity.

LESSONS IN ASTRONOMY.—XIX.

TEMPORARY STARS—CLUSTERS AND NEBULÆ—THE NEBULAR HYPOTHESIS—CONCLUSION.

CLOSELY allied to the variable stars are the new or temporary stars, which have at times attracted so much attention. Several such appearances have been recorded; one of the most remarkable, however, is that observed by Tycho Brahe, in November, 1572. This star seems to have burst forth very suddenly, as it is said that the constellation Cassiopeia, in which it appeared, had been carefully observed by an astronomer only two evenings before the star was seen, and that then no trace of it was observed. The star continued visible for about sixteen months, gradually becoming fainter till it disappeared. Its brilliancy at first was so great that it cast a sensible shadow, and it is said to have been visible by day. In 945 and 1264 stars had appeared in the same constellation in a somewhat similar manner, and as the intervals between the three dates are almost equal, it has been conjectured that they might be three appearances of the same object. If this be the case, we may in the course of a few years gaze again upon this star, which in former times attracted so much attention.

Another temporary star of considerable brilliancy appeared in the year 1604, and was also carefully observed by Brahe. Modern times have, however, furnished us with several instances of this kind. In 1848 Mr. Hind observed a new star in Ophiuchus. It increased in brilliancy to the fourth magnitude, but subsequently decreased to the eleventh or twelfth, at which it now remains.

In 1866 a new star also appeared in the Northern Crown, and was very minutely examined. It had been previously noted as of the ninth magnitude, but in May it suddenly shone out as a second magnitude star; its light, however, diminished very rapidly indeed for some time. Attention was immediately directed to it, the spectroscope being now available for its observation. This instrument showed, in addition to the ordinary spectrum of the star, a second spectrum of bright lines, prominent among which were those indicative of burning hydrogen, so that it appears that, in this instance, a sudden blaze was produced by incandescent hydrogen and other substances.

If we compare old star catalogues with those of the present day, we find, in addition to many changes of magnitude, that several stars whose places are there recorded are now no longer to be found; and, on the other hand, we find that some of those now known are not recorded in the old lists, although their brilliancy is considerable, and would probably have ensured their insertion had they been visible. Doubtless, in many of these cases, the discrepancy may arise from errors of observation; but there is no doubt that many stars have altogether disappeared, and it is not improbable that some of these may be variables, which after a more or less prolonged absence may again become visible.

Various explanations have been offered to account for these phenomena. Some imagine the star to rotate, and one portion of its surface to be more luminous than another; others suppose that a planet may revolve around the star, and thus eclipse its light. None of the theories stated, however, appear satisfactory, and we can only wait in the hope that future research, aided by the spectroscope and by more refined instruments, may throw fresh light on the whole subject. All the variables are being closely watched with this object.

Besides the stars and planets, we easily distinguish in the sky various groups called clusters or nebulæ. These are usually divided into

Irregular Groups, more or less visible to the naked eye;
Clusters, resolved by a good telescope; and
Nebulæ, many of which are irresolvable with the most powerful telescopes yet made.

There are many examples of the first class, among which may be mentioned Præsepe, or the Beehive, and the Sword Handle in Perseus, both of which are very beautiful objects for the telescope. Very many objects of the second class have also been noted. In ordinary telescopes they appear for the most part as faint cloudy masses; but as more powerful instruments are directed to them they begin to resolve into stars placed very close together. Every increase yet made in the power of the telescope has had the effect of resolving more of these clusters.

In shape and appearance they vary greatly, some being globular or elliptical masses, while others present very strange forms. The Great Nebula in Orion (Fig. 46), and the Dumb Bell Nebula in Vulpecula (see "Recreative Science," XIV., Vol. V., p. 313, for illustration of this nebula), are examples of this. Many, however, can only be partially resolved, films of misty matter, gradually fading away, being distinguishable apart from the stars. No defined line can indeed be drawn to divide between clusters and nebulæ.

So great is the number of these objects that a catalogue of them, compiled by Sir John Herschel, contains no less than 5,079.

Of their distances we can form no conception. If we attempt to determine it by the space-penetrating power of the telescopes required to resolve them, we find it to be such that light would take many thousand years to travel from them to us.

Some idea of the extreme faintness of these objects may be formed from the estimate which has been made that their light varies from $\frac{1}{1500}$ to $\frac{1}{2000}$ of that of a sperm candle a quarter of a mile distant.

Some of these nebulæ have a spiral form. The best known of these is in the constellation Canes Venatici. In Sir John Herschel's telescope it presented the appearance shown at Fig. 47, a bright globular cluster, partially resolvable, occupying the centre, while surrounding it is a ring divided for nearly half the circumference into two bands. Just outside this is a second cluster. When, however, Lord Rosse's magnificent reflector was turned to this nebula, it presented quite a different appearance (Fig. 48), and seemed to consist of spiral coils of nebulous matter, with which the outer portion was connected. Several other spiral nebulæ are known.

Besides these masses, nebulous stars may be observed in different parts of the sky. These are usually of a circular form, and consist of a star surrounded with a faint cloudy mass, which is quite irresolvable.

The nebulæ are not distributed by any means uniformly over the surface of the sky, the majority being situated in a zone crossing the Milky Way at right angles. In the constellation Virgo there is the greatest aggregation of them, one portion of it being known as the nebulous region of Virgo; and in the southern hemisphere, not far removed from the pole, are two brilliant cloud-like patches called the Magellanic Clouds or Nubeculæ. These, when examined by the telescope, are found to consist of large numbers of stars, clusters, and nebulæ collected together. In appearance they somewhat resemble a portion of the Milky Way, but they are quite distinct from it.

Some of the nebulæ, like some of the stars already referred to, are found to be variable. In October, 1852, Mr. Hind discovered a very small one with a tenth magnitude star near to it. This was afterwards observed and its position noted by other astronomers, but in 1861 it had entirely disappeared. Another nebula, which had frequently been observed as a well-defined, compact cluster, was found, in May, 1860, to be replaced by a star of the seventh magnitude. After a few weeks the stellar appearance had ceased, and the cluster seemed to be resuming its usual form.

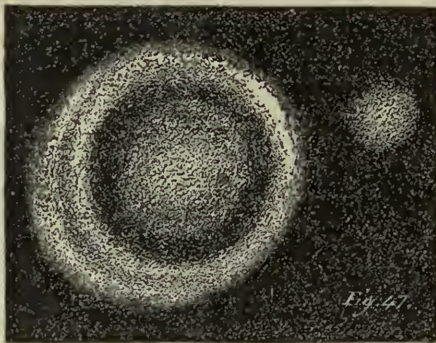
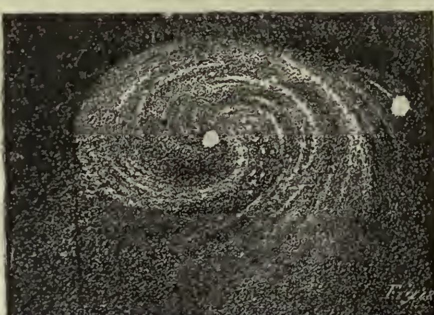


Fig. 47.

The question as to the real constitution of the nebulæ is one that has given rise to much inquiry and controversy. There seems now to be little or no doubt that many of them are universes somewhat resembling our own, immensely removed from us. This theory rapidly gained ground as one after another of the nebulæ was resolved, by the construction of more powerful telescopes, and it was very generally believed that all the nebulæ would ultimately be thus resolved. The hypothesis previously received was that they consist merely of masses of cloud-like matter, and modern researches seem now to indicate that in some few cases this may be correct. When the spectroscope was first directed to one of those objects, no spectrum could be obtained, but merely a short luminous band. A second and third much fainter bands were afterwards made out, and these lines were found to correspond with those indicative of nitrogen, hydrogen, and barium. These facts seem to point strongly to the conclusion that the nebulæ did not consist of solid matter, but merely of an incandescent gas.

Fig. 46.

The Nebular Hypothesis, as it is termed, not only accounts for the nebulæ, but also for the formation of our entire system. According to it, the sun and all the planets originally existed in the form of a globular mass of nebulous matter, filling a space greatly exceeding the orbit of Neptune. This mass was set in rotation, and, as it gradually cooled, became more and more condensed, until at length some part assumed the liquid form, and would then form a ring surrounding the central mass. This ring was, of course, in rotation, and as it could scarcely be of uniform thickness throughout, would soon break up; the matter composing it was then collected into a ball still rotating around the centre, and at the same time turning on its own axis.



In this way all the planets were in turn formed, and they, by centrifugal force, threw off their satellites and rings, till at length the system was complete, and the planets cooled down into solid masses. The comets and nebulæ, then, consist of uncondensed portions of this matter still existing in space.

The theory is a most plausible and ingenious one, and accounts fully for the most remarkable features in the planetary motions, namely, the motion of the planets in the same direction, and nearly the same plane; the motion of the secondaries in the same direction as their primaries; and the coincidence in direction of the motion of the planets on their own axes with their motion round the sun. The flattening of the planets at the poles further tends to uphold this theory, which thus seems to have the balance of probabilities greatly in its favour.

We have now completed our hasty survey of this, the most wondrous and sublime of all the sciences. Passing from the early and rude observations of shepherd astronomers, down to the grand discoveries of modern times, we have seen how step after step has been taken in solving the mysteries of the heavens; and how, by the united and persevering efforts of a long series of astronomers, our knowledge of the heavenly bodies has steadily increased. Instead of the apparent disorder and confusion which the earliest astronomers imagined to exist, we find the most perfect order and harmony, and behold all those stupendous orbs rolling on in their courses and sustained by the action of a few grand yet simple laws.

We have, as it were, just opened the door to the student of Nature, and having pointed out the boundless fields of investigation which stretch before him, we leave him at the threshold to pursue his onward course. A series of papers like the present cannot introduce him to all the depths of the science. If, however, he has followed us, he will have acquired such an acquaintance with its first principles as will enable him to proceed further and further in his inquiries, and though he will often meet with difficulties, patient observation and thought will enable him to overcome most, if not all of them.

Let us, however, remember that, as has been said,

"The undevout astronomer is mad."

As we gaze on the endless range of suns and systems which crowd the sky, and by the aid of our powerful instruments discover numerous other systems infinitely more distant from us, let us learn something of His *Glory* who made them all. As we form some faint idea of the immensity of these systems, and behold in them all constant motion, and yet the utmost stability, let us learn His *Power*, and remember that "His single arm guides the millions of sweeping suns, and around His throne circles the great constellation of unnumbered universes;" and, as we behold the wondrous adjustments by which each globe is poised in the system, and made to move on in its own appointed path, let us admire His matchless *Wisdom*, and learn His *Omniscience*. Truly all these things should make us exclaim with the inspired writer, "The heavens declare the glory of God; and the firmament sheweth His handiwork."

LESSONS IN FRENCH.—XCI.

§ 147.—ANGLO-FRENCH HOMONYMS AND PARONYMS (*continued*).

English Words.	French Equivalents.	French Words.	English Equivalents.
Choke,	*foin* (*of the artichoke*).	Choc,	*shock; clashing; encounter.*
Chose, *v.*	*choisis, choisit, choisîmes, choisîtes, choisirent.*	Chose, *n.*	*thing; object.*
Clause,	*proposition, membre de phrase; clause.*	Clause,	*condition, clause.*
Cloak,	*manteau.*	Cloaque,	*sink; heap, receptacle of filth; filthy person;* (anat.) *cloaca; common sewer.*
Clout,	*torchon, chiffon; tape, coup; pièce pour raccommoder.*	Clou,	*nail.*
Coin,	*pièce de monnaie; encognure;* (print., artil.) *coin; angle.*	Coin,	*corner; wedge; stamp, puncheon* (*for stamping coins and medals*); *quoin, coin.*
Colon,	(gramm.) *deux-points;* (anat.) *colon.*	Colon,	*colonist, planter, settler;* (anat.) *colon.*
Come, *v.*	*viens, venez.*	Comme, *conj.*	*as, like; in like manner.*
Command, *n.*	*commandement, ordre; pouvoir, puissance.*	Command, *nm.*	(law) *he who has charged another to purchase for him; principal.*
		Commande, *nf.*	*order to a tradesman for goods.*
to Commend, *v.*	*louer; recommander; commettre.*	Commander	*to command, to order.*
Comment, *n.*	*commentaire.*	Comment, *adv.*	*how.*
Commenter, *n.*	*annotateur.*	Commenter,	*to comment.*
Complaint,	*plainte; maladie, mal.*	Complainte,	*plaintive popular song.*
Confidence,	*confiance; hardiesse.*	Confidence,	*telling a secret to another; the secret thus revealed.*
Conformer, *n.*	*celui, celle qui se conforme, qui obéit.*	Conformer, *v.*	*to conform; to comply.*
Confuter, *n.*	*réfutateur.*	Confuter, *v.*	*to disapprove; to confute.*
Console, *n.*	*console.*	Console, *nf.*	*corbel; pier-table; bracket; console.*
Conspirer, *n.*	*conspirateur.*	Conspirer, *v.*	*to conspire, to plot.*
Consummation,	*fin, but; consommation.*	Consommation,	*consummation; consumption; destruction.*
Copier, *n.*	*copiste.*	Copier, *v.*	*to copy.*
Corn,	*blé; céréales; cor* (*au pied*).	Corne,	*horn; dog's ear* (*in books*); *shoe-horn; outside rind* (*of horses' hoofs*).
Corner, *n.*	*coin, encognure, angle.*	Corner, *v.*	*to blow, to sound a horn; to wheeze; to tingle* (*of the ears*); *to be tainted* (*of meat*).
Coucher, *n.*	*oculiste.*	Coucher, *v.*	*to lay down; to put to bed; to lay low; to go to bed; to lie down.*
Conntenance,	*figure, mine, physionomie, air.*	Contenance,	*capaciousness, capacity; posture, attitude, look, air, deportment;* (nav.) *burden.*
Courtier,	*courtisan.*	Courtier,	*broker, commission agent.*
Crane,	*grue; siphon* (tech.); *grue* (bird).	Crâne,	*cranium, skull.*
Crier, *n.*	*crieur.*	Crier, *v.*	*to cry; to call out; to shriek, to scream.*
Crisper, *n.*	*celui, celle,* or *ce qui frise, boucle ou crêpe.*	Crisper, *v.*	*to shrivel, to contract; to shrink; to irritate* (*the nerves*); *to fidget.*
Cross,	*croix;* (fig.) *revers, traverse.*	Crosse,	(*of bishop*) *crosier; butt-end* (*of muskets*); *cricket-bat; cricket* (*game*).
to Cross, *v.*			

English Words.	French Equivalents.	French Words.	English Equivalents.
Curate,	*vicaire.*	Curé,	*parson, vicar.*
Curer, *n.*	*guérisseur;* (*of meat*) *saleur.*	Curer, *v.*	*to clean* (*harbours, sewers, etc.*); *to pick the teeth.*
Dauber, *n.*	*barbouilleur.*	Dauber, *v.*	*to cuff, to drub; to banter, to jeer.*
Decanter, *n.*	*carafe.*	Décanter, *v.*	*to decant; to pour off gently.*
Defiance,	*défi.*	Défiance,	*distrust, mistrust; diffidence.*
Defier, *n.*	*celui, celle qui défie.*	Défier, *v.*	*to defy, to challenge, to brave, to dare, to set at defiance.*
Defiler, *n.*	*corrupteur, ravisseur.*	Défiler, *v.*	*to file off; to unstring, to unthread.*
Denier, *n.*	*celui, celle qui nie, dénie.*	Denier, *n.*	*denier* (*obsolete French coin* = ½ *of a farthing*); *money; rate of interest;* (*weight*) *scruple.*
		Dénier, *v.*	*to deny; to refuse.*
Dent,	*coche, creux.*	Dent,	*tooth, notch, cog.*
to Deride,	*tourner en dérision, railler.*	Dérider, *v.*	*to unwrinkle; to smooth.*
Derider, *n.*	*moqueur, railleur.*		
Deriver, *n.*	*celui, celle qui retire, puise, obtient.*	Dériver, *v.*	*to derive, to proceed from;* (nav.) *to drift; to get clear of the shore.*
Designer, *n.*	*dessinateur, inventeur;* (b.s.) *machinateur.*	Désigner, *v.*	*to designate; to appoint; to fix.*
Destitution,	*dénûment.*	Destitution,	*dismissal, removal* (*from office*).
Detester, *n.*	*celui, celle qui déteste.*	Détester, *v.*	*to detest.*
Devise, *n.*	*disposition testamentaire, testament; projet, invention, plan, expédient.*	Deviser, *v.*	*to talk, to converse, to chat.*
to Devise,	*disposer, par testament; projeter, imaginer, inventer.*		
Difference,	*différence;* (*quarrel*) *dispute, différend.*	Différence,	*difference, odds; diversity, disproportion, contrast, disparity.*
Different,	*différent.*	Différend,	*quarrel, dispute, difference.*
Dilater, *n.*	*celui, celle qui dilate.*	Dilater,	*to expand, to distend; to dilate, to enlarge, to widen.*
Dire, *adj.*	*terrible, affreux, cruel.*	Dire, *v.*	*to say, to tell.*
to Distract,	*diviser; jeter dans la confusion, bouleverser; mettre hors de soi; détourner.*	Distraire,	*to separate; to subtract; to divert from; to entertain, to divert.*
Distracted,	*éperdu, bouleversé, hors de soi.*	Distrait,	*absent* (*in mind*); *inattentive, vacant, heedless.*
Distraction,	*division, séparation; déchirement, confusion, démence.*	Distraction,	*separation, subtraction; abstraction, absence of mind; recreation, relief, diversion.*
to Divert,	*détourner, distraire; faire diversion; divertir, réjouir, récréer.*	Divertir,	*to amuse, to recreate; to embezzle, to convert to one's own use; to divert.*
Doll,	*poupée.*	Dol,	(law.) *deceit, fraud.*
Donzel,	*jeune domestique, page.*	Donzelle,	*damsel; loose woman.*
to Don,	(*of garments*) *mettre, revêtir.*	Donner,	*to give.*
Dot,	*point.*	Dot,	*marriage-portion, dowry.*
to Dot,	*marquer de points; pointiller.*		
to Dote,	*radoter, extravaguer; aimer éperdument.*	Doter, *v.*	*to endow; to give a marriage portion, a dowry.*
Doter,	*radoteur; amoureux fou.*		
Doubler, *n.*	*doubleur.*	Doubler, *v.*	*to double.*

English Words.	French Equivalents.	French Words.	English Equivalents.
Dress, *n.*	*robe; habit; habillement, mise.*	**Dresser**, *v.*	*to erect; to straighten; to raise; to lay (a snare); to make out accounts; to draw up (a report); to prick up (the ears); to train.*
Dresser, *n.*	*habilleur, habilleuse; appréteur; table de cuisine;* (med.) *externe.*		
Droll, *n.*	*plaisante, farceur.*	**Drôle**, *n.*	*scamp, rogue, rascal, scoundrel; sharp fellow.*
Education,	*éducation; élève, instruction.*	**Éducation,**	*good-breeding; rearing (of animals); gentlemanliness, good manners.*
Enchanter, *n.*	*enchanteur, enchanteresse.*	**Enchanter,** *v.*	*to enchant, to delight.*
Encore,	*bis.*	**Encore,**	*yet, still, again.*
to **Encore,**	*bisser.*		
Endurer, *n.*	*celui, celle qui endure.*	**Endurer**, *v.*	*to endure, to suffer.*
Engager, *n.*	*celui, celle qui contracte un engagement.*	**Engager**, *v.*	*to engage; to induce; to invite; to enlist; to pawn, to pledge.*
		Ennoblir,	*to ennoble.*
to **Ennoble,**	*anoblir, ennoblir; illustrer.*	**Anoblir,**	*to raise to the peerage, to nobility.*
Epaule,	*épaule (d'un bastion).*	**Épaule,**	*shoulder; epaule (of a bastion).*
Equipage,	*équipage; équipement.*	**Équipage,**	(nav.) *crew; equipage.*
Ere, *prep., adv.*	*avant; plus tôt.*	**Ere**, *n.*	*era.*
to **Exact**, *v.*	*exiger.*	**Exact**, *adj.*	*accurate, correct, close; punctual; exact.*
Examiner, *n.*	*examinateur.*	**Examiner**, *v.*	*to examine; to inquire into, to inspect; to survey.*
Exigent,	*urgent, pressant.*	**Exigeant,**	*hard to please; exacting too much; troublesome; particular, unreasonable.*
Expensive,	*dispendieux, coûteux; dépensier.*	**Expansif,**	*open-hearted; expansive; unreserved.*
Fat, *adj., n.*	*gras; gros; graisse, gras.*	**Fat**, *nm., adj.*	*coxcomb, fop; foppish, coxcombical.*
Fast, *adj., adv.*	*rapide, vite.*	**Faste**, *nm.*	*pageantry, pomp, display, vain show, ostentation.*
Fend, *v.*	*se défendre de; empêcher d'entrer; écarter, éloigner; parer.*	**Fendre**, *v.*	*to cleave, to split.*
Fender, *n.*	*garde-cendre.*	**Fendeur**, *n.*	*cleaver, splitter.*
Figure,	*forme; taille; tournure; figure;* (arith.) *chiffre.*	**Figure,**	*figure, form, shape; countenance; (cards) court-card; diagram; representation;* (mus.) *figured passage.*
File,	*lime (tool); (of papers) liasse; liste; collection (of newspapers);* (milit.) *file.*	**File,**	*row; rank, file* (milit.).
Filer, *n.*	*limeur.*	**Filer**, *v.*	*to spin;* (nav.) *to veer; to rope;* (milit.) *to file; (of cats) to purr; (of ships, stars) to shoot; (of light) to flare; to cut off, to take one's self off.*
Fin, *n.*	(icht.) *nageoire; (of a whale) barbe, fanon.*	**Fin**, *nf., adj.*	*end, conclusion; aim, view, intention; fine, thin, refined, cunning, sly; (of writing) small hand.*
Foin, *n.*	*(fenc.) botte, coup.*	**Foin**, *n.*	*hay; choke (of artichokes).*
to **Foin**, *v.*	*porter, allonger une botte.*		
Fond, *adj.*	*passionné; badin, folâtre; vain, fou, faible; indulgent, bon.*	**Fond**, *nm.*	*bottom, ground; foundation; main point;* (paint.) *background;* (theat.) *back scene;* (min.) *underground;* (nav.) *flooring.*
to **Fond**, *v.*	*caresser; gâter; dorloter.*		
For, *prep., conj.*	*pour; car.*	**For**, *nm.*	*tribunal (conscience).*

LESSONS IN SPANISH.—XXI.

THE VERB.

THE TENSES OF THE SUBJUNCTIVE MOOD (*continued*).

The pluperfect tense of the subjunctive mentions a doubtful or contingent action or event that would or might have been completed under certain conditions; and is also used in Spanish whenever in English a conditional conjunction or expression of fear, doubt, or wish precedes the pluperfect indicative; as—

Ella habría ido ayer á la catedral si hubiese estado buena,	*She would have gone yesterday to the cathedral, if she had been well.*
No era creible que hubiese vmd. abandonado á unos amigos antiguos como nosotros,	*It was not credible that you would have abandoned such old friends as we.*
¡Ojalá hubiese yo sido estudioso!	*Oh that I had been studious!*

This compound tense of the subjunctive is used with the endings in *ra, ría*, and *se* of the auxiliary verb *haber* (*hubiera, habria*, and *hubiese*), under the same conditions and in the same manner as these endings are employed in the imperfect tense; as—

Si no te hubiera pagado, yo te habría prestado dinero; *or*, si no te hubiese pagado, yo te habría prestado dinero; *or*, si no te hubiese pagado, yo te hubiera prestado dinero; *or*, si no te hubiera pagado, yo te hubiera prestado dinero;	*If he should not have (if he had not) paid thee, I would have lent thee money.*

The form of the last example, though permitted, is not to be recommended, since the ending *ra* occurs in the conditional proposition (*si no te hubiera pagado*), and also in the principal proposition (*yo te hubiera prestado dinero*). Nor could we change in any case the principal proposition of the sentence, by substituting *hubiese prestado*, since the form in *se* can be employed only with conditional conjunctions or exclamations, etc.

There is in Spanish a peculiar method sometimes employed for expressing such a contingency of an action as is implied in the pluperfect tense: this consists in prefixing the preposition *á* before the infinitive *haber*, and affixing the past participle of the verb to be used; thus, "á haber venido" is to be rendered the same as "si hubiera (*or* hubiese) venido," *if he should have come*, or, as it is generally expressed in English, *if he had come*, or, *had he come*. So "á haber hablado" is to be rendered the same as "si hubiese hablado," *if he had spoken*.

The first future tense of the subjunctive mentions a doubtful or contingent action or event as to take place at a future time:—

Si así fuere, mis deseos quedarán satisfechos,	*If thus it should be, my desires will remain satisfied.*
Si yo hablare lénguas de hombres y de ángeles, y no tuviera caridad, náda soy,	*If I should speak with the tongues of men and of angels, and should not have charity, I am nothing.*

The second future of the subjunctive mentions a doubtful or contingent action or event as having taken place at a future time at or before some other future action or event shall occur:—

Si Pedro no hubiere llegado ántes de amanecer, le escribiré una carta,	*If Peter shall not have arrived before daybreak, I shall write him a letter.*

A verb is not necessarily in the subjunctive mood because a conjunction may precede it; for an action or event which is known to be certain requires the verb to be in the indicative mood, even though a conjunction precede it; as, "though John was speaking low, I heard him distinctly," *aunque Juan hablaba*, etc. If, however, there is uncertainty or doubt expressed, the subjunctive mood is required; as, "though John were speaking, I would not listen," *aunque Juan hablara*, etc.

After the relative pronouns or the adjective cuanto, *how much*, or the adverb cuando, *when*, if these pronouns or this adjective or adverb are themselves preceded by a verb expressive of an action which the other part of the sentence shows to depend on mere choice or contingency, the subjunctive mood is used, though in English in such cases the indicative is generally employed; as—

Elige, pues, de estas naranjas la que mas te agrade (*or* agradare),	*Choose, then, from these oranges that which most pleaseth thee (may please or shall please thee).*
Seré rico, cuando quiera (*or* quisiere) la fortuna,	*I shall be rich when fortune wills (i.e., when fortune may will).*
Prometió darme el dinero que yo necesitara,	*He promised to give me the money that I wanted (might want).*

*

Verbs expressing *will*, *desire*, *command*, *permission*, *promise*, *fear*, *doubt*, *probability*, *fitness*, or *necessity*, followed by the conjunction *que* (or any other conditional conjunction), generally require the verb which follows the conjunction to be in the subjunctive mood (and not in the indicative, as in English); as—

Dudo que tengas aciete, *I doubt whether thou hast (mayest have) oil.*
Es posible que tengan uvas, *it is possible that they have (may have) grapes).*
Es preciso que me vaya, *it is necessary that I go (may go).*
No creo que tenga peras, *I do not think that he has (may have) pears.*
Temo que no tengan dinero, *I fear that they will not have (may not have) money.*

There are some conjunctive phrases which, as they imply a condition or doubt in themselves, are always followed by the subjunctive mood; these are, para que, *in order that;* dado que, *granted that;* no sea que, *lest;* á ménos que, *unless;* á fin de que, *to the end that;* con tal que, *provided that;* ántes que, *before that;* supuesto que, *suppose that;* en caso de que, *in case that;* bien que, *although;* sin que, *without* or *unless that;* como quiera que, *notwithstanding that;* por mas que, *however;* siempre que, *whenever that;* ojalá, *would that*, or *would to God that;* as, hablo para que puedas juzcar, *I speak in order that thou mayest be able to judge.*

The conjunction *ought* always to be expressed in Spanish; as, "he promised us [that] he would come," *nos prometió que vendría.*

THE PASSIVE VERB.

The passive verb is generally rendered in Spanish by *ser*, and always when the subject of the verb is acted upon by an agent; that is, when in English it would be accompanied with the preposition *by;* as—

Este discurso fué escrito por Diego, *This discourse was written by James.*

The passive verb must be rendered in Spanish by *estar* when the past participle is used adjectively; that is, when the subject of the verb does not seem so much to be acted upon by an agent as to have its state or condition described; as—

El discurso estuvo bien escrito, *the discourse was well written.*
El libro está correjido, *the book is corrected.*

The passive verb formed by *ser* is used in Spanish in the present and imperfect of the indicative mood, only when it is designed to express a mental act or a state of the emotions; as in this example:—

María es amada de Cárlos, *Mary is beloved by Charles.*

When a mental act or a state of the emotions is not expressed, the passive verb, if it be used, must not be in the present or imperfect of the indicative mood; thus we cannot say, el libro es escrito por un Español, *the book is written by a Spaniard*, but, el libro ha sido escrito por un Español, *the book has been written by a Spaniard.*

When a mental act or state of the emotions is expressed, the prepositions *de* or *por* may be used after the passive verb before the agent; but when a mental act or state of the emotions is not expressed, *por* only can be used; as—

Todas las cosas fueron hechas por Dios, *all things were made by God.*
María es amada de (or por) Cárlos, *Mary is beloved by Charles.*

The reflective pronoun *se* is often used with verbs of the active voice, which are required to be rendered in English by the passive.

THE REGIMEN OF VERBS.

The *object* or *regimen* of the verb is either *direct* or *indirect.* The *direct regimen* is that on which the action immediately falls without the aid of any preposition; as—

Doy una pluma, *I give a pen.*

The *indirect regimen* is that on which the action of the verb cannot fall without the aid of a preposition; as—

Dijo á la muger, *He said to the woman.*

Sometimes both regimens are required after the verb; as—

Dió una pluma á la muger, *He gave a pen to the woman.*

When the object of an active verb is a person or inanimate thing personified, it must be preceded by the preposition *á;** as in these examples:—

La muger á quien vimos no es rica, *the woman whom we saw is not rich.*
Diego vió a la madre de Juan, *James saw the mother of John.*

Sometimes the harmony of the sentence requires the *á* to be suppressed, especially after the persons of the verb tener, *to have* or *to possess;* as—

Tengo un hijo y tres hijas, *I have one son and three daughters.*

One verb governs another in the infinitive mood; as—

Quieren imitarle, *They want to imitate him.*

Some verbs, as a general rule, require the preposition *á* before the infinitive which they govern; such as those which mean *to attempt, to come, to go, to begin, to devote, to offer, to dare, to serve, to invite, to learn, to teach, to urge, to assist, to call, to advise, to submit, to prepare, to compel, to decide, to remain*, and *to accustom one's self;* as—

Probó á levantarse, *he attempted to raise himself.*
Voy á verla, *I am going to see her.*

Some verbs generally require the preposition *de* before the infinitive which they govern; such as those which mean *to cease, to be glad, to be ashamed, to resolve, to deprive, to fail, to finish, to abstain, to pity;* as—

Dejó de estudiar, *he ceased to study.*
No faltaré de hacerlo, *I will not fail to do it.*

When the preposition *to* in English is used before the infinitive in the sense *in order to* (as *he labours to acquire fame*, meaning *he labours in order to acquire fame*), the preposition *para* is used in Spanish before the infinitive; as—

El hombre fué criado para aspirar á la felicidad, *Man was created in order to aspire to felicity.*

Sometimes *que* precedes the infinitive instead of *por* or *para;* as for example:—

Tiene algo que decirte, *He has something (which) to tell thee.*

The infinitive is often used without any preposition before it, especially when it is governed by verbs which mean *to be able, to permit, to wish, to endeavour, to make, to feign, to owe, to seem, to be wont, to know, to avail, to see, to hear, to succeed, to hope, to be necessary, to think, to believe, to promise, to deign, to be the duty, to pretend, to judge, to prescribe, to require, to suffice;* as—

No puede hacerlo, *he is not able to do it.*
Deseo aprender, *I wish to learn.*

The infinitive in Spanish, when used as a present participle in English, may take any preposition before it; as—

Sintió la necesidad de ponerle en manos de la juventud, *He felt the necessity of placing it in the hands of the youth.*
Es constante en amarla, *He is constant in loving her.*

The verbs *to see* and *to hear* never govern the gerund in Spanish, but always the infinitive; thus we cannot say, le vío viendo, *I saw him coming*, but, le vío venir, *I saw him come.*

To know how is expressed in Spanish by *to know;* as—

Yo no sé nadar, *I know not (how) to swim.*

The infinitive, when governed by another verb in Spanish, is sometimes required to be rendered by another mood in English; as—

Piensa morir de alegría, *He thinks to die (that he will die) of joy.*
Sabe deber su mérito á Dios solo, *He knows to owe his merit (that his merit is owing) to God alone.*
Creo ver á mi padre, *I believe to see (that I see) my father.*

When in English a reflective verb, or a verb implying command, governs an infinitive in the passive voice, in Spanish this infinitive must be in the active voice; as—

No te dejes vencer de lo malo, *suffer not thyself to be overcome of evil.*
El rey se lo mandó dar, *the king ordered it to be given to him.*

When a verb is governed by another in English, and can be rendered in another mood by using the conjunction *that*, this latter mood should be employed in Spanish; as—

Espero que tendré el gusto de verle en breve, *I hope to have (that I shall have) the pleasure of seeing him soon.*

VERBS FOLLOWED BY CERTAIN PREPOSITIONS.

Verbs which signify *to compare, to give, to yield, to resist, to concern, to belong, to refuse, to ask, to promise, to owe*, etc.

* This is a very important rule of Spanish syntax.

generally require the preposition *á* before the noun to which the action of the verb passes over; as—

Ella se parece á su madre, *She resembles her mother.*
Demanda sabiduría al Señor, *He asks wisdom from (to) the Lord.*

Sometimes verbs having the sense *to remove* or *to take away*, require the preposition *á* before the noun to which the action of the verb passes over; as—

Cain quitó la vida á su hermano Abel, *Cain took away the life of (to) his brother Abel.*
Cortaron la cabeza á Saul, *They cut off the head of (to) Saul.*

Verbs denoting *to be abundant, to lack, to be astonished, to blame, to repent, to pity, to make use, to absolve, to make sport, to remember, to forget,* indirectly govern a noun by means of the preposition *de;* as—

Los valles abundan de trigo, *The valleys abound with (of) wheat.*
Los discipulos se asombraron de sus palabras, *The disciples were astonished at (of) the words.*
Llenaron la casa de perros, *They filled the house with (of) dogs.*

Olvidar, *to forget,* is followed by *de* only when it is used as a reflective verb; as—

Olvidarse de lo pasado,* *To forget the past.*
Olvidar su nombre, *To forget his name.*

The verb *ser,* when used to imply property or possession, requires the noun denoting the possessor to be preceded by the preposition *de;* as—

El libro es de mi padre, *The book belongs to (is of) my father.*

De generally precedes nouns which denote the causes of which the verb explains the effect; as—

Tiembla de miedo, *He trembles with (from) fear.*
Tirita de frio, *He shivers with (of) cold.*
Sus ojos se bañaron de lágrimas, *His eyes were wet with (of) tears.*

The preposition *á* (to) should not be used in Spanish when we speak of motion merely directed towards a place, but *hácia* and *para;* as—

Está caminando hácia Tolosa, *He is journeying towards Tolosa.*
Mi padre salió para Madrid, *My father set out for Madrid.*

Gerunds require the same prepositions as the verbs from which they are derived; as—

Acordándose de sus obras, *Remembering his works.*

USE OF THE VERBS *SER* AND *ESTAR*.

The right manner of using the verbs *ser* and *estar* being of great importance, and yet attended with some difficulty to students, we will give a few explicit rules.

Ser is used to affirm the existence of essential, natural, permanent, or characteristic states or qualities of the mind, persons or things, and to affirm what, or of what a person or thing is, was, or will be; as—

El yelo es frío, *ice is cold.*
Soy sobérbio, *I am proud.*
Lóndres no es pequeña, *London is not small.*
Perdonar las injúrias es obrar como Cristianos, *to forgive injuries is to act like Christians.*
La miel es dulce, *honey is sweet.*
Es tarde, *it is late.*
Pedro era capitan, ahora es mayor, y será coronel, *Peter was captain, now is major, and will be colonel.*

The natural beauties of the body, and its defects when regarded as permanent, are affirmed with *ser;* as—

Lucía es hermosa, *Lucy is beautiful.*
Ella es corcobada y ciega,† *she is hump-backed and blind.*

The materials of which anything is made are affirmed by *ser;* also the possession or destination of anything; as—

La taza es de oro, *the cup is of gold.*
La corona es de la reina, *the crown is the queen's.*
Cervántes es de Alcalá, *Cervantes is from Alcala.*
Es de dia, *it is day.*
Este vino es de España, *this wine is from Spain.*
Esta flor es para María, *this flower is for Mary.*

Estar is used to affirm the temporary, non-natural, accidental, or contingent condition or location of persons or things, transient emotions of the mind; that is, to affirm how or where a thing exists, existed, or will exist, at any period of time; as—

* Literally, *to forget oneself of the past.*
† That is, permanently blind.

El tiempo estará nublado, *the weather will be cloudy.*
El mar. está airado, *the sea is raging.*
Estoy alegre, *I am merry.*
Está enfadado, *he is angry.*
Yo estaba ciego,* *I was blind.*

The physical changes, and state of the health of the animal body, as also the chemical and mechanical changes of substances, are affirmed by *estar;* as—

Estoy bueno, *I am well.*
Yo estaba cojo, *I was lame.*
La leche está ágria, *the milk is sour.*
Vmd. está despierto, *you are awake.*
La carne estaba asada, *the meat was roasted.*

In affirming any manner, situation, position, or location of persons or things, *estar* is used; as—

Juan está de moda, *John is in the fashion.*
Está de rodillas, *he is on (his) knees.*
Estoy de prisa, *I am in haste.*
La comida está en la mesa, *the dinner is on the table.*
¿ Donde está mi padre? *where is my father?*
Está en la cama, *he is in bed.*

Estar (and not *ser*) is always employed before the gerund, since this serves to show the manner of being occupied; as—

Jorge está silbando, *George is whistling.*
Ella estará regañando, *she will be scolding.*
Ellos están leyendo, *they are reading.*
Estoy escribiendo, *I am writing.*

Estar is sometimes used with a preposition to form a particular idiomatic phrase; thus estar sin means *to be destitute of;* estar á, *to understand;* estar en, *to be resolved on, to know.*

The manner of using *ser* and *estar,* in forming the passive voice, has already been explained.

HUMAN PHYSIOLOGY.—X.

RESPIRATION.

THE parts concerned in the function of respiration are the windpipe, or trachea, and the lungs, included in their serous sacs—the pleuræ. The trachea, or windpipe, is a cylindrical tube, partly membranous and partly cartilaginous, about four and a half inches in length and three-quarters of an inch in diameter, which latter is always greater in man than woman. It extends from the lower extremity of the larynx (the organ of voice), the upper opening of which was described as lying in front of the œsophagus, protected by the epiglottis, to opposite the third dorsal vertebra, where it divides into two bronchi, one for each lung. The right bronchus, wider but shorter than the left, is about an inch in length, and continues more in a straight line with the canal of the trachea than the left; from which cause, and on account of its greater width, any foreign substance introduced into the windpipe almost universally falls into the right, and not into the left bronchus.

The left bronchus is nearly two inches in length, and enters the left lung on a lower level by nearly an inch than the right bronchus does the right lung. In structure the trachea and bronchi coincide; they are made up of cartilaginous rings—or rather half rings, the hinder portion of the rings being absent—and membrane, which latter completes the circle, and joins the various rings together. In the trachea there are from sixteen to twenty of these incomplete rings, in the right bronchus from six to eight, and in the left from nine to twelve. The interior of the canal is lined with mucous membrane, continuous above with that of the larynx, and below with that of the lung; overlying the cartilaginous and membranous walls are some elastic tissue and muscular fibres of the organic type.

Each lung is enclosed in a membrane called the pleura. This is one of the serous membranes, and is consequently a shut sac, having a double wall: the inner one, which covers the surface of the lung, is called the visceral; the outer, lining the walls of the thorax, the parietal portion. The space between the two is the cavity of the pleura, which in the healthy state contains a small quantity of fluid, to enable the walls to glide easily on each other without friction. The two pleuræ do not communicate, but are in relation with each other, except for a short distance in front; this space between them, which contains the heart enclosed in the pericardium and the large blood-vessels, is called the mediastinum. The right pleural sac is shorter and wider, and extends higher into the neck than the left.

The lungs, the most important organs of respiration, are two

* That is, transiently blind.

in number, the right and the left, and occupy the corresponding lateral cavities of the chest; they are conical in shape, the smaller end of the cone being placed the highest, and extending into the root of the neck from an inch to an inch and a half above the level of the first rib; the broad base of each lung rests upon the diaphragm, and extends lower behind than in front. Each lung is composed of two parts, called the upper and the lower lobes, which are separated from each other by a fissure. In the right lung the upper lobe is partly split into two by a shorter fissure, so that the right lung is said to have three lobes, whilst the left has only two. The right lung is always the largest; it is broader than the left, in consequence of the greater divergence of the heart to the left side; but this is in some measure compensated for by its being shorter, because of the liver forcing up the diaphragm to a higher level on the right side. About the centre of the inner surface of each lung is a spot where the bronchus, the pulmonary artery, and pulmonary vein, and nerves enter the substance of the lung; these structures, together with arteries and veins proper to the bronchus and the bronchial glands, are all enclosed in a process of the pleura, and form what is called the root of the lung. The two lungs taken together in the adult weigh from two pounds and three-quarters to three pounds; they are heavier in the male than the female. The colour of the lung varies with the age of the individual. At birth they are of a pinkish white; in the adult they become mottled with patches of a dark slate-colour, in consequence of the deposit of colouring matter of a carbonaceous character; as old age advances, these patches become nearly black. The substance of the healthy lung is light and spongy, floating in water, and crackling when handled, a frothy fluid being squeezed out. In disease it often becomes solid, and is then heavier than water, and contains no air; this is one of the results of inflammation of the lungs.

We must now consider the minute structure of these curious organs. The substance proper of the lung is enclosed in a serous coat, derived from the pleura, and is made up of an infinite number of small divisions, called lobules, which, though closely bound together by connective tissue, are still quite distinct from each other. Each lobule is composed of a number of cells, called air-cells, clustered upon, and opening into, the terminal branches of the bronchi, with the minute divisions of the blood-vessels and nerves. When the bronchus enters the lung it divides into two, and these branches repeat the process until the ultimate ones have a diameter of less than the $\frac{1}{100}$ of an inch. In the largest branches the structure remains the same as in the bronchus; they have walls, formed of tough membrane and imperfect cartilaginous rings, by which they are held open; but as they attain their greater degree of minuteness, the walls consist simply of membrane. Into these smaller ones the air-cells open, and over them the pulmonary capillaries spread their close network. The air-cells vary much in form, according to the amount of pressure to which they are subjected; their walls, which are nearly in contact, are formed of very thin membrane. The size of an air-cell is from the $\frac{1}{200}$ to the $\frac{1}{70}$ of an inch in diameter; they communicate freely with each other, and are, as before stated, arranged in groups along the sides of the bronchial tubes. It has been estimated that the total number in the lungs exceeds 600,000,000. Outside of these cells and tubes the capillary plexus is so dense, that the meshes are narrower than the vessels which compose them; the capillaries here have an average diameter of the $\frac{1}{3000}$ of an inch. Thus the blood is brought into the most intimate relation with the air contained in these myriads of cells, there being nothing interposed between them but the very thin walls of the cells and capillaries, and frequently, this bringing the blood and air together, is even more perfectly provided for, as one capillary will often have a layer of air-cells on each side of it. The cells of one lobule do not communicate with those of another, and consequently if the bronchial tube going to a lobule become stopped, the supply of air to that lobule ceases, and it is rendered useless.

The function of respiration consists of two distinct acts, called respectively inspiration (by which the lungs are inflated with air) and expiration (by which the air, after having served its purpose, is driven out of the lungs). To understand this process, we must fix firmly in our minds the conditions under which it is performed. The highly elastic lungs are enclosed in the cavity of the thorax, the bony framework of which is completed in all its deficient parts by muscular structure, and the capacity of which is capable of great alteration by muscular agency. Likewise we must remember that in the healthy living body no such thing as the cavity of the thorax exists; the lungs and heart completely fill up this space, and are in close relation to its walls in every part. The result of these arrangements is that when by any means the capacity of the chest is diminished, air is driven out of the lungs, and when the pressure is removed the lungs by their elasticity expand and follow the walls of the thorax, and so create a vacuum in some of the air-cells, and the atmospheric air at once rushes in through the windpipe to fill the empty cells. During inspiration, the capacity of the chest is, as a rule, increased in every direction, but the way in which this increase is obtained varies in different instances. In young children the act of inspiration is performed almost entirely by the diaphragm, which, descending, forces down the contents of the abdomen, and so increases the size of the chest. In the adult, in addition to the diaphragm, which still performs a large part of the work, the elevation of the ribs by the numerous muscles attached to them comes into play; and in consequence of the way in which the ribs are articulated with the spine, and their cartilages with the breastbone, making the centre of the rib the lowest point, any raising of the ribs at the same time draws them outwards, and the ends being both more or less fixed tends to bring the ribs into nearly a straight line with the cartilages, and so, as a matter of course, enlarges in a very marked degree the capacity of the chest. This action will be at once understood, if reference be made to the illustration of the thorax, given in one of the earlier lessons on this subject. The chest and lungs during expiration resume their ordinary size by reason of their elasticity, which in deep expiration is aided by the abdominal muscles contracting and forcing up the diaphragm, which remains passive during expiration.

The quantity of air changed at each inspiration varies in different people, and this variation has been taken as a measure or index of the physical strength and constitution of the individual. Thus it has been found by experiment that a healthy man five feet seven inches in height can expire 225 cubic inches of air, and that for every additional inch of stature an increase of eight cubic inches in the capacity takes place. This rule is not much affected by the weight of the person, but age is found to modify it to a certain extent; thus the capacity increases from about the fifteenth to the thirty-fifth year, and then gradually diminishes. The number of respirations in the minute is, on an average, from fourteen to eighteen in a state of repose of body and mind; but this is liable to great variation from disease, mental emotion, or physical exertion.

The purpose of this function of respiration is to submit the blood charged with the waste material of the body to the purifying action of the air; from this contact of the blood with the air, certain changes are induced in both the blood and the air; these must now be examined, and, as a preliminary, we must stop for a minute, and see of what the atmospheric air is composed. In almost all positions the composition of the air is identical, and for our present purpose it will be enough to say that it contains oxygen, nitrogen, carbonic acid, and watery vapour. There is in it about 21 per cent. of oxygen to 79 per cent. of nitrogen by measure, or 23 per cent. of oxygen to 77 per cent. of nitrogen by weight. The quantity of carbonic acid is very small, not more than 4 to 5 parts in 10,000. The quantity of water in a state of vapour varies greatly, being influenced by temperature and other causes; but it is never entirely absent from the atmosphere. The changes which take place in the air during respiration are as follow: First, the oxygen is diminished; secondly, the carbonic acid is increased; thirdly, the temperature is raised; fourthly, the moisture is increased. Of these changes the first two are by far the most important, and may be considered together, as one is in a great measure dependent on the other. The oxygen is diminished, because it is absorbed, and enters into combination with the surplus carbon of the system, to form carbonic acid—not that the whole of the oxygen absorbed is utilised in this manner; some of it, doubtless, assists in forming some of the other compounds carried out of the body by means of the skin and kidneys. The quantity of oxygen absorbed varies with different circumstances and in different individuals. Animals of a small size consume a much larger quantity in proportion to their size than larger ones. The kind of food on which an animal lives also influences the consumption; it is considerably greater on an animal than on a farinaceous diet.

The increase of the carbonic acid is mainly dependent on the absorption of oxygen, and this, therefore, is also affected by like circumstances. In an ordinary way, it is calculated that a man exhales 173 grains of carbon per hour, or rather more than eight ounces in the twenty-four hours. Other authorities place it as low as five, whilst Liebig estimates the amount from the skin and lungs together at nearly fourteen ounces. Age and sex have some influence in this matter: thus, the amount in males regularly increases from eight to thirty years of age, and from forty to extreme old age steadily diminishes. Temperature also affects the result, the higher the temperature the less the amount of carbonic acid exhaled. If the air is impure, as where there is not sufficient ventilation, and in consequence the same air is breathed more than once, the quantity of carbonic acid is diminished, showing that in the absence of the proper proportion of oxygen, the necessary purification of the blood does not take place. By food the quantity is increased, by fasting it is diminished; physical exertion increases it; rest, especially sleep, diminishes it. The temperature of the expired air is in almost all cases raised, its average heat being about 98 to 99 degrees. The moisture is also always increased, the increase being greater the dryer the air is before it is inspired, the expired air being always nearly saturated with moisture. The quantity of water given off by the lungs during the twenty-four hours is estimated to vary from six to twenty-seven ounces.

The changes produced in the blood during respiration are manifested, first, by change of colour—the dark venous blood acquiring the bright arterial hue during its passage through the lungs; secondly, by the temperature of the blood being raised by the same process. The way in which the oxygen inspired is absorbed, and the carbonic acid expired is formed, has been much disputed. It used to be formerly held that the oxygen at once, at its entrance into the lungs, combined with the carbon contained in the blood, and thus formed the carbonic acid; but it has now been conclusively shown that though, no doubt, some of the carbonic acid is produced in this way, yet the greater part exists already in the blood by the time it reaches the lungs. The origin of this, the larger part of the carbonic acid, is thus explained:—When the venous blood is passing through the lungs, it gives up the carbonic acid with which it is charged, and absorbs the oxygen, the red corpuscles being credited with the greater part of this work; the oxygen thus held in solution, and not in combination, by the aërated blood, is conveyed by the arteries to the capillary system, where it is brought into intimate relation with the elementary tissues, and the oxygen assists in the nutrition of the system, and, combining with the waste carbon of the worn-out structures, forms carbonic acid and water, which are conveyed by the veins back to the lungs, there to be removed from the body. In their office of purification the lungs are powerfully assisted by the skin. From the whole surface of the body there is constantly going on an exudation of watery fluid containing many elements derived from the wasted tissue—and, notably, carbonic acid. It is very difficult to estimate the amount of carbonic acid thus excreted, but the importance of the proper performance of this function of the skin is proved by the fact that animals whose skin had been covered with an impermeable varnish, and thus prevented from doing its duty, soon died with all the symptoms of suffocation. This also shows how necessary for the preservation of health it is that the skin should be kept healthy and active by the free use of baths, etc., to clear away the exuded material from its surface.

Closely connected with this function of respiration is the question of animal heat, and the causes which produce and maintain it; the chief, if not the only one, is that combination of oxygen with the various other elements of the body, which is mainly brought about by respiration. The formation of carbonic acid, water, etc., in the body are all instances of chemical action, and heat is necessarily produced; and as these changes are continually going on in all parts of the body, it follows that a greater or less amount of increase of temperature is also being constantly brought about. And it has been conclusively shown by experiment that sufficient, or nearly sufficient, heat is produced during these processes to account for all the animal heat of the body.

LESSONS IN ALGEBRA.—XL.

CONTINUED GEOMETRICAL PROPORTION OR PROGRESSION.

WHEN all the ratios of a series of proportionals are equal, the quantities are said to be in *continued proportion* or *progression*.

As arithmetical proportion continued is arithmetical progression, so geometrical proportion continued is geometrical progression. It is sometimes called progression by quotient.

The numbers 64, 32, 16, 8, 4, are in continued geometrical proportion.

In this series, if each preceding term be *divided* by the common ratio, the quotient will be the following term. Thus,

$$\tfrac{64}{2} = 32, \text{ and } \tfrac{32}{2} = 16, \text{ and } \tfrac{16}{2} = 8, \text{ and } \tfrac{8}{2} = 4.$$

If the order of the series be *inverted*, the proportion will still be preserved, and the common divisor will become a multiplier. In the series 4, 8, 16, 32, 64, etc.,

$$4 \times 2 = 8, \text{ and } 8 \times 2 = 16, \text{ and } 16 \times 2 = 32, \text{ etc.}$$

Quantities then are in geometrical progression when they increase by a common multiplier, or decrease by a common divisor.

This common multiplier or divisor is called the *ratio*. For most purposes, however, it will be more simple to consider the ratio as always a *multiplier*, either integral or fractional.

In the series 64, 32, 16, 8, 4, the ratio is either 2 considered as a divisor, or $\frac{1}{2}$ considered as a multiplier.

When several quantities are in *continued* proportion, the *number of couplets*, and of course the *number of ratios*, is *one less* than the number of quantities. Thus the five proportional quantities, a, b, c, d, e, form four couplets containing four ratios; and the ratio of $a : e$ is equal to the ratio of $a^4 : b^4$, that is, the ratio of the fourth power of the first quantity to the fourth power of the second. Hence,

If *three* quantities are proportional, *the first is to the third as the square of the first to the square of the second, or as the square of the second to the square of the third.* In other words, the first has to the third a *duplicate* ratio of the first to the second. And conversely, if the first of the three quantities is to the third as the square of the first to the square of the second, the three quantities are proportional.

If $a : b :: b : c$, then $a : c :: a^2 : b^2$. And universally,

If *several* quantities are in continued proportion, the ratio of the *first* to the *last* is equal to one of the intervening ratios raised to a power whose index is one less than the number of quantities.

If there are *four* proportionals, a, b, c, d, then $a : d :: a^3 : b^3$.

If there are *five*, a, b, c, d, e; $a : e :: a^4 : b^4$, etc.

If several quantities are in continued proportion, they will be proportional when the order of the whole is *inverted*. This has already been proved with respect to *four* proportional quantities. It may be extended to any number of quantities.

Between the numbers,	64, 32, 16, 8, 4,
The ratios are,	2, 2, 2, 2.
Between the same inverted,	4, 8, 16, 32, 64,
The ratios are,	$\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$.

So if the order of any proportional quantities be inverted, the ratios in one series will be the *reciprocals* of those in the other. For by the inversion each antecedent becomes a consequent, and *vice versâ*; but the ratio of a consequent to its antecedent is the reciprocal of the ratio of the antecedent to the consequent. That the reciprocals of equal quantities are themselves equal is evident from Ax. 4.

To investigate the properties of geometrical progression, we may take nearly the same course as in arithmetical progression, observing to substitute continual *multiplication and division*, instead of addition and subtraction. It is evident, in the first place, that,

In an *ascending* geometrical series, each succeeding term is found by *multiplying the ratio* into the preceding term.

If the first term is a, and the ratio r,

Then $a \times r = ar$, the second term; $ar \times r = ar^2$, the third; $ar^2 \times r = ar^3$, the fourth; $ar^3 \times r = ar^4$, the fifth, etc.

And the series is a, ar, ar^2, ar^3, ar^4, ar^5, etc.

If the *first term* and the *ratio* are the *same*, the progression is simply a series of powers.

If the first term and ratio are each equal to r,

Then $r \times r = r^2$, the second term; $r^2 \times r = r^3$, the third; $r^3 \times r = r^4$, the fourth; $r^4 \times r = r^5$, the fifth.

And the series is $r, r^2, r^3, r^4, r^5, r^6$, etc.

In a *descending* series, each succeeding term is found by *dividing* the preceding term by the ratio, or *multiplying* by the fractional ratio.

If the first term is ar^6, and the ratio r,

$$\text{The second term is } \frac{ar^6}{r}, \text{ or } ar^6 \times \frac{1}{r} = ar^5.$$

And the series is $ar^6, ar^5, ar^4, ar^3, ar^2, ar, a$, etc.

If the first term is a, and the ratio r,

$$\text{The series is } a, \frac{a}{r}, \frac{a}{r^2}, \frac{a}{r^3}, \text{ etc., or } a, ar^{-1}, ar^{-2}, \text{ etc.}$$

1st. 2nd. 3rd. 4th. 5th. 6th.

By attending to the series, $a, ar, ar^2, ar^3, ar^4, ar^5$, etc., it will be seen that, in each term, the exponent of the power of the ratio is *one less* than the number of the term.

If then $a =$ the first term, $r =$ the ratio,
$z =$ the last, $n =$ the number of terms,
we have the equation $z = ar^{n-1}$, the last term; that is,

In geometrical progression, *the last term is equal to the product of the first into that power of the ratio whose index is one less than the number of terms.*

When the first term and the ratio are the *same*, the equation becomes $z = rr^{n-1} = r^n$.

Of the four quantities, a, z, r and n, any *three* being given, the other may be found.

1. By the last article,

$$z = ar^{n-1} = \text{the } \textit{last term.}$$

2. Dividing by r^{n-1},

$$\frac{z}{r^{n-1}} = a = \text{the } \textit{first term.}$$

3. Dividing the 1st by a, and extracting the root,

$$\left(\frac{z}{a}\right)^{\frac{1}{n-1}} = r = \text{the } \textit{ratio.}$$

By the last equation may be found any number of *geometrical means* between two given numbers. If $m =$ the number of means, $m + 2 = n$, the *whole* number of terms. Substituting $m + 2$ for n in the equation, we have,

$$\left(\frac{z}{a}\right)^{\frac{1}{m+1}} = r, \text{ the } \textit{ratio.}$$

When the ratio is found, the means are obtained by continued multiplication.

The next thing to be attended to is the rule for finding the *sum of all the terms.*

If any term, in a geometrical series, be multiplied by the ratio, the product will be the succeeding term. Of course, if *each* of the terms be multiplied by the ratio, a new series will be produced, in which all the terms except the last will be the same, as all except the first in the other series. To make this plain, let the new series be written under the other, in such a manner that each term shall be removed one step to the right of that from which it is produced in the line above.

Take, for instance, the series, 2, 4, 8, 16, 32.
Multiplying each term by the ratio, 4, 8, 16, 32, 64.

Here it will be seen at once that the last four terms in the upper line are the same as the first four in the lower line. The only terms which are not in *both*, are the *first* of the one series, and the *last* of the other. So that when we subtract the one series from the other, all the terms except these two will disappear, by balancing each other.

If the given series is, $a, ar, ar^2, ar^3, \ldots ar^{n-1}$.
Then mult. by r, we have $ar, ar^2, ar^3, \ldots ar^{n-1}, ar^n$.

Now let $s =$ the sum of the terms.

Then, $s = a + ar + ar^2 + ar^3, \ldots + ar^{n-1}$.
And mult. by r, $rs = ar + ar^2 + ar^3, \ldots + ar^{n-1} + ar^n$.

Subt. the first equation from the second, $rs - s = ar^n - a$.

And dividing by $(r - 1)$, $s = \dfrac{ar^n - a}{r - 1}$.

In this equation, ar^n is the last term in the new series, and is therefore the product of the ratio into the last term in the *given series.*

Therefore, $s = \dfrac{rz - a}{r - 1}$, that is,

To find the sum of a geometrical series:

Multiply the last term into the ratio, from the product subtract the first term, and divide the remainder by the ratio less one.

EXAMPLE.—If in a series of numbers in geometrical progression, the first term is 6, the last term 1458, and the ratio 3, what is the sum of all the terms?

$$s = \frac{rz - a}{r - 1} = \frac{3 \times 1458 - 6}{3 - 1} = 2184. \quad \textit{Ans.}$$

EXERCISE 71.

1. Find two geometrical means between 4 and 256
2. Find three geometrical means between $\frac{1}{9}$ and 9.
3. If the first term of a decreasing geometrical series is $\frac{1}{2}$, the ratio $\frac{1}{3}$, and the number of terms 5, what is the sum of the series?
4. What is the sum of the series 1, 3, 9, 27, etc., to 7 terms?
5. What is the sum of ten terms of the series 1, $\frac{1}{3}$, $\frac{1}{9}$, $\frac{1}{27}$, etc.?
6. If the first term of a series is 2, the ratio 2, and the number of terms 13, what is the last term?
7. What is the 12th term of a series, the first term of which is 3, and the ratio 3? Also find the sum of the series.
8. A man bought a horse, agreeing to give one farthing for the first nail in his shoes, three for the second, and so on. The shoes contained 32 nails; what was the cost of the horse?

Quantities in geometrical progression are proportional to their differences.

Let the series be a, ar, ar^2, ar^3, ar^4, etc.

By the nature of geometrical progression,

$$a : ar :: ar : ar^2 :: ar^2 : ar^3 :: ar^3 : ar^4, \text{ etc.}$$

In each couplet let the antecedent be subtracted from the consequent.

Then $a : ar :: ar - a : ar^2 - ar :: ar^2 - ar : ar^3 - ar^2$, etc.

That is, the first term is to the second, as the difference between the first and second to the difference between the second and third; and as the difference between the second and third to the difference between the third and fourth, etc.

If quantities are in geometrical progression, their *differences* are also in geometrical progression.

Thus the numbers 3, 9, 27, 81, 243, etc.
And their differences 6, 18, 54, 162, etc.,
are in geometrical progression.

Problems in geometrical progression may be solved, as in other parts of algebra, by means of equations.

EXAMPLE.—Find three numbers in geometrical progression, such that their sum shall be 14, and the sum of their squares 84.

Let the three numbers be x, y, and z.

By the conditions, $x : y :: y : z$, or $xz = y^2$
And $x + y + z = 14$.
And $x^2 + y^2 + z^2 = 84$.

From these three equations, x, y, and $z = 2$, 4 and 8. *Ans.*

EXERCISE 72.

1. There are three numbers in geometrical progression whose product is 64, and the sum of their cubes is 584. What are the numbers?
2. There are three numbers in geometrical progression: the sum of the first and last is 52, and the square of the mean is 100. What are the numbers?
3. Of four numbers in geometrical progression, the sum of the first two is 15, and the sum of the last two is 60. What are the numbers?
4. A gentleman divided £210 among three servants, in such a manner that their portions were in geometrical progression; and the first had £90 more than the last. How much had each?
5. There are three numbers in geometrical progression, the greatest of which exceeds the least by 15; and the difference of the squares of the greatest and the least is to the sum of the squares of all the three numbers as 5 to 7. What are the numbers?
6. There are four numbers in geometrical progression, the second of which is less than the fourth by 24; and the sum of the extremes is to the sum of the means as 7 to 3. What are the numbers?

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XXXIX.

EXERCISE 70.

1. $3\frac{1}{2}$.	7. 20 and 24.	12. 25 gallons of rum, 5 gallons of brandy.
2. 24 and 32.	8. 30 bushels at first; sold $13\frac{1}{2}$ bushels.	13. 24 and 16.
3. 10 and 8.	9. 15 and 9.	14. 20 and 16.
4. 8 and 6.	10. 10 and 2.	[illegible] 32 and 18.
5. 6.	11. 18 an[illegible]	
6. 4 and 6.		

RECREATIVE SCIENCE.—XXI.

THE PHENAKISTISCOPE—BEALE'S AUTOMATIC FACE—THE WHEEL ANIMALCULE.

HALF a century ago an amusing toy was invented, called the Phenakistiscope, from the Greek φενακιζω, to deceive. It consisted of a number of devices painted round the circumference of a disc, each device similar in its general subject, but having a difference of position in some of its details in each successive compartment; in short, a complete action, as that of a ball running around the interior of a ring, was finished in twelve repeats of the device.

The method of observing the singular illusion of the phenakistiscope, until Mr. Rose's kalotrope was invented, was to look upon its reflection in a mirror, through slits or openings in the disc, whilst it was in rapid revolution. This mode of using the disc of course confined its use for the time to one individual; and notwithstanding repeated attempts by the optician, no movement had been contrived by which the illusion could be shown to an entire audience.

Since the invention of this interesting toy, various eminent opticians sought earnestly for the means of showing it to a whole company at once, and this with a view to making it a powerful and interesting aid in the production of effects to be exhibited by the magic lantern. All attempts before the invention of Mr. Rose's kalotrope, failed, either from want of efficiency, or from their being too intricate and expensive, or from both of these causes together.

An apparatus for the magic lantern, constructed by Messrs. Duboscq, answered pretty fairly, but was very limited in its results, and this was quite superseded by the larger and more scientific contrivance invented and given to the writer by Mr. Rose, called the Photodrome (*light-runner*, or *light-course*), already alluded to at page 233 of this volume of the POPULAR EDUCATOR.

A further interest was imparted to this class of optical deceptions by the construction of the Zoetrope, or Wheel of Life, by which a large family party may be amused by the curious movements of various figures seen through slits in a revolving circular box, in which the slips of paper bearing the devices are placed, and changed at pleasure. The enormous sale of these toys reminds the historian of optical toys that the like success attended the sale of Sir David Brewster's kaleidoscope; indeed, the popularity of both contrivances brings home to us the truth of Goldsmith's words—

> "And still they gazed, and still the wonder grew."

And deservedly so, for both have become regular inmates of the toy cupboard. There are, however optical contrivances which take a high position on account of the very ingenious manner in which they are contrived; and amongst machines that illustrate the various phases of "persistence of vision," none are more interesting than those invented by Mr. John Beale, of Greenwich—invented not for any personal advantage, but for the advancement of scientific recreation.

The first to be described is the "Automatic Picture," in which the face of a charming young lady, waking from an apparent lethargy, rolls its eyes, opens and shuts its mouth, and occasionally, for the special delectation of "rude" boys, pops out its tongue, or varies the amusement by grinning "horribly a ghastly smile," very provocative of merriment, and useful, as Dr. Walcot says, for

> "Care to our coffin adds a nail, no doubt;
> And every grin, so merry, draws one out."

In Fig. 1 two standards, A A, carry the shaft, B, which is turned by the handle, C. A wheel, D, keyed on to the shaft, B, drives a pinion, E, say in the ratio of two to one; the pinion carries round a shaft, having fixed on it a slotted disc, F, perforated with eight radial slots or apertures. When a powerful artificial light, either the oxy-hydrogen, or lime-light, or electric light, is arranged in a box with a condensing lens, so as to throw the point of the cone of rays, or focus of rays, through one of the apertures, and of course, when the slotted disc rotates, eight flashes of light will pass at each revolution, and as the wheel and pinion are two to one, sixteen flashes of light will pass, and illuminate the screen G when the automatic face is shown for each turn of the handle C.

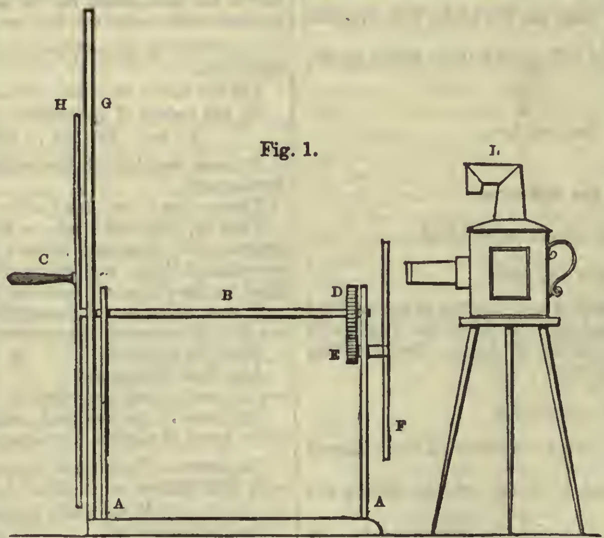


Fig. 1.

Let us now suppose that on the screen G the smart hat and feathers, curls, neck, shoulders, and bust of a young lady are depicted, but that, instead of a face being shown, an opening is cut through the screen G of the size of the human face, and that on the circular disc, or card, H (Fig. 2), which is carried round by the shaft B, and is behind though close up to the screen G, sixteen faces are so arranged that one of these faces shall be in the right position to register with the hole cut through the screen G at each flash of light, so that the face and the hat, curls, neck, shoulders, bust, make up together one complete picture of the human face divine. It is evident that if the sixteen faces were all painted *alike*, the resultant picture would, when the discs were revolving and the flashes of brilliant light illuminating the screen G, be apparently the same as when the apparatus was at rest, *i.e.*, when any one of the sixteen drawings of the faces is flush with the opening cut through the screen G. If, however, the sixteen faces are all painted with different expressions, viz., one of them with the eyes and mouth closed, the next with the eyes and mouth a trifle open, and so on with each succeeding picture of the series, opening the eyes and mouth more and more, then an appearance of opening the eyes and mouth would be given, but, like all other illusions of this class, a mere repetition of the same effects in fixed order would be produced. Mr. Beale's *automatic face* apparatus enables the experimentalist to produce a novel and curious spontaneous movement on the part of the "lady," who elegantly diversifies the effects already mentioned by thrusting out her tongue occasionally.

This part of the illusory effect is thus obtained: the sixteen faces form two distinct groups of eight each, as arranged and painted on the card disc, Fig. 2; the figures 1 to 8 are faces arranged as already described, showing by a series of gradations the opening and shutting of the eyes and mouth; and the letters *a* to *h* are the other group, showing eyes always open, but rolling from side to side, and instead of displaying the opening and shutting of the mouth, suppose the tongue to be gradually protruded so as to hang in a négligé style over the chin, it is evident that the operator has two groups of face pictures painted on the same disc, making different motions.

It must be remembered that the sixteen faces are successively illuminated by flashes of light through the eight slots, or apertures, and it will be seen that if every other slot is closed, so as to leave four apertures open, they will illuminate one group of the sixteen faces; and if those slots are closed in their turn, the other four apertures will illuminate the second group of the sixteen faces.

To enable the operator to do this, there is placed in front of the slotted disc another disc called the *interceptor*—which in fact constitutes the novelty in the mechanism of the "automatic face"—so arranged as to allow every other slot to be open, and every other slot to be closed; and this *interceptor* is not fixed tightly on the shaft, but is driven merely by friction with the surface of the slotted or perforated disc. It must necessarily occur that in the course of movements the *interceptor* allows sometimes one group of painted faces, and sometimes another, to be seen; but shifting its position at varying and uncertain intervals of time, it produces an effect which gives the spectator the idea that the lady is truly "automatic," and can do as she pleases.

The interceptor is shown at Fig. 3, with the face in front of it, and the curtains should always be arranged so as to hide the automatic lady until the shaft B (Fig. 1) is in motion, and all light, except that passing through the slots from the oxy-hydrogen lantern, carefully excluded. Of course other figures may be used, but there are none better than the one suggested, because refinement should be a matter of course with the fair sex; and it seems to be such a libel on a pretty face to convict it of a want of good breeding, and to verify part of Doctor Johnson's epitaph for Hogarth—

> "The attentive eyes,
> That saw *the manner* in the face."

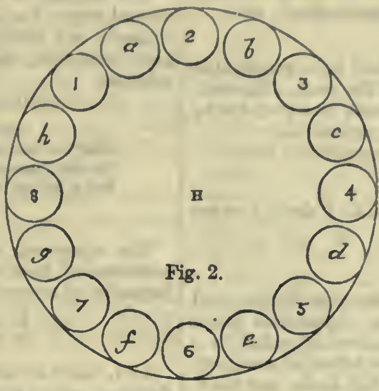


Fig. 2.

The spectator will see the tongue sometimes thrust out, and the eyes wildly rolling for a dozen times in succession; then perhaps the eyes suddenly close or open, and the mouth gapes wide open; and then, in the middle of an elegant yawn, the mouth is suddenly closed, and the tongue protruded, because the *interceptor* changes its position by variations in the friction of the perforated wheel, and always at uncertain and varying intervals. To recapitulate, Fig. 1 shows the whole apparatus in section; Fig. 3, the back of the slotted disc and the *interceptor*, the lantern being removed to allow the latter to be well shown. The lantern throws the light through the slots to the face, which is concealed by the curtains until the movements are commenced and the room darkened. Fig. 2 is the cardboard disc, upon which the sixteen faces are painted in groups, as already described; and this works behind the screen upon which the hat, curls, neck, shoulders, etc., of the "automatic lady" are depicted.

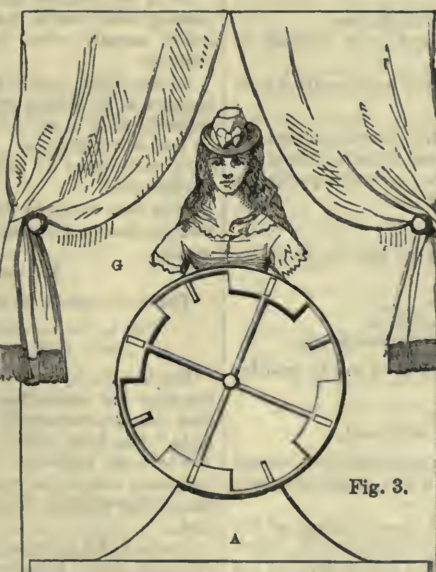


Fig. 3.

By artificial means the semblance of nature is given to a picture of the human face; but even here it cannot be said that the idea is new, because Nature herself appears to simulate motions, some of which attracted the attention of Faraday, and formed part of the subject of a very interesting paper written by him in the *Journal of the Royal Institution*, vol. i., p. 220. The paper refers to the curious appearance exhibited by the "Wheel Animalcule."

This little insect has been well described by Mr. Baker and others, and can only be viewed distinctly under a high magnifying power; it then presents an elongated, sack-like form, either attached by the posterior part to the side of the vessel containing the water in which it exists, or else floating in the fluid. When the effect in question is observable, there is seen the appearance of two wheels, one on each side of the head; they seem formed of deep teeth or short radii, perhaps fourteen or fifteen in number. The form of these teeth is not sharp or well defined, but hazy at the edges; the interval between them is perhaps rather more than the width of the teeth. The teeth are not distinctly set on to a nave or axis, but appear sometimes even to melt away, or attenuate, at the part towards the centre, and sometimes appear as independent portions, *i.e.*, as much separated from the centre part, or supposed place of attachment, as from the neighbouring teeth.

These parts are never seen as wheels, except in motion; the animal is sometimes seen without them, the parts which produce the appearance being then either retracted and drawn inwards, or disposed in other forms, for the animal is of a very changeable nature. The motion of the wheels is continuous, as if they were spinning constantly in one direction upon their axis; the velocity is such as to carry the teeth rapidly before the eye, but is not enough to confound the impression of one tooth with that of its neighbour, and therefore they may be distinctly seen.

In this and a former lesson the toy called the Zoetrope, or Wheel of Life, has been mentioned, and, as it is a simple contrivance, and easy of construction, we may as well give a detailed description of it here, so that any of our readers who are mechanically inclined may be able to make one for themselves.

First it is necessary to procure a circular disc of wood, ten inches in diameter and half an inch or rather more in thickness. This disc should be made to revolve freely on an iron pin put into a handle like the handle of a skipping-rope or bradawl, which must have a disc of wood about three inches in diameter at the top, on which the larger disc may rest, and which will prevent it from having an oscillating motion from side to side when it is turned rapidly round. The larger disc should be prevented from slipping off the pin on which it revolves by means of a small nut. A long screw passed through the larger disc into the handle will do as well as the iron pin and nut.

Next take a strip of pasteboard thirty-three inches in length and seven in breadth. This will be enough to go round the disc and leave one and a half inches for lapping over and joining up the pasteboard into a cylindrical form, which may be effected by a few stitches, or by means of brass rivets similar to those generally used by shoemakers and staymakers. Having done this, divide the pasteboard into two equal parts by a line drawn along its length, and in the upper part cut eleven or thirteen vertical slits, two and three-quarters inches long and three-sixteenths of an inch broad, at equal distances from one another, the bottom of each slit touching the line drawn across the pasteboard. Care must be taken to cut the slits in such a manner that there may be the same distance between the slits at each end when the cylinder is joined up as there is between any two of the slits; and before cutting them out it will be as well to paste white paper on the side of the pasteboard intended for the *inside* of the cylinder and black paper on the *outside*. The slits should then be cut out with a sharp penknife. When the cylinder has been joined up so as to fit exactly round the disc, it may be fastened to it by means of a few iron tacks, taking care that the perforated part remains uppermost.

Strips of paper, three inches wide and long enough to fit round the interior of the cylinder and lap over a little, should now be taken, and figures, similar in form and colour, but in different attitudes, drawn on them. The figures should be *equal in number to the slits in the cylinder*, and so drawn that when the strip is placed within it a figure may appear exactly under each slit. When the above directions have been attended to, and the cylinder is caused to revolve by the hand, the eye being at the same time directed to the interior through the slits, the figures will appear to be endowed with motion.

LESSONS IN ENGLISH.—LIV.

VARIOUS FORMS OF THE SUBJECT OF A PROPOSITION.

We now come to the noun *man* in our model sentence—

The sick *man* copiously drinks.

The noun *man* is the subject to the verb *drinks*. We thus see that a noun may be the subject of a proposition. Is there any other part of speech that may be the subject of a proposition?

1. An adjective may be the subject of a proposition; as—

The sick drink.

But here it must be observed that for *drinks* I have substituted *drink*, the plural for the singular form of the verb. The rule then is, that *adjectives when used in the plural, and preceded by the definite article, may be the subject of a proposition.*

2. A pronoun may be the subject of a proposition; as—

I, the sick man, drink.

Here *I* is the subject to the verb *drink*, as *I drink;* so we may say—

You, the sick man, drink.
I, you, we, they drink.

These additions to the subject modify the signification, and offer instances of what is called *apposition*. Apposition (from ad, *to*, and pono, *I place*) exists when a noun is added to a pronoun or a noun in order to explain the intended meaning. Thus here it is not *I* merely that drinks, but *I, the sick man.* Instead of a pronoun, you may have a noun; as—

Alexander, the son of Philip, conquered Darius.

Apposition takes place in the object as well as in the subject; as in this sentence:—

Wine overcame Alexander, *the son of Philip.*

3. An infinitive mood may be the subject of a proposition; as—

To labour is pleasant.

Other words may be connected with the infinitive mood; as—

A Noun.—To drink *water* is pleasant.
A Noun and Adjective.—To drink *good water* is wholesome.
A Noun, Adjective, and Adverb.—To drink *good water copiously* is wholesome.

4. A present participle may be the subject of a proposition; as,

Drinking is bad.

Drinking has here the force of a noun, while it retains also its participial force. That it is a noun is clear from its being the subject to the verb *is*. That it has also the force of a participle is clear from its power to govern an object; as—

Drinking *spirits* is bad.

As a noun, *drinking* may be qualified by an article, an adjective, and a personal pronoun; as—

Article.—*The* drinking was injurious.
Adjective.—*Much* drinking is very injurious.
Pers. Pron.—*His* drinking has been injurious to him.

Equally may the participial force carry with it words qualifying the object; as—

Drinking *pure water* is wholesome.
Drinking *even a glass of wine* may be blamed.

This last sentence presents a subject compounded of several words, for the subject to the verb *may* is the clause *drinking even a glass of wine.*

Here is a clear and striking instance of the advantage of the term *subject* over the term *nominative* or *nominative case.* These words are the subject, but they are not the nominative of the verb *may*. The nominative case must be restricted to *drinking.*

A past participle may be added to a present participle, so as to form the subject of a proposition; as—

Being involved in debt drove him from his country.

Here, too, qualifying words may be introduced; as—

Being *greatly* involved in debt, etc.

The past participle itself cannot, however, be a subject to a proposition. We may indeed say—

Driven is a past participle;

but here *driven* is used in a general sense as a noun, and may have prefixed to it these terms, *the word;* as, "the word *driven* is a noun."

When this participial noun has the article connected with it, it in a measure loses its participial force, and, becoming a noun, is connected with a second noun by means of a preposition; as—

The driving *of* the cattle was blamed.

With the noun, however, adverbs may be joined; as—

The driving *off* of cattle is a crime at law.

The subject of a sentence is sometimes a proposition, or several words introduced by an adverb or a preposition. Such subjects are likely to give the learner trouble; I therefore give specimens, marking the words which form the several subjects.

COMPOUND OR ADVERBIAL SUBJECTS.

Subject.	*Predicate.*
That too much care can injure	is a dangerous doctrine.
By what means I may serve you	is unknown to me.
For a prince to be reduced	is a great calamity.

AGREEMENT.

The compound subjects I have now laid before you contain instances of both agreement and government. They contain instances of *agreement* in—

1. *Much* drinking is very injurious.
2. Drinking *pure* water is wholesome.

In 1, *much* is an adjective agreeing with the participial noun *drinking*, whose meaning it qualifies. In 2, *pure* is an adjective agreeing with *water*, whose meaning it qualifies.

The instances of *government* which it is chiefly important to notice are found in these propositions:—

1. Drinking *spirits* is bad.
2. Drinking *a glass of wine* is not necessary.
3. Disturbing *the peace of the Queen's subjects.*

In 1, we have the simple case of the object depending on the verb, and the rule may be given as *the object of a proposition depends on or is governed by its verb.*

In 2, we find the Norman or false genitive in the words *a glass of wine*, where the two nouns are connected by *of*, and the latter, namely, *wine*, depends on or is governed by the preposition.

In the third sentence the words *queen's subjects* present an instance of the Saxon genitive, in which the former term, *queen's*, depends on or is governed by the term *subjects*. The rule may be laid down thus:—

Of two nouns in immediate dependence, the former is in the genitive case.

This last example contains an instance of both the Norman and the Saxon genitive, and that too in combination, as in the words—

The peace *of* the Queen's subjects.

These two genitives may be indicated thus:—

THE SAXON GENITIVE.	THE NORMAN GENITIVE.
Queen's subjects.	The peace *of the subjects.*

For the Saxon genitive, the rule is that when two nouns come together the dependent noun is in the genitive case. Observe that the dependence is merely structural, as in "queen's subjects," the form *queen* becomes the form *queen's* by being dependent on *subjects*. You may state the rule thus, also, *the possessive case is the case of the possessor,* as *John's books.* Thus stated the relation is more than structural, for possession is a fact.

Instead of a noun, a clause, or several words, may govern the genitive case. Instances of this kind involve idioms that may be called peculiarly English, though similar constructions appear in Greek:—

What is the reason of *this person's hasty dismissal* of his servants?
What is the reason of this *person's dismissing his servant* so hastily?
He prevented his *army's being enclosed.*

Possessive pronouns may hold the place of the genitive; as—

This is the last time of *my acting* so imprudently.

In this instance the pronoun agrees with the participle as if it were a noun.

Sometimes the idea of possession is wholly dropped, and the participle stands alone, either simply agreeing with a noun, or with a gerundial force; as—

He produced an argument *against Moses being* the author of the Pentateuch.

Participles sometimes occur as simple participles, when in truth they have the force and should have the construction of nouns, as in the following sentence :—

Wrong.—Cyrus did not wait for the Babylonians coming to attack him.—*Rollin.*

Right.—Cyrus did not wait for the Babylonians' coming to attack him.

Compound or adverbial subjects require the verb in the singular number. Respecting pronouns considered as subjects, a few details are necessary. Pronouns that denote one person or object must have their verb in the singular number. Pronouns that denote more than one person or object must have their verb in the plural number. When two or more pronouns occur in one sentence, and refer to the same person or thing, they must be in the same gender, number, and person; as—

I saw *my* dog bite the man. | *She* came to show me *her* bonnet.

But if different persons or things are intended, the proper pronouns must be employed; as—

I saw *his* dog bite the man. | She came to show me *your* hat.

The distributive pronouns *each*, *every*, *whoever*, etc., being singular in form, should have a verb in the singular number; they should also have corresponding pronouns in the singular number; as—

Each man *is* coming for *his* wages.

"Every good gift and every perfect gift *cometh** down from above." (James i. 17.)

Whoever comes, let *him* enter.

Inaccurate speakers are wont to put the second pronoun in the plural, saying—

Whoever comes, let *them* enter.

The error is the more to be guarded against, because *every one*, etc., implies a number, and is nearly equivalent to *all*.

POSITION OF THE SUBJECT AND ITS AGREEMENT WITH THE VERB.

Position of the Subject.—The ordinary place of the subject is immediately before the verb; as—

The *sick man* drinks.

One word or more may intervene before the subject.

The subject, however, comes after the verb (1) in questions; as in this example :—

Does the sick man drink wine?

(2) With the imperative mood; as—

Go thou; *come* ye.

(3) On the expression of a strong wish; as—

May they learn wisdom by what they suffer.

(4) When the conjunction *if* is dropped; as—

Were my father alive, for "if my father were," etc.

(5) With the conjunction *nor;* as—

Nor can your turpitude be denied.

(6) In cases of emphasis; as—

Rich is the reward of the righteous.

(7) After an adverb or adverbial phrase; as—

After the infantry marched the grenadiers, *then* followed the horse.

(8) With an interposed verb; as—

"My children," *replied* the dying father, "I entreat you."

The imperative mood of the first and third person singular and plural is formed with the assistance of *let;* as—

Let him go; *let* them eat.

Here it will be observed the pronouns are in the objective case. The reason is that *let* is really an independent verb, and as such governs the objects *him* and *them* in the objective case, *go* and *eat* being infinitives depending on *let*. This is the true analysis of such sentences.

An adverb, when it begins a sentence, puts the subject after its verb; as—

"*There* will I plead with you face to face." (Ezek. xx. 35.)

Yet by no means universally; as—

"There *they* buried Abraham and Sarah." (Gen. xlix. 31.)

* An instance of two nouns combining to form one thought, and so putting the verb in the singular.

When, however, *there* is used as an expletive, the subject follows the verb; as—

"*There* shall be no night there." (Rev. xxi. 25.)

"An expletive" is a word which, according to its derivation, signifies *a word which fills* up or is redundant. A regard to idiom may sometimes require the retention of expletives.

Adverbial phrases have great force in causing the subject to take place after the verb.

AGREEMENT OF THE SUBJECT AND VERB.

While the subject of a proposition may agree with a qualifying adjective and a limiting or defining article, it specially agrees with the verb. The agreement is of two kinds, one of form, another of substance; one flexional, another logical.

We may express these facts differently, by saying that if the verb is in the plural number, its subject must be in the plural number; and if the subject is in the plural number, the verb must be in the plural number. In other words, both subject and verb take the same condition; and this is what I mean by stating that *the subject and the verb must agree.* In general, then, the rule is this :—

The subject and the verb must be in the same number and person; or, to state the same fact differently, *the subjects and their verb must agree in number and person.*

Nouns of multitude, that is, *nouns signifying many, take their verbs in the plural.*

When, however, the idea of *one* predominates—that is, when you regard the object spoken of *as a whole*, and not as consisting of parts—then a collective noun requires its verb to be in the singular number; as—

The Parliament *was* dissolved; but
The people *were* admitted to the Queen's presence;

for the word *people* gives the idea of many persons.

Nouns are of the third person. But some grammarians have ascribed all the three persons to nouns. In only one form of construction, however—namely, the form that bears the name of *apposition*—can nouns have a first, a second, as well as a third person. For example :—

Nouns in the First Person.—It is *I*, your old friend.
Nouns in the Second Person.—*Thou*, the man of my heart.
Nouns in the Third Person.—*He*, the king of the Jews.

Two or more nouns, or a noun and a pronoun, are said to be in apposition, when, being in the same number, person, and case, they refer to the same person or thing, and when the second is put in order to explain or add something in meaning to the first.

The essence of apposition is in the fact that a word or words are apposed (ad, *to*, and pono, *I put*), with a view to explain, enlarge, or qualify a foregoing noun or pronoun.

Observe that in every case of apposition there are two parts, the apposed part, and the part to which the apposition is made. Thus, in the sentence, "Richard, the king, lost his crown," the king is the apposed part, and Richard is the part to which the apposition is made.

ADVERBS: SYNTAX OF THE PREDICATE COMPLETED.

In the following phrase—

The sick man drinks copiously,

copiously is the adverb of the proposition. Instead of an adverb we may have in the proposition an adverbial phrase; as—

The sick man drinks *with freedom*.

Whatever affects the affirmation of a sentence performs the office, and may be said to hold the place, of an adverb. Phrases which in some way affect the affirmation are numerous, as they vary with the variation of time, place, and manner; as—

Time.—The sick man { yesterday drank. / on falling sick drank.

Place.—The sick man { drank in his chamber. / drank in his bed.

Manner.—The sick man { drank with eagerness. / drank at one draught.

Position of the Adverb.—The ordinary place for the adverb is immediately before or after the verb. Euphony, as well as idiom, has an influence in determining the position of the adverb. Sometimes an adverb is placed before the verb in order to allow the verb and its object to stand together; as—

The sick man *copiously* drank water.

The position of the adverb has much to do with the sense. There is a great difference between these two statements :—

Only the man went out.
The man *only went out*.

The first states that the man went out, and no one else; the second states that the man did nothing but go out.

Agreement of Adverbs.—Adverbs, though so called because they are *put* to verbs, qualify adjectives as well as verbs; as—

"Any passion that *habitually* discomposes our temper, or unfits us for *properly* discharging the duties of life, has *most certainly* gained a very dangerous ascendancy."—*Blair.*

Adjectives may also be said to qualify participles, but as the participle is only a part of the verb, a separate statement of the fact is hardly necessary.

There are elliptical forms which seem to make some adverbs independent of any verb. But the independence is only apparent. In reality every adverb on examination will be found to qualify an affirmation.

The words *yes* and *no* are exceptions. When I ask a child, "Do you love me?" and the child answers "Yes," the adverb *yes* is only an abbreviated form of the sentence *I do love you.*

No and *not* are often misused. *No* is the answer to a question when no other answer is given; *not* is prefixed to the verb employed in giving the answer; as—

Are you ill? *No.*
Are you ill? I am *not* ill.

Hence in all sentences *not* should be used; consequently "whether or no" is wrong; it should be *whether or not.*

When *not* is prefixed to the verb, and so affects or negatives the whole affirmation, if a negative is required with a succeeding member, *or* should be used; but if the *not* (or *neither*) negatives only one word or one phrase, then with the succeeding or corresponding word or phrase employ *nor;* as—

For two months I could not think or speak.
He allowed me not to speak nor to write.
He gave me neither money nor clothes.

Observe that *neither* is properly used of two only, meaning *not either*, that is, not one of two. Hence it takes in the second clause *nor.*

PARTICIPLE.

Of the predicate in the sentence,

The man drinks a beverage made of wine and water,

the word *made*, the word *of*, and the word *and* remain to be studied.

These words might have stood in the subject. Their position in either the subject or the predicate is of no importance. The only thing of importance is to show that a simple sentence may embrace all the parts of speech; for thus you learn that, when you have mastered the syntax of a simple sentence, you have mastered the essential doctrines of English grammar.

The past participle *made* offers an instance of agreement and government united in one word; for *made* agrees with *beverage*, and together with *beverage* is governed by *drinks.* In general it may be stated that *participles admit of concord and dependence.*

Participles perform other offices besides that which is strictly their own.

The present participle is used as a noun sometimes without, sometimes with a pronoun, also sometimes with and sometimes without an object; as—

"*Describing* a past event as present has a fine effect in language.—*Kames.*

The present participle may have the force of an infinitive; as—

"Avoid being ostentatious and affected."—*Blair.*

The present participle has the force of an infinitive also when combined with the past participle; as—

"Habits are soon assumed; but when we strive
To strip them off, 'tis *being flayed* alive."—*Cowper.*

A present participle may at the same time have the force and construction of a participle and a noun :—

"Mr. Dryden makes a very handsome observation on *Ovid's writing a letter* from Dido to Æneas."—*Spectator.*

The construction in this last example deserves study: the preposition *on* governs *writing* as a noun; *writing* as a noun governs *Ovid's*, and *writing* as a participle governs *letter.*

The present participle used as a noun may have a preposition or an adverb in combination with it; as—

"Their hope shall be as the *giving up* of the ghost." (Job xi. 20.)

Participles in general have the government of the verbs from which they come; consequently the question whether or not a preposition should be appended to a participle depends on the usage of the verb; often *of* is inserted where it is not needed, especially by the untaught in conversation; as—

Incorrect.—"They left *beating of* Paul." (Acts xxi. 32.)

Some verbs take a present participle after them instead of an infinitive; as—

Verbs of Desisting.—"They have done *speaking.*"—*Harris.*
Verbs of Omitting.—"He omits giving an account of them."—*Tooke.*
Verbs of Preventing.—"Our sex are prevented from *engaging* in these turbulent scenes."—*West.*
Verbs of Avoiding.—"He might have avoided *treating* of the origin of ideas."—*Tooke.*

After verbs expressive of the operations of the senses the participle or the infinitive may be used, but with a slight difference in the meaning; the participle describing the act as at the moment actually proceeding; as—

I saw the bird *fly.* | I saw the bird *flying.*

TERMS USED IN COMMERCE.—IX.

RECEIPT.—An acknowledgment in writing of having received a certain sum of money from a person named.

RE-EXCHANGE.—A charge upon the drawer of a dishonoured foreign bill of exchange upon a re-drawing by the holder. Whatever expense or damage is incurred in consequence of the dishonour of the bill is included under this head. The whole is, however, frequently consolidated by custom into fixed per-centage rates for particular places.

REFERENCE.—The direction given by a person requiring credit, to the trader of whom he requires it, to a third party, who may be questioned relative to his commercial standing.

REGISTRATION.—Registering ships at the Custom House so as to entitle them to the enjoyment of the privileges attending British-built vessels. A certificate of registry is granted, which states the build, tonnage, and names of the owners and master, and forms a proof of the nation to which a vessel belongs.

RE-INSURANCE. — A sub-insurance effected with others by insurers who have incurred too great a liability, or who have become dissatisfied with the nature of the risk they have contracted to take upon themselves.

RELEASE FOR FREIGHT.—A formal release given by the owners of vessels or their agents on receipt of an amount of freight, when notice has been previously given by them to the dock companies or wharfingers to stop delivery of the goods pending its payment.

REMITTANCE.—A sum of money or bills of exchange sent from one person to another.

RESERVE.—A fund set aside for the purpose of meeting any extraordinary contingencies or losses likely to arise in the course of business.

RESIDUE.—That which is left of an estate after all claims upon it have been satisfied.

REST.—In banking, the accumulated amount of profit applicable for the purposes of dividend.

RETURNS.—A term applied to any merchandise or bills of exchange purchased as a means of returning the proceeds of consignments received; also the amount of a trader's sales.

REVENUE.—Income derived from a collective source; usually applied to the annual receipts of a country from taxes, Customs' duties, and other sources.

REVERSION — REVERSIONARY INTEREST. — A right to the possession of money or property at a certain future period, or after the death of another.

SALARY. — A stipulated annual or periodical payment for services.

SALVAGE is compensation allowed to persons who are instrumental in saving goods or ships from the dangers of the sea, or from fire. The term is also applied to the goods saved.

SAMPLE.—A small portion obtained from the bulk of any article of merchandise, to serve as a specimen of the whole.

SCHEDULE.—A sheet of paper appended to any written instrument, and containing a detailed statement or a list of the property mentioned therein.

LESSONS IN GERMAN.—LXXI.

§ 109.—PREPOSITIONS CONSTRUED WITH THE GENITIVE.

WE now give again the prepositions governing the several cases respectively, with their proper definitions; subjoining, also, some few observations on such of them as seem to require further explanation. And, first, we mention those construed with the genitive.

Anstatt, or statt, instead.	Um—willen, for the sake of.
Außerhalb, without, outside.	Ungeachtet, notwithstanding.
Diesseit, or diesseits, on this side.	Unterhalb, below, on the lower side.
Halben, or halber, on account of.	Unfern, near, not far from.
Innerhalb, within, inside.	Unweit, near, not far from.
Jenseit, or jenseits, on that side, beyond.	Vermittelst, or mittelst, by means of.
Kraft, by virtue of.	Vermöge, by dint of.
Längs, (also gov. Dat.) along.	Während, during.
Laut, according to.	Wegen, on account of.
Oberhalb, above.	Zufolge, (also gov. Dat.) in consequence of.
Trotz, (also gov. Dat.) in spite of.	

§ 110.—OBSERVATIONS.

(1.) Anstatt is compounded of an (*in*) and Statt (*place*), and these components may sometimes be separated; thus, an des Bruders Statt, *in* the brother's *stead*. In this case, the part Statt takes its proper character, which is that of a noun.

(2.) Halben, like wegen and um—willen, expresses *motive*. Strictly speaking, however, halben seems to point to a motive that is *direct*, *immediate*, and *special*; wegen indicates an object less *definite* and more *distant*; while um—willen looks to the *will*, *wish*, or *welfare* of that which is expressed by the genitive. These distinctions, however, are not always regarded, even by writers of reputation.

(3.) Halben or halber is always placed *after* the noun which it governs; thus, des Geldes halben, for the sake of money; Vergnügens halber, for the sake of pleasure. Halben is often united with the genitive of the personal pronouns; in which case the final letter (r) is omitted, and its place supplied by t: thus, meinethalben (instead of meinerhalben), for my sake; deinethalben, for thy sake; seinethalben, for his sake, etc. So, too, it occurs in the compounds deßhalb, on account of that; weßhalb, on account of which; wherein, as in außerhalb, innerhalb, oberhalb, unterhalb, the form halben is shortened into halb. In the last four, halb has the sense of *part* or *side*; as, außerhalb, out*side*, etc.

(4.) Wegen may either come *before* or *after* its noun; as, wegen der großen Gefahr, on account of the great danger; seiner Gesundheit wegen, on account of his health.

(5.) Um—willen is always separated by the genitive which it governs; thus, um Gottes willen, for God's sake.

(6.) Ungeachtet may either *pre*cede or *suc*ceed its noun; as, ungeachtet aller Hindernisse, notwithstanding all hindrances; seines Fleißes ungeachtet, notwithstanding his industry.

(7.) Vermöge, *by dint* or *means of*, indicates physical ability; as, vermöge des Fleißes, by means of industry. It thus differs from kraft, which points rather to the exercise of moral power; as, kraft meines Amtes, by virtue of my office.

(8.) Zufolge, when it comes *after* the word which it governs, takes the latter in the *dative*; as, dem Befehle zufolge, in consequence of (or pursuant *to*) the order.

(9.) Längs and trotz may also govern the dative.

§ 111.—PREPOSITIONS CONSTRUED WITH THE DATIVE.

Aus, out, out of.	Nächst, next, next to.
Außer, without, outside of.	Nebst, together with.
Bei, by, near, with.	Ob, over, at.
Binnen, within.	Sammt, together with.
Entgegen, towards, opposite to.	Seit, since.
Gegenüber, over against.	Von, from, of.
Gemäß, conformably with.	Zu, to, at.
Mit, with.	Zuwider, against, contrary.
Nach, after, to, according to.	

§ 112.—OBSERVATIONS.

(1.) Aus indicates the *place*, the *source*, or the *material* whence anything is produced; as, aus dem Hause, out of the house; aus Liebe, out of love; aus Nichts hat Gott die Welt gemacht, out of nothing has God made the world.

(2.) Außer differs from aus, in that it denotes *situation* rather than *transition*; thus, aus dem Hause marks *motion* from or out of the house, while außer dem Hause signifies position in respect to the house, that is, outside of the house, abroad; hence comes also the signification *besides*, *exclusive of*; as, Niemand außer mir war zugegen, no one besides, or except me, was present.

(3.) Bei shows the relation of *proximity* or *identity* in respect to persons, places, times, etc.; as, er wohnt bei seinem Bruder, he resides *with* his brother; bei dem Hause, *by* or *near* the house; bei der Schöpfung, *at* the creation; bei meiner Ankunft, *at* or *upon* my arrival; bei dem Plato, *in* Plato, that is, in the works of Plato. Bei is also used in making oath or protest; as, bei Gott; bei meiner Ehre; *by* God; *by* or *upon* my honour: a use easily derived from the primary signification of the word. It should be added that the German bei (unlike the English *by*) is not properly employed to denote the cause, means, or instrument of an action; this is done by the words durch, von, or mit: ich fahre mit der Eisenbahn.

(4.) Binnen is used in denoting a limitation of *time*; as, binnen acht Tagen, within eight days.

(5.) Entgegen always comes *after* its noun, and denotes the relation of parties moving *towards* one another so as to meet: hence it gets the signification *opposite to*, *over against*; thus, der Knabe läuft seinem Vater entgegen, the boy runs *towards*, that is, *to meet* his father; dem Winde entgegen, *against* the wind.

(6.) Gegenüber marks an opposite *position* of things, and, like entgegen, comes *after* its noun: as, dem Hause gegenüber, *opposite to*, or *fronting* the house.

(7.) Mit signifies sometimes the relation of *union*; sometimes that of *instrumentality*; as, er arbeitet mit seinem Vater, he works with his father; mit einem Messer schneiden, to cut *with* a knife; sometimes, also, it indicates the *manner* of an action; as, mit Gewalt, mit List.

(8.) Nach, in all its uses, has its nearest equivalent in the English word *after*; as, zehn Minuten nach vier, ten minutes *after* four; nach englischer Mode, *after* the English fashion; der Nase nach, *after* (that is, *following* after) your nose; dem Strome nach, *after* (that is, *in the direction of*) the stream; der Beschreibung nach, *after* (that is, *according to*) the description; wir gehen nach der Stadt, we are going *after* (that is, *in the direction of*, *towards*, or *to*) the city; das Schiff ist nach Amerika bestimmt, the ship is bound *after* (that is, *for*) America, etc.

(9.) When direction towards a *person*, instead of a place, is indicated, zu is employed; as, ich werde zu meinem Vater gehen, I shall go to my father. Sometimes nach is used in connection with zu; as, er lief nach der Stadt zu, he ran (literally, *after to*) *towards* the city. When it denotes direction *with*, as in the phrase dem Strome nach, following or going *with* the stream, it is put *after* the noun which it governs: so, also, when it has the kindred sense, *according to*; as, meiner Meinung nach, according to my opinion. If, however, in the latter case, a genitive depends on the noun under the government of the preposition, nach *precedes*; as, nach der Beschreibung Schiller's, according to Schiller's description.

(10.) Nebst and sammt have the same *general* signification, *together with*; but, strictly speaking, differ in this, that sammt not only indicates *conjoint*, but also *simultaneous* action; thus, Aaron sammt seinen Söhnen sollen ihre Hände auf sein Haupt legen, Aaron together with (i.e., *simultaneously with*) his sons shall lay their hands upon his head.

(11.) Ob is seldom used except in poetry.

(12.) Von marks the *source* or *origin* of a thing, and has the same latitude of signification as its English equivalent *from*; thus, der Wind wehet von Osten, the wind blows from the East; das Gedicht ist von ihm, that poem is from (*by*) him. With an or auf following, it indicates the extent of a period of time: von der ersten Kindheit an, from earliest childhood on; von seiner Jugend auf, from his youth up.

(13.) Zu primarily is a mere sign of *transition*; but is made to denote a variety of cognate relations, from a state of motion to a state of rest. Examples best illustrate its use; thus, ich will zu meinem Vater gehen, I will go to my father; wir reisen zu Wasser und zu Lande. we travel by land and by water; zu Pferde, on horseback; zu Fuße, on foot; zu Hause, at home; zu jener Zeit, at that time; er hat mich zum (for zu dem) Narren gemacht, he has made me (*to become*) a fool; er thut es mir zu Liebe, he does it to (*show*) love for me. It is sometimes used as an adverb; as, geh zu, go on; zu viel, too much; mache die Thür zu, shut the door to. (See Sect. LXXIII. 1.)

(14.) Zuwider, *against, contrary to*, comes *after* the word which it governs.

§ 113.—PREPOSITIONS CONSTRUED WITH THE ACCUSATIVE.

Durch, through.	Sonder, without.
Für, for.	Um, about, around.
Gegen or gen, towards.	Wider, against.
Ohne, without.	

§ 114.—OBSERVATIONS.

(1.) Durch has its exact equivalent in the English word *through*; as, durch die Stadt gehen, to go through the city; durch Ihren Beistand, through your aid; das ganze Jahr durch (where, as often in English, the preposition comes *after* the noun), *the whole year through*.

(2.) Gegen (contracted, gen) indicates motion *towards*; and hence has the signification *opposite to*; but whether it marks direction towards in a manner friendly or otherwise, must be determined by the context. In this respect, it differs from wider, *against*, which denotes an opposition, doing, or designing evil.

(3.) Ohne and sonder are of the same import; but the latter is seldom used, and then only when the substantive has no article before it.

(4.) Um, like the English word *about*, indicates the going or being of one thing around another; and hence denotes also nearness, change of position, succession, etc.; thus, um den Tisch sitzen, to sit round the table; wirf deinen Mantel um dich, throw thy cloak about thee; um zwei Uhr, about (literally, *close about*, i.e., *exactly*) two o'clock; einen Tag um den andern, one day *about* another, that is, every other day; es ist um ihn geschehen, it is done *about* him, that is, it is over with him; um Geld spielen, to play about (*for*) money; um zehn Jahre jünger, younger about (*by*) ten years, etc. Before an infinitive preceded by zu (that is, before the *supine*, as it is sometimes called), um denotes purpose; as, um Ihnen zu zeigen, *in order* to show you; um zu schreiben, *in order* to write, or for the *purpose* of writing.

§ 115.—PREPOSITIONS CONSTRUED WITH THE DATIVE OR ACCUSATIVE.

An, on, at, near.	Ueber, over, above.
Auf on, upon.	Unter, under, among.
Hinter, behind.	Vor, before.
In, in, or into.	Zwischen, betwixt, between.
Neben, beside.	

§ 116.—OBSERVATIONS.

These prepositions govern either the accusative or the dative, but not without a difference of signification; for when motion *towards*, that is, motion from one point to another, is indicated, the accusative is required; when, however, motion or rest *in* any given place or condition is signified, the dative is used; thus, der Knabe läuft in den Garten, the boy runs *into* (motion *towards*) the garden; der Knabe läuft in dem Garten, the boy runs *in* (motion *within*) the garden. This is the *general* principle, which will be found, with more or less distinctness, everywhere to prevail in the use of the prepositions of this class. We subjoin a list of examples:—

Dat. An einem Orte wohnen, to dwell in or at a place.
Acc. An einen Freund schreiben, to write to a friend.
Dat. Schwach an Verstande, weak in understanding.
Acc. Bis an den Abend, even to or until evening.
Dat. Am Morgen und am Abend, in the morning and in the evening.
Dat. Auf dem Lande wohnen, to live in the country.
Acc. Auf das Land reisen, to travel into the country.
Acc. So viel auf den Mann, so much for a, or per man.
Acc. Auf deutsche Art, in (i.e., *following after*) the German way.
Dat. Er steht hinter mir, he stands behind me.
Acc. Er trat hinter mich, he stepped behind me.
Dat. Ich wohne in der Stadt, I live in the city.
Acc. Ich gehe in die Stadt, I am going into the city.
Dat. Er stand neben mir, he stood near to me.
Acc. Er stellte sich neben mich, he placed himself near me.
Dat. Ueber der Arbeit, over (i.e., *while at*) the work.
Acc. Ueber meine Kräfte, beyond my strength.
Dat. Ich stand unter einem Baume, I stood under a tree.
Acc. Der Hund kriecht unter den Tisch, the dog creeps under the table.
Dat. So will ich mich nicht vor dir verbergen, then will I not hide myself from thee.
Acc. Ich gehe vor die Thür, I go before the door.
Dat. Ich saß zwischen zwei Freunden, I sat between two friends.
Acc. Ich stellte mich zwischen beide, I placed myself between the two.

§ 117.—THE CONJUNCTIONS.

(1.) Conjunctions are words used in connecting sentences. As, however, there are various *kinds* of connections existing among sentences, it has been customary to classify the conjunctions according to the nature of the connection which they are employed to indicate. Hence we have (among other classes) the following:—

Copulatives:	as, und, and; auch, also.
Disjunctives:	as, entweder, either; oder, or.
Adversatives:	as, aber, but, however; allein, but; doch, yet.
Negatives:	as, weder, neither; noch, nor.
Comparatives:	as, wie, as; so, so, thus; als, than; gleichwie, just as.
Conditionals:	as, wenn, if; falls, in case that; wofern, provided that.
Causals:	as, denn, for; weil, since, because.
Conclusives:	as, darum, therefore; daher, hence; deßhalb, therefore.
Concessives:	as, obwohl, obschon, obgleich, wenn, although.
Finals:	as, daß, that; auf daß and damit, in order that; um zu, in order to.

(2.) We give below a list of the conjunctions that most commonly occur in German: premising only that some of the words here set down as conjunctions are also employed as adverbs; for it will of course be kept in mind, that the *office* performed by a word determines its name and character. For numerous examples illustrating their uses, see Sect. XCIX.

Aber, but.	Mithin, consequently.
Allein, but.	Nachdem, after that.
Als, as, than, when.	Noch, nor, nor yet.
Also, so then, consequently.	Nun, therefore, then.
Auch, also, *ever*.	Nur, but, only.
Auf daß, in order that.	Ob, whether, if.
Bis, until.	Obgleich, though, although.
Da, since.	Obschon, though, although.
Daher, therefore, hence.	Obwohl, though, although.
Dafern, in case that, if.	Oder, or.
Daß, that, in order that.	Ohne, without, except.
Damit, in order that.	Ohngeachtet, notwithstanding.
Darum, therefore, on that account.	So, thus, therefore, if.
Denn, for, because, than.	Sondern, but.
Dennoch, still, nevertheless.	Und, and.
Deßhalb, therefore, on that account.	Ungeachtet, notwithstanding.
Desto, the. (Sect. XXX. 6.)	Während, whilst.
Doch, yet, however, still.	Während dem, whilst.
Ehe, before that, ere.	Während daß, whilst, than.
Entweder, either.	Weder, neither.
Falls, in case that.	Wenn, if, as.
Folglich, consequently.	Weil, because.
Je, — desto, the — the. (Sect. XXX. 6.)	Wenngleich, although.
Jedoch, yet, nevertheless.	Wennschon, although.
Indem, while, because, since.	Wie, as, when.
	Wiewohl, though.
	Wo, if.
	Wofern, if, in case that.

§ 118.—INTERJECTIONS.

(1.) Interjections, as the name implies, are commonly *thrown into* a sentence, without, however, changing either its structure or its signification. They are merely the signs of strong or sudden emotion; and may be classified according to the nature of the emotion which they indicate: some expressing *joy*, some *sorrow*, some *surprise*, and so on. The list below contains those only that most commonly occur.

Ach! alas!	Holla! holla!	Heisa! hurrah!
Ah! ah!	Husch! quick! hush!	Juchheisa! huzza!
Ei! eigh!	Leider! alas!	Wohlan! well then!
Ha! ha!	Oh! o! oh! O!	Hui! hoa! quick!
He! ho!	Pfui! fy!	Sieh! lo!
He da! ho there!	Pst! hist!	Hum! hem!
Halt! hold! stop!	Wehe! wo! alas!	

(2.) It may be added that other parts of speech, and even whole phrases, are often employed as interjections, and in parsing are treated as such.

KEY TO EXERCISES IN LESSONS IN GERMAN.

Exercise 183 (Vol. III., page 380).

1. Hören Sie auf das, was ich Ihnen sage? 2. Ja, ich höre auf das, was Sie sagen. 3. Glauben Sie, daß er willig auf jenen Vorschlag hören wird? 4. Wenn Sie auf das achten, was der Lehrer Ihnen vorträgt, so erlangen Sie Kenntnisse. 5. Können wir bei Ihnen bleiben, bis der Sturm nachgelassen hat? 6. Sobald der Regen aufhört, werden wir unsere Reise fortsetzen. 7. Sobald wir unsern Lehrer erblickten, hörten wir auf zu spielen, und fingen an zu schreiben. 8. Hunderte und aber Hunderte verloren ihr Leben bei der Revolution in Frankreich. 9. Nachdem seine unbedachtsame Speculation ihn zu Grunde gerichtet hatte, wurde er vorsichtiger. 10. Es gereicht einem Könige zur Ehre, wenn er sein Land in Frieden regiert. 11. Verzage nicht, wenn dir das Glück nicht lächelt, oder selbst wenn du in das tiefste Elend versunken bist; denn es kann Rath werden, ehe du es glaubst, daß du aller deiner Leiden durch die Vorsehung enthoben wirst.

LESSONS IN ENGLISH LITERATURE.—XXI.

THE RESTORATION PERIOD: THE DRAMATISTS AND PROSE WRITERS.

We have already had to say something about the stage after the Restoration, in speaking of the career of Dryden. But with all his greatness as a poet, and all his fame as a play-writer among his own contemporaries, Dryden's place amongst the dramatists of his day is not, according to the unanimous decision of modern critics, a high one.

The tragic and comic drama were both alike diligently cultivated in the period of which we are now speaking, and partly, no doubt, through French influence and French example which were then supreme, the line of demarcation between tragedy and comedy was very carefully observed.

In tragedy the highest place must be assigned to the unfortunate Otway. Thomas Otway was a man of good birth and education, but his career, varied as it was in its incidents, was one unbroken succession of misfortunes and distresses, and he died at last in the most abject want and misery in 1685, when only thirty-four years of age. The best of his tragedies, and those upon which his fame now exclusively rests, are "The Orphans" and "Venice Preserved." These plays show that Otway possessed the power of pathos and the power of moving our sympathies in a very rare degree. His conceptions of character are powerful, if not always very natural, and his style is vigorous and elevated. In his comedies, of which he left a considerable number, Otway's genius shows to far less advantage. His true domain was tragedy, and tragedy of the saddest and most pathetic kind.

Nathaniel Lee was also a writer of much tragic power, though through all his plays there runs a vein of a kind of strange wildness, which may be explained by the tendency to insanity which on more than one occasion during his life became developed into actual madness. The best known of his pieces is "The Rival Queens; or, Alexander the Great."

Thomas Southerne and Nicholas Rowe may be conveniently mentioned here as belonging to the same dramatic school with those of whom we have spoken, though both of them in the more active period of their lives were contemporaries rather of Pope than of Dryden. Few plays appear to have enjoyed a more genuine popularity than Southerne's tragedy of "Oroonoko." Rowe was one of the most prominent of the men of letters of his time. He edited the plays of Shakespeare, and filled the office of poet laureate. Of his plays the most successful were "Jane Shore" and "The Fair Penitent," the latter of which is founded upon Massinger's "Fatal Dowry," of which we have already given some account.

Far more characteristic, however, than its tragic stage is the comic drama of the Restoration. It is in it far more than in any other branch of literature that we find the whole spirit and temper of the Restoration reflected—its lightness and gaiety, its utter want of earnestness or serious purpose, its licentiousness, its rebellion against all rules as savouring of Puritan austerity, its foreign tastes and sympathies. Its immorality is not like that which we find in so many of the Elizabethan comedies—that grossness of thought and expression, that coarse animalism which always belong to an age of great force and energy, but little refinement. The immorality of the Restoration drama lies far deeper, and indicates a very different tone and spirit in society. It is the immorality of an age and class which knows no object worthy of pursuit but pleasure, which not only ignores but despises every higher principle, every noble end, and every more serious or earnest pursuit. This is a spirit which has seldom been at all prevalent in English society. And this has gone far to prevent the comedies of the Restoration retaining with posterity anything like the favour which they enjoyed in their own day; and in the present day their sheer indecency prevents their reproduction on the stage. But we should convey a very false impression if we led our readers to suppose that the dramatists of the Restoration owed their success to their immorality or their frivolity. In their faults they reflected the world they lived in. Their genius was their own, and the greatest among them were men of rare comic genius. The plays are full of the most humorous delineations of character, are inexhaustible in variety of amusing intrigues and incident, and sparkle with the highest wit.

The school of dramatists of which we are now speaking first became prominent immediately after the Restoration, and was distinctly its product, and for this reason we speak of it as belonging to this period. But it must be remembered that several of these dramatists, including the most distinguished of them all, lived to see the final fall of the House of Stuart and the accession of the reigning dynasty. The earliest of the dramatists of this class was Sir George Etherege, a man who presented a fair type of the cavalier in the days of his prosperity. His comedies are amusing, but their fame was soon quite eclipsed by his more distinguished successors.

William Wycherley was born in 1640, of a good family. He was educated in France, and returned to England, when the exiled cavaliers were returning to enjoy their triumph in England after the Restoration. He soon became the most popular of dramatists, though by no means the most prolific. Nor was he less successful in society than on the stage, his brilliant wit, courtly manners, and handsome person securing him an enviable position at the gay court of Charles II. But with him, as with most others of his type, court favour proved uncertain, and pleasure passed with youth; he fell into poverty, purchased his release from want of James II., at the usual price, by turning Roman Catholic in obedience to the royal command, and died in obscurity. His plays show in a very high degree that resource and fertility of invention, that brilliancy and brightness which are characteristic of the class of dramatists to which he belonged; but, in point of morality, nothing can be more debased. He has been not unfairly described as "the most licentious and hard-hearted of a singularly licentious and hard-hearted school." The best of his plays are "The Country Wife" and "The Plain Dealer."

Sir John Vanbrugh was born in 1666, being the son of a wealthy sugar-baker in London. The family was originally Dutch, and was one of the many which settled in England during the persecution of the Protestants under the Duke of Alva. Of Vanbrugh's education and early life very little is known; but he seems to have served for some time as a soldier abroad. In later life he held positions of some dignity in the Herald's College, and for his services of this nature was knighted by George I. But his real fame rests upon his distinction in the two arts of architecture and the drama. As an architect he acquired the highest reputation, though his productions, of which Blenheim palace is the most important, have been very variously judged by modern critics. As a comic dramatist, his merits are very great. His characters are drawn with singular freshness and clearness, and the conduct of his plots is admirable. Of his five comedies the best known is, perhaps, "The Provoked Wife." Living as Vanbrugh did, later than Wycherley, and writing under the more wholesome influences prevalent after the Revolution of 1688, his plays, at least the later ones, are by no means so grossly immoral as those of his predecessor. Vanbrugh died in 1726.

George Farquhar was born at Londonderry in 1678. He became an actor; then left the stage and served in the army; and finally returned to the stage, and became eminent as a comic dramatist. His plays are chiefly distinguished by the variety and truth to nature of the characters which they introduce, and the touches of humour which constantly recur in the course of them. The most popular of his pieces is "The Beaux's Stratagem." Farquhar died early, in great want, in 1707.

The most eminent, however, of the comic dramatists of this period was William Congreve. He was born in Ireland, though of English parents, in 1670. He received his education at Trinity College, and it is evident that he enjoyed a far more systematic training than most of his brother dramatists. He early settled in London; and his qualities being exactly such as best justified him for social and literary success in the period at which he lived, he very soon acquired a leading position among the wits, authors, and men of fashion of the day. Few men have been so uniformly successful as Congreve. In his early youth his criticism was respectfully sought by Dryden, then in the very zenith of his fame. In later life he was honoured by Pope with the dedication to him of his Homer. Among the wits Congreve was supreme; in fashionable society he was irresistible. He was always prosperous in his circumstances, always enjoyed comfortable appointments under the state, and among the comic dramatists he was the acknowledged leader. His plots are not as carefully or skilfully constructed as those of many of his contemporaries; but his characters are admirably portrayed, and if not as fresh are at least as lifelike as those of any of the comic dramatists. The qualities, however, in which he stands supreme are the brilliancy of his dialogue, his mastery of language, and the unfailing flow of his wit. The best of Congreve's plays are "The Old Bachelor" and "Love for Love." Congreve lived till 1729, but he had retired from the dramatic art many years before his death. In his own day Congreve was not less famous as a tragic writer and as a poet than in the comic stage; but his somewhat pompous and artificial tragic style has little charm for modern readers; and his poems, if graceful, are nothing more.

The comic dramatists of this period all show, as we have seen, a very strongly marked common character, and are in very close harmony with the age in which they wrote. The prose literature of the same period has nothing of the kind about it. It is both scanty in amount, and the several works composing it are wholly isolated in character.

Few men of his age played a more prominent part in the history of his country than Edward Hyde, Earl of Clarendon. As a member of the House of Commons, he bore his share in the contests between the king and the Commons in the Long Parliament. He was at first a supporter, though a moderate one, of the popular cause; but he ultimately joined the king, and after the death of Charles I. he became the faithful friend and counsellor of his son, afterwards Charles II., sharing his long years of exile, and undergoing with him all the trials and privations of those gloomy years for the royalist party. Hyde returned with his master from exile, became Lord Chancellor and Earl of Clarendon, and for some years was one of the most influential and probably the wisest of the king's advisers. His daughter married the Duke of York, afterwards James II., and he thus became father-in-law of one king, and grandfather of two successive queens. But Clarendon's favour with the king declined, while his unpopularity with the people increased, and, being impeached, he chose to resign himself to voluntary exile, and passed the remainder of his life abroad. He died in 1674.

In the history of English literature Clarendon is entitled to a high place in virtue of his "History of the Great Rebellion." Histories may generally be divided into two classes. There are histories written by eye-witnesses, who describe what they themselves have seen and known; these, for the most part, derive their whole value from the personal knowledge of the writer, and have seldom any claim to philosophical or literary merit. There are histories written by men of philosophical mind, of calm impartiality, judgment, and discernment, and with the graces of literary style. But it is one of the rarest things in the history of literature to find the merits of these two kinds of history combined, as they are in a very high degree, in Clarendon's history. He writes of the events of his own times, events all occurring under his own eyes, and in which he himself took an active part. But, though his history is undoubtedly very partial, he yet writes also with much of that calm judgment upon men and things, and that insight into character, which belong to the philosophical historian; and his style, though not a model of English writing, is manly and dignified.

Izaak Walton was born in 1593. He passed the active years of his life in the exercise of the trade of a linendraper in London; but having at a comparatively early age acquired a moderate competence, he retired from business, and passed the last forty years of his long life in retirement in the country, enjoying the society of his many accomplished friends, his books, and his fishing. He died in 1683. His works are his "Lives," and his treatise on fishing, "The Complete Angler." The lives which he wrote are those of Donne, the celebrated satirist and Dean of St. Paul's, Sir Henry Wotton, Hooker, George Herbert, and Bishop Sanderson. Few books in the language are more attractive than these exquisitely written biographies. "The Complete Angler" is a book unlike any other ever written. It is, like its author, a quaint mixture of ardent enthusiasm on the one subject of angling, with great delicacy of taste, love of nature, keen observation, and a loving tenderness of spirit. The style and language, in their quaint simplicity, are quite in keeping with the subject.

But of the prose writers of this age none is comparable in genius to Bunyan. John Bunyan was born in 1628. He was born in the very lowest rank of society, for his father was a tinker, and he himself in early life followed the same trade. Bunyan, therefore, enjoyed as scanty opportunities of education as it is possible to imagine; no great writer, indeed, ever owed less to external aids than he did. For some years he served in the army of Cromwell during the civil war; but having received strong religious convictions, he abandoned the army and became a preacher, attaching himself to the sect of the Baptists. He pursued his mission with that zeal and devoutness which showed themselves in all he did, and became singularly powerful and popular as a preacher; but the Restoration, and the persecution of all Dissenters which followed it, interrupted his career. He was thrown into Bedford gaol for the offence of preaching and praying in his own way, and there spent no less than twelve years. At the end of that time he was released, and resumed his old calling of a preacher. He died in 1688. Besides numerous tracts and other less important treatises, Bunyan was the author of three remarkable works. His "Grace Abounding in the Chief of Sinners" is a confession or autobiography, a history of the changes in his own heart and life through which he was led from the state which he afterwards portrayed under the image of the City of Destruction to that in which we see him in his later life. As a history of a great and notable character, told with perfect candour and wonderful power, it is a book of supreme interest.

But Bunyan's greatest work is the "Pilgrim's Progress." Probably no book in the English language, certainly no prose work, has ever had anything like the same kind and degree of popularity with this. For all classes and ages, during two centuries, wherever the English language is spoken, this book has been found to have an irresistible charm. And it owes its power not to the peculiar religious views of its author—for when read with care it will be found very unsectarian—nor to the ingenuity of the allegory, though this is very great. Its special power lies in the breadth, simplicity, and directness of its teaching, and, above all, in the force of genius which pervades every page of it, showing itself now in portraying the anguish and conflict of the human heart, now in the keen appreciation and sweetest description of the loveliness of nature, now in passages of infinite tenderness and pathos. Allegory though it be, there are few stories which, merely as stories, have anything like the absorbing interest of the "Pilgrim's Progress." Its stylo is perfect in its purity and simplicity.

The "Holy War" is an allegory of something the same class as the "Pilgrim's Progress," but is much inferior in power and interest.

MINERALOGY.—IV.

CLASSIFICATION OF MINERALS—NATIVE ELEMENTS—OXYGEN COMPOUNDS.

ALL minerals may be conveniently classed under one of these five divisions:—

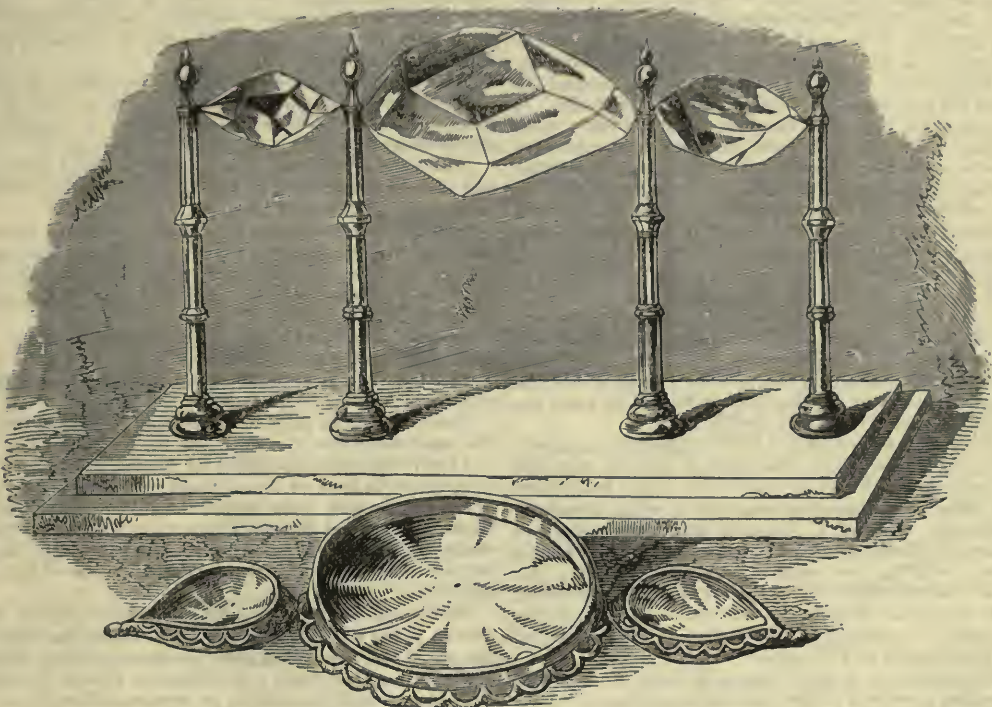
1. Native Elements.
2. Oxygen Compounds.
3. Fluorides and Chlorides.
4. Sulphides and Arsenides.
5. Organic Compounds.

1.—NATIVE ELEMENTS.

There are sixty-three elements or simple substances which defy all attempts of the chemist to alter or change them. The union of these elements with each other produces compound substances, and every body in Nature must either be an element or a compound. Copper, for example, is an element. Hitherto it has defied all endeavours to split it up into constituent substances. Occasionally this metal appears as copper—that is, in its native state, but most usually it is found compounded with other elements—oxygen, sulphur, carbon. In copper pyrites, the copper is in chemical combination with sulphur; and a new body, having a totally different appearance from either sulphur or copper, is found. In malachite, again, the metal is joined with oxygen and carbon, making a carbonate of copper. The copper, sulphur, oxygen, and carbon are elements; and the pyrites and malachite are compounds. Some, indeed most bodies, are never found in their native or elementary state. The reason of this is, that the affinity they exhibit for oxygen, or some other element, is so great, and the opportunities they have of obeying the impulse so numerous, that it becomes a certainty that the union of the two elements will be made. An example of this is seen in the case of iron. If a piece of that metal be at all exposed to the air, it soon rusts; or in other words, the oxygen of the air having a great affinity for iron, enters into combination with it, and forms the oxide of iron, or rust. But a piece of gold will not lose its brightness, though it be exposed to the air for years, since oxygen has scarcely any affinity for gold. Enough has already been said to indicate that but few minerals are elements; however, there are some.

GOLD always appears native, never as an ore. It crystallises in the monometric system, in cubes or octahedra. It is very ductile. H. (hardness) = 2·5—3; specific gravity = 12—20. Although we say this metal appears "native," yet it is seldom perfectly pure, generally being alloyed with silver or copper. This accounts for the variation in the specific gravity. It is found in alluvial detritus—that is, in a deposit which has been placed in its position by water at a recent period, speaking geologically. It appears either in grains or nuggets, having been washed out of its original matrix when the water which produced the detritus wore down the quartz in which the gold was embedded. Its original position seems generally to have been in quartz veins which traverse metamorphic rocks.

SILVER.—Native silver is also of the monometric system. H. = 2·5—3; sp. gr. = 10·3—10·5. It appears generally in filiform and arborescent shapes, often alloyed with gold or copper. The silver rootlets penetrate rocks usually in the neighbourhood of dykes. The mines of Kongsberg, in Norway, yield fine specimens. The largest mass ever found was obtained in the Huantajaya mines in Peru: it weighed 8 cwt. Beautiful specimens are found with native copper near Lake Superior. The filaments of the silver interlace the copper rootlets. This fact seems to point to electricity as the depositing agent, for if the metals had been in a fused state they must have become alloyed with each other.



THE KOH-I-NOOR, OR MOUNTAIN OF LIGHT.

PLATINUM.—Native platinum is of the monometric system. H. = 4—4·5; sp. gr. = 16—19. Sometimes it is found in cubes, and like gold appears in alluvial gravel, being usually alloyed with some of the rarer metals—iridium, rhodium, osmium, palladium. It was first discovered in the deposits of Choco, in South America, where it received its name platina, *little silver*. Since then it has been supplied from the gravels at the foot of the Ural Mountains, and so plentiful was the yield that platinum was once used for coins in Russia. Its great infusibility, and its power of withstanding the effect of acids, make it valuable to the chemist.

NATIVE QUICKSILVER is sometimes found in small globules mixed with the matrix in which is the ore cinnabar. No doubt the presence of the metal is due to the reduction of the ore by some cause or other.

IRON, associated with nickel, is found native in meteoric stones.

LEAD, TIN, BISMUTH, ARSENIC, and ANTIMONY have been found native in very small quantities.

SULPHUR is found in the neighbourhood of volcanoes mixed with the earth. When crystallised it is *trimetric;* usually in octahedrons, but more frequently it is massive. Our chief European supply is obtained from the valley of Noto and Mazzaro, in Sicily. However, large quantities are procured from copper and iron pyrites. Sulphur is dimorphous, for when artificially crystallised it appears in the monometric system.

CARBON.—This element is found native in three distinct conditions—*Diamond*, *Graphite* or *Plumbago*, and *Anthracite*.

The Diamond crystallises in the monometric system; usually in octahedra and dodecahedra, which have very often curved faces. It exhibits a very perfect octahedral cleavage. H. = 10; sp. gr. = 3·48—3·55. It is almost pure carbon. When heated to redness in a cage of platinum wire, and plunged into a jar of oxygen, the gem burns into carbonic acid gas, leaving sometimes a little silica ash in the cage. There is every reason to believe the diamond was formed in sandstone rocks, called *Itacolumite*, from carbon accumulated by animal or vegetable life. It is now found in the loose soil and gravel which the degradation of such rocks has produced. It is yielded by such deposits in Brazil, in North Carolina, in the Ural, and near Delhi, and Golconda. Slaves are employed to wash the gravel, and an experienced eye readily picks out any diamonds which may be in the cradle. It usually appears like a broken lump of glass, but has a more lustrous glitter. To cut it, in order that its great refractive and dispersive power may be exhibited to advantage, it is fitted with a metallic cement into a handle, and then pressed down upon a disc of steel about six or eight inches in diameter, which rapidly revolves horizontally. The steel is impregnated with diamond dust, and this wears a facet. Great art is required, for there is a grain in the diamond, and if the stone be set so that the plate attempts to cut it against the grain, the steel is cut and not the diamond. Diamond-cutting was first attempted in Europe by Louis Berquen, a citizen of Bruges, in 1456, and the Dutch monopolised the trade until very recently. Before the introduction of machinery the process was most tedious. Two diamonds set in metallic cement were rubbed by hand one against the other until a facet was worn in each.

Diamonds are sold by weight. A *carat* is the unit employed, and is about $3\frac{1}{2}$ grains troy. The term is derived from the name of a bean used in Africa to weigh gold. These beans were carried to India, and there were employed to weigh diamonds. To determine the value of a diamond, double the weight in carats, and multiply the square of the product by £2. Thus a cut diamond weighing one carat would be worth £8; one weighing ten carats, £800. The largest diamond on record belonged to the Great Mogul. It was found in 1550, in the mine of Colone. It weighed in its rough state 900 carats, but in cutting was reduced to $272\frac{1}{2}$ carats.

Upon the annexation of the Punjaub in 1850, the Queen of England became possessod of the Koh-i-Noor, a diamond whose original weight was 793 carats, but which has been reduced by repeated cuttings to its present weight of $103\frac{3}{4}$ carats. The Koh-i-Noor has a long history. We first hear of it in the year 50 A.C., when it was in the possession of the Rajah of Mjayin; and since that remote date it has been worn by princes innumerable, and has ornamented idols many, until, to-day, it has tho honour of being worn by our Queen. Our illustration shows this jewel, with two smaller diamonds, as it appeared in the Exhibition of 1851. Below is the gold-work in which it was set. Since this time it has been re-cut.

The Russian diamond was purchased by Catherine II. It was stolen from a Brahminican idol, to whom it was an eye, by a French grenadier. It weighs 194 carats, and has in its time been sold for £90,000 and an annuity of £4,000 a-year!

Graphite or Plumbago—the blacklead of pencils—is pure carbon; occasionally it contains a little iron. It is found, when bearing any crystalline structure, in short, tabular, prismatic crystals, which, being six-sided, belong to the hexagonal system. It is found in metamorphic rocks, and is believed to be beds of coal which have undergone metamorphism.

Anthracite is a term used to express coal which does not contain any bitumen. It is the amorphous form of native carbon—the charcoal of Nature.

2.—OXYGEN COMPOUNDS.

An oxide is formed when oxygen enters into chemical combination with an element. Thus the rust of iron is the oxide of that metal—a compound of the two elements, iron and oxygen. There are many such oxides in the mineral kingdom.

QUARTZ is the oxide of silicon. When pure, as rock crystal it occurs in the hexagonal system, as six-sided prisms terminated by six-sided pyramids, as is shown in Fig. 30 (p. 176). Quartz is the most widely distributed mineral, being almost the sole component of sandstone. H. = 7. It scratches glass. Sp. gr. = 2·6—2·7. Acids have no action upon it. By these characters it is readily distinguished. It is one of the three constituents of granite. When coloured by various metallic oxides it assumes forms known by the names—

Amethyst, violet quartz.

Chalcedony, opaque quartz.

Cornelian, red chalcedony.

Agate consists of alternate layers of pure quartz and chalcedony.

Onyx is agate which has the layers evenly and horizontally arranged, and is much used for cutting cameos.

Cat's-eye is translucent chalcedony which throws reflected light from its interior. This is due to filaments of asbestos which are distributed through it.

Flint is massive silica which occurs in nodules in chalk.

Jasper is opaque quartz, coloured yellow and red by peroxide of iron. It is found with the bog iron ore of Germany, among the pebbles of the Nile, and some few other places.

Bloodstone or *Heliotrope* is a variety of silica which is green and slightly translucent, containing spots of red, bearing some resemblance to stains of blood.

Opal is quartz containing four to ten per cent. of water in combination; its peculiarity is that it presents an internal play of colours when turned in the hand. It is found in cavities in the Trachyte rocks in Hungary. *Hyalite* is a colourless variety found in Mexico.

Siliceous Sinter has often the composition of opal. It is deposited by the Geysers of Iceland.

Tabasheer is a most peculiar variety, being an aggregation of silica, which forms in the joints of the bamboo.

CORUNDUM is an oxide of aluminium, containing two atoms of the metal and three of oxygen. It occurs massive in Saxony, and from this source is derived for commerce, and sold as *emery*. It is almost as hard as the diamond. When transparent it is precious. In this state it is found in the alluvial deposits of Ceylon, China, and Siam. If blue, it is *Sapphire*, a gem which rivals the diamond in value; when red, it is *Ruby*, but then its composition is not so simple, as it contains one of the oxides of chromium.

OXIDES OF IRON.—*Red Hematite* is a sesquioxide of iron—that is, it has a similar composition to corundum, two atoms of the metal to three of the gas. As *Specular Iron Ore*, it has a perfectly metallic lustre; as *Micaceous Iron*, it is foliated; as *Red Hematite*, it is massive, or in mammillary masses, which show a fibrous structure, and from its appearance has deserved the name of *Kidney* ore.

Brown Hematite is a variety of the red hematite, which is associated with water; it frequently occurs as incrustations attached to other rocks.

Magnetic Iron Ore contains three atoms of iron and four of oxygen; it is the only oxide of iron capable of magnetisation, and is therefore affected by the earth's magnetism, producing the "lodestone."

OXIDES OF COPPER.—*The Red Copper Ore* is a suboxide of the metal, containing two atoms of the metal and one of oxygen. It is often found in regular octahedrons of the monometric system. Its colour is deep red; lustre, adamantine. H. = 3·5—4; sp. gr. = 6.

Black Copper Ore or *Tenorite* is the protoxide of copper, containing one atom of the metal united with one of oxygen. It generally occurs in dull black masses, and in veins traversing other copper ores; occasionally it is found in crystals which are cubes.

THE OXIDE OF TIN.—*Tinstone* is the source of the metal. When crystallised it appears in the dimetric system in modified square prisms, terminated by the solid angle of the octahedron. Tinstone has been mined in Cornwall for ages. The great mariners of the ancient world—the Phœnicians—dared to pass the Pillars of Hercules, and come to Britain for this ore. It is found in small quantities in Saxony, Austria, and Finland; but in the East Indies there are some valuable deposits. The island of

Banca is almost wholly composed of it. When a district in which tinstone occurs is eroded by a stream, the water acts upon the ore as upon rocks, wearing down small pieces of it which are found in the bed of the stream like gravel, and are called *stream-tin*. H. = 6·7 ; sp. gr. = 6·5—7·1.

OXIDES OF MANGANESE.—*Pyrolusite* is the binoxide or black oxide of manganese—that is, two atoms of oxygen are associated with one of manganese. Its name is derived from πυρ (pure), *fire*, and λυω (lu′-o), *I wash*, because it can take out of glass the brown and green tints. It is mainly used to procure chlorine for bleaching purposes, which gas is liberated when pyrolusite is heated with hydrochloric acid. This ore is extensively worked in Thuringia and Prussia, also in Devonshire, Somersetshire, and Aberdeenshire.

Psilomelane is pyrolusite containing water. Pyrolusite is an iron-black, but psilomelane has a greener hue; the hardness of the former is only 2, but of the latter 5. Pyrolusite is found crystallised in small rectangular prisms of the trimetric system, but its neighbour is always massive. The name *psilomelane* is derived from ψιλος (psi′-los), *smooth*, and μελας (mel′as), *black*.

OXIDE OF TITANIUM is very remarkable as occurring in two distinct systems, offering an example of dimorphism. *Rutile* and *Anatase* are both oxides of titanium, crystallising in the dimetric system; while *Brookite*, which has a like composition, appears in the *trimetric* system.

This completes the class of simple oxides.

LESSONS IN FRENCH.—XCII.

§ 147.—ANGLO-FRENCH HOMONYMS AND PARONYMS (*continued*).

English Words.	French Equivalents.	French Words.	English Equivalents.
Fool,	*sot, imbécile, insensé, idiot.*	**Foule,** *nf.*	*crowd, throng.*
Foul, *adj.*	*sale; vilain; impur; infâme.*		
Four,	*quatre.*	**Four,** *nm.*	*oven.*
Fumage,	*fouage.*	**Fumage.**	*manuring of land; colouring of silver wire; smoking of fish, meat; a kind of mushrooms.*
Fumet,	(hunt.) *fumées* (*of the stag*); *crottes* (*of the hare*).	**Fumet,**	*flavour* (*of meat, wine*); *raciness.*
Furniture,	*meubles, ameublement; appareil, équipage;* (print.) *garniture.*	**Fourniture,**	*supply, provision; furnishing, providing, supplying.*
Furrier,	*fourreur, marchand de fourrures.*	**Fourrier,**	(milit.) *quarter-master;* (fig.) *harbinger, forerunner, precursor.*
Gale,	*vent frais, coup de vent, brise, bourrasque.*	**Gale,**	*itch; scab; mange; scurf* (*of fruits, etc.*).
Game,	*jeu.*	**Gamme,**	(mus.) *gamut, scale.*
Gare,	*écouailles* (coarse wool).	**Gare,** *interj., nf.*	*look out! beware! wet dock;* (*railways*) *terminus; siding; shunting line.*
Gender,	*genre; espèce, sorte.*	**Gendre,**	*son-in-law.*
Gland,	*glande* (anat.).	**Gland,**	*acorn.*
Glue,	*colle-forte.*	**Glu,**	*bird-lime.*
Grape,	*raisin.*	**Grappe,**	*bunch;* (fig.) *vine.*
Gratify,	*satisfaire, faire plaisir, récompenser.*	**Gratifier,**	*to confer on, to bestow on; to attribute, to ascribe.*
Grief,	*chagrin.*	**Grief,** *nm., adj.*	*grievance, wrong, injury, complaint; grievous, grave.*
Gripe,	*poignée, prise, étreinte, serrement;* (nav.) *bas du taille-mer;* (fig.) *oppression, vexation.*	**Grippe,**	*fancy, whim, hobby; dislike;* (med.) *influenza.*
Groin,	(anat.) *aine;* (arch.) *arête* (*of the line of intersection of two vaults*); *brise-lames* (*made of wood*).	**Groin,**	*snout* (*of a hog*); (fig.) *ugly face.*
Guardian,	*tuteur* (*of minors*); *curateur; administrateur; gardien* (*protector*).	**Gardien,**	*keeper; jailer; turnkey;* (*protector*) *guardian; door-keeper.*
Habit,	*habitude, coutume;* (*dress*) *habit, habillement.*	**Habit,**	*coat; dress-coat; garment, dress.*
Hair,	*cheveu, cheveux; poil.*	**Haire,**	*hair-shirt; sackcloth.*
Hall,	*salle; palais; barreau; vestibule, manoir.*	**Halle,**	*market; market-place; exchange.*
to Hiss,	*siffler.*	**Hisser,**	*to hoist, to hoist up, to heave, to heave up; to raise; to haul out* (*sails*), *to sway up* (*yards*).
Home,	*domicile; foyer domestique.*	**Homme,**	*man.*
If, *conj.*	*si; soit, soit que.*	**If,** *nm.*	*yew-tree; triangular stand for illumination lamps.*
Ill,	*mal; mauvais; peu; malade.*	**Il,** *pron.*	*he, it.*
Impair, *adj.*	*inconvenable.*	**Impair,** *adj.*	*odd, uneven* (*of numbers*).
to Impair, *v.*	*détériorer; affaiblir, altérer, délabrer; nuire à.*		
Incense, *n.*	*encens.*	**Encenser,** *v.*	*to incense* (*to perfume with incense*).
to Incense,	*encenser; courroucer, provoquer, exaspérer, irriter.*		
Ingenuity,	*habileté, talent, génie, art, caractère ingénieux.*	**Ingénuité,**	*ingenuousness, frankness, candidness, simplicity.*
to Injure, *v.*	*nuire à, faire tort à; blesser; porter atteinte; gâter;* (med.) *léser;* (surg.) *intéresser.*	**Injure,** *n.*	*insult, wrong, injury;* (plur.) *abuse, insults.*
		Injurier, *v.*	*to insult, to abuse, to call names.*
Injurious,	*nuisible, blessant, injuste.*	**Injurieux,**	*abusive, offensive, reviling.*
Injury,	*tort, mal, préjudice, injustice, injure.*	**Injure,**	*insult, wrong, injury;* (plur.) *abuse, insults.*
Instructor,	*instituteur, professeur, précepteur.*	**Instructeur,**	*drill-sergeant.*
Interceder, *n.*	*intercesseur*	**Intercéder,** *v.*	*to intercede.*
Jest,	*plaisanterie, facétie, bon mot.*	**Geste,**	*gesture, action, movement, sign.*
Jet,	(min.) *jais, jaïet;* (of water) *jet d'eau; jet.*	**Jet,**	*casting, throwing, throw; shoot, sprout; casting* (*smelting*); *tiller; jet* (*of water*); *new swarm of bees.*
Jole,	*joue;* (of a fish) *hure.*	**Geôle,**	*gaol, jail, prison.*
Jolly,	*gai, joyeux, gaillard.*	**Joli,**	*pretty.*
Journey,	*voyage.*	**Journée,**	*day* (*time of duration of daylight*); *day's work; day's wages.*
Land,	*pays, terre, contrée.*	**Lande,**	*moor, heath.*
Lard,	*saindoux.*	**Lard,**	*bacon.*
Large,	*grand, gros.*	**Large,**	*wide, broad.*
Late,	*tard, tardif; ancien; dernier; décédé, feu; avancé* (of the hour).	**Latte,**	*lath.*
Lecture,	*discours, sermon, leçon;* (scolding) *mercuriale, semonce, sermon.*	**Lecture,**	*reading, perusal.*
Leg, Legs,	*jambe, jambes;* (of birds, insects, small animals) *patte;* (of boots.) *tige;* (of poultry) *cuisse;* (of furniture) *pied;* (of mutton) *gigot.*	**Legs,**	*legacy.*
Lever, *n.*	*levier; bascule.*	**Lever,** *v.*	*to lift, to raise, to heave; to levy, to rise, to get up.*
Librarian,	*bibliothécaire.*	**Libraire,**	*publisher, bookseller.*
Library,	*bibliothèque.*	**Librairie,**	*book-trade; bookseller's shop.*
Lime,	*chaux.*	**Lime,**	*file* (*tool*).

English Words.	French Equivalents.	French Words.	English Equivalents.
Lunatic,	*fou, aliéné.*	**Lunatique,**	*moon-struck; whimsical, fantastical.*
Lunette,	*lunette.*	**Lunette,**	*lunette; seat (of water-closet, close-stool); spying-glass; merry-thought (of a fowl); telescope;* (plur.) *spectacles.*
Maggot,	*asticot.*	**Magot,**	*magot, Barbary ape; booby; ill-favoured man; grotesque figure of plaster, china, etc.); hoard of money, hidden treasure.*
Magnifier, *n*	*verre grossissant; celui, celle qui exalte, panégyriste.*	**Magnifier,** *v.*	*to magnify, to extol, to exalt.*
Mail,	*maille* (coat); *malle, malle-poste* (coach); *courrier; dépêche* (post-office).	**Mail,** *nm.*	*mallet; mall (game, place).*
		Maille, *nf.*	*mesh; mail; haw (eyes of animals); obsolete French coin.*
		Malle, *nf.*	*trunk; pedlar's box; mail, mail-coach.*
Mall,	*gros maillet; mail (game, place).*	**Mal,** *nm., adj., adv.*	*evil, ill; sickness; mischief; misfortune; bad; badly; wrongly.*
Mange, *n.*	*gale* (of dogs, etc.).	**Mange,** *v.*	*eat (thou) (imperative).*
Marry, *v.*	*marier; épouser, se marier.*	**Marri,** *adj.*	*sorry, vexed.*
		Mari, *n.*	*husband.*
Marrier, *n.*	*marieur.*	**Marier,** *v.*	*to marry, to give in marriage; to perform the ceremony of marriage.*
		Mat, *nm., adj.*	*mate, check-mate (chess); unpolished, dull.*
Mat, *n.*	(of rush) *natte;* (of straw) *paillasson.*	**Mât,** *nm.*	*mast.*
Mechanic,	*artisan, ouvrier.*	**Mécanique,** *nf.*	*mechanics; mechanism; machine, machinery, piece of machinery.*
Merchant,	*négociant.*	**Marchand,**	*tradesman, shopkeeper.*
Mien, *n.*	*mine, air.*	**le Mien,** *pron.*	*mine, my own.*
to Mine, *v.*	*creuser, exploiter, une mine; employer de sourdes menées* (in order to injure some one).	**Mine,** *nf.*	*air, look, mien; mine (of metals); ore; source; store; an obsolete French measure = 75 quarts;* (antiq.) *mina.*
Miner,	*mineur, carrier.*	**Miner,** *v.*	*to undermine, to sap; to mine; to prey upon.*
Mire,	*boue, vase.*	**Mire,**	(artil.) *aim, sight, mark.*
More, *adv.*	*plus.*	**More,** or **Maure,**	*Moor.*
Net, *n., adj.*	*filé*	**Net,** *adj.*	*neat; net, nett; pure, unadulterated.*
Noise,	*bruit, tapage, fracas;* (in the ears) *tintement, bourdonnement;* (fig.) *éclat, retentissement.*	**Noise,**	*quarrel.*
Noter, *n.*	*annotateur; celui, celle qui remarque.*	**Noter,** *v.*	*to note, to note down; to mark, to observe, to notice, to take notice.*
Obeisance,	*révérence, salut.*	**Obéissance,**	*obedience.*
On, *prep.*	*sur.*	**On,** *pron.*	*we, you, they, people.*
Once, *adv.*	*une fois.*	**Once,** *n.*	*ounce (weight); ounce (jaguar).*
Or, *conj.*	*ou, soit.*	**Or,** *nm., conj.*	*gold; now.*
Pain,	*peine; douleur, mal.*	**Pain,**	*bread.*
Pair,	*paire, couple.*	**Pair,**	*peer; equal.*
Pale, *n., adj.*	*pieu, échalas;* (her., punishment) *pal; giron; sein; enceinte; pâle, blême.*	**Pâle,** *adj.*	*pale, wan, pallid.*
to Pale, *v.*	*pâlir, faire pâlir.*		
Pall,	*poêle, drap mortuaire;* (of an archbishop) *pallium; manteau.*	**Pal,** *nm.*	*pale (punishment); stake;* (her.) *pale.*

English Words.	French Equivalents.	French Words.	English Equivalents.
Pamphlet,	*brochure.*	**Pamphlet,**	*libel.*
Pannade,	*courbette (of horses).*	**Panade,**	*panada (soup).*
Parcel,	*paquet; parcelle, portion, partie; tas (in contempt, of a number of people); envoie.*	**Parcelle,**	*particle; portion, instalment.*
Part, *n.*	*partie, portion, part; rôle; parti; défense; livraison (of books, etc.); quartier;* (mus.) *partie;* (plur.) *talent, moyens.*	**Part,** *nf.*	*share, part, portion, concern, side.*
to Part, *v.*	*partager, séparer, diviser; casser; rompre; se séparer.*	**Part,** *nm.*	(law) *new-born child.*
Pat, *n., adj., adv.*	*tape; à propos, tout juste; justement, à point.*	**Pat,** *nm.*	*stalemate (chess).*
to Pat, *v.*	*donner une tape.*	**Pât,** *nm.*	*food (for falcons).*
		Pâte, *nf.*	*paste, dough; constitution, temper; kind, sort;* (print.) *pie.*
		Pâté, *nm.*	*pie, pastry; blot (of ink on paper);* (print.) *pie;* (fort.) *pate.*
Pate, *n.*	*caboche; peau de la tête du veau;* (fort.) *pâté.*	**Pâtée,** *nf.*	*paste (to fatten poultry); mess (for cats, dogs, etc.).*
		Patte, *nf.*	*paw (of dogs, cats, etc.); flap (of pockets); foot (of birds); leg (of insects).*
Pathos,	*pathétique, pathos.*	**Pathos,**	*fustian, rant;* (rhet.) *pathos.*
Physician,	*médecin.*	**Physicien,**	*natural philosopher, physicist.*
Physic, *n.*	*médecine, remède.*	**Physique,** *nm.*	*natural constitution of man; exterior.*
to Physic, *v.*	*médicamenter; médeciner; droguer; guérir.*	**Physique,** *nf.*	*natural philosophy.*
Pie, *n.*	(of meat) *pâté;* (of fruit) *tourte;* (orni.) *pie;* (print.) *pâté, pâte.*	**Pie,** *nf., adj.*	*magpie; pious, charitable.*
Pile,	*pile; tas, monceau; (of muskets) faisceau;* (building) *construction, édifice, bâtiment; (of shot) pile;* (arch.) *pieu, pilotis; (of cloth, velvet) poil;* (phys.) *pile; (funeral pile) bûcher; (of medals, coins) pile.*	**Pile,**	*pile, heap; pier (of a bridge); mole (in building);* (arch.) *tambour;* (phys.) *pile; (of weights) pile;* (her.) *pile; (of medals, coins) pile.*
to Pile,	*entasser, empiler, amonceler;* (military) *mettre en faisceaux; piloter, enfoncer des pieux.*	**Piler,** *v.*	*to pound.*
Pin,	*épingle; cheville; esse, clavette; fiche; (of a pulley) essieu; fétu, rien.*	**Pin,**	*pine-tree.*
to Plan,	*tracer un plan; projeter.*	**Planer,**	*to planish, to make smooth, to plane.*

LESSONS IN LOGARITHMS.—V.

ANTILOGARITHMS.

We now bring our "Lessons in Logarithms" to a conclusion with an explanation of the term Antilogarithm, and a table of Antilogarithms.

An *Antilogarithm* plainly means *the opposite of a logarithm*—that is, *the number corresponding to any given logarithm.* The following table is arranged exactly like the former, and contains the mantissæ of all logarithms lying between ·0000 and ·9999.

As a logarithm, according to the rules laid down regarding the first table, always consists of *four figures*, and the table of antilogarithms contains no more and no less, one rule will be quite sufficient to enable the student to *take out* the number

*

answering to any given logarithm. It is as follows :—Look for the first two figures of the mantissa of the given logarithm in the first column of the *Table of Antilogarithms*, and in the same horizontal line with these two figures, in one of the ten adjoining columns on the right, under the *third figure* of the mantissa at the top, you will find the antilogarithm answering to the *first three figures* of the mantissa. Next, in the same horizontal line with this number, in one of the nine other columns, headed *Fourth Figure*, and under the *fourth figure* of the mantissa at the top, you will find a number which is to be *added* to the antilogarithm already found, in order to make it the complete antilogarithm required. Now, according to the nature of the index of the given logarithm, by the rules laid down in our preceding lessons, point this antilogarithm—that is, mark it either as integer or decimal or mixed number, as the case may be—and you will have the *number required*.

Example.—Let it be required to find the number corresponding to the logarithm 0·1635. Here, looking for ·16 in the first column of the table, you find in the same horizontal line in one of the *ten* adjoining columns on the right, under 3 (the third figure of the mantissa) at the top, the antilogarithm 1455; and in the same horizontal line with this antilogarithm, in one of the next *nine* adjoining columns, under 5 (the fourth figure of the mantissa) at the top, the number 2, which is to be added to 1455; this being done, you have 1457 for the complete antilogarithm required. Now, as the index of the given logarithm is 0, this indicates that the number must contain only one integer figure; and the antilogarithm 1457 being pointed according to this index, you have 1·457 for the *number* required.

Had the given logarithms been 1·1635, 2·1635, and 5·1635, the corresponding numbers would have been 14·57 145·7, and 145709.

TABLE OF ANTILOGARITHMS.

	THIRD FIGURE.										FOURTH FIGURE.								
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
·00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1	1	2	2	2
·01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	2	2	2
·02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	1	2	2	2
·03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1	1	2	2	2
·04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1	2	2	2	2
·05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	1	2	2	2	2
·06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1	2	2	2	2
·07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	1	2	2	2	2
·08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1	2	2	2	3
·09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1	2	2	2	3
·10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1	2	2	2	3
·11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	2	2	2	2	3
·12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	2	2	2	2	3
·13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	2	2	2	3	3
·14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	2	2	2	3	3
·15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	2	2	2	3	3
·16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	2	2	2	3	3
·17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	2	2	2	3	3
·18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	2	2	2	3	3
·19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	2	2	3	3	3
·20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	2	2	3	3	3
·21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	2	2	2	3	3	3
·22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	2	2	2	3	3	3
·23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	2	2	2	3	3	4
·24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	2	2	2	3	3	4
·25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	2	2	2	3	3	4
·26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	2	2	3	3	3	4
·27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	2	2	3	3	3	4
·28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	2	2	3	3	4	4
·29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	2	2	3	3	4	4
·30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2	3	3	4	4
·31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2	3	3	4	4
·32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2	3	3	4	4
·33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2	3	3	4	4
·34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3	3	4	4	5
·35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3	3	4	4	5
·36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3	3	4	4	5
·37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3	3	4	4	5
·38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3	3	4	4	5
·39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3	3	4	5	5
·40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3	4	4	5	5
·41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3	4	4	5	5
·42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3	4	4	5	6
·43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	3	3	4	4	5	6
·44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3	4	4	5	6
·45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3	4	5	5	6
·46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3	4	5	5	6
·47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3	4	5	5	6
·48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	4	4	5	6	6
·49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4	4	5	6	6
·50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4	4	5	6	7
·51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	2	2	3	4	5	5	6	7
·52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	2	2	3	4	5	5	6	7
·53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4	5	6	6	7
·54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4	5	6	6	7
·55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4	5	6	7	7
·56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	3	3	4	5	6	7	8
·57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4	5	6	7	8
·58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	4	4	5	6	7	8
·59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	2	3	4	5	5	6	7	8
·60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	2	3	4	5	6	6	7	8
·61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	2	3	4	5	6	7	8	9
·62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	2	3	4	5	6	7	8	9
·63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	2	3	4	5	6	7	8	9
·64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	2	3	4	5	6	7	8	9
·65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	2	3	4	5	6	7	8	9
·66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	2	3	4	5	6	7	9	10
·67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	1	2	3	4	5	7	8	9	10
·68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	2	3	4	6	7	8	9	10
·69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6	7	8	9	10
·70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	4	5	6	7	8	9	11
·71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6	7	8	10	11
·72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6	7	9	10	11
·73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6	8	9	10	11
·74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6	8	9	10	12
·75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	3	4	5	7	8	9	10	12
·76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7	8	9	11	12
·77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7	8	10	11	12
·78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7	8	10	11	13
·79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7	9	10	11	13
·80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7	9	10	12	13
·81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8	9	11	12	14
·82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8	9	11	13	14
·83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8	9	11	13	14
·84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	6	8	10	11	13	15
·85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8	10	12	13	15
·86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8	10	12	13	15
·87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	3	5	7	9	10	12	14	16
·88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9	11	12	14	16
·89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	5	7	9	11	13	14	16
·90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9	11	13	15	17
·91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9	11	13	15	17
·92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10	12	14	15	17
·93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10	12	14	16	18
·94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10	12	14	16	18
·95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10	12	15	17	19
·96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	8	11	13	15	17	19
·97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	7	9	11	13	15	17	20
·98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11	13	16	18	20
·99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11	13	16	18	20

LESSONS IN ITALIAN.—XLI.

POSSESSIVE PRONOUNS.

Rule 37.—The possessive pronouns are generally preceded by the definite article *il*, *lo*, or *la*; as—

Il mio fazzoletto e la mia scatola, *my handkerchief and snuff-box.*

Il tuo cappello e la tua parrucca, *your hat and wig.*

Il suo padre e la sua madre, *his father and mother.*

I nostri prati e le nostre vigne, *our meadows and vines.*

I suoi fratelli e le sue sorelle, *his brothers and sisters.*

Rule 38.—The possessive pronouns must agree in gender and number with their substantives; as—

Il mio libro ed il vostro, *my book and yours.*

La vostra opinione e la mia, *your opinion and mine.*

I nostri amici ricusarono le nostre mercanzie, *our friends refused our goods.*

Esse non hanno parlato se non del mio cane e della loro gatta, *they have spoken only of my dog and their cat.*

Il padre ama sua figlia, e la madre suo figlio, *the father loves his daughter, and the mother her son.*

Rule 39.—The possessive pronouns may be put either before or after the substantives with which they agree; as—

Io attendo ai fatti miei, *I mind my own business.*
Egli va satollando la fame a spese mie, *he satiates his hunger at my expense.*
Hai guastato i fatti tuoi, *you have spoiled your affairs.*
Egli ha scritto al suo amico, *he has written to his friend.*
Letta la vostra lettera, entrò nelle sue camere, *after having read your letter, he entered into his apartment.*

Rule 40.—The possessive pronouns preceded by *ogni, qualche, alcuno, molto, questo, quello, quegli, uno, due, tre,* have no article; as—

Ogni mio ufficio verso te è fornito, *all my kind offices towards thee are at an end.*
Per consiglio di qualche suo amico, *by the advice of some of his friends.*
Ella con questo suo figliuolo sen' andava in contado, *she went away into the country with her son.*
Lasciò erede un suo figliuolo, *he left an only son all his fortune.*

The possessive pronouns preceded by prepositions take no article in the following expressions:—

In mia, tua, sua, vita, *in my, thy, his life.*
In mio, tuo, poter, *in my, thy power.*
In favor mio, *in my favour.*
In presenza mia, *in my presence.*
In casa mia, *in my house.*
Per mio consiglio, *by my advice.*
Per amor mio, *for my sake.*
Per mia, sua, difesa, *for my, his defence.*
Per nostro bene, *for our good.*
Per parte mia, or da parte mia, *for my part,* or *on my part.*

Rule 41.—No article generally precedes the possessive pronouns when the latter are prefixed to substantives which express (1st.) kindred or relation, such as *padre, madre, figlio, sorella, marito,* etc.; (2nd.) the rank and quality, such as *altezza, eccellenza, maestà,* etc.; as—

Chi è vostro padre? *who is your father?*
Mia madre, un fratello minore, ed io, siamo restati nell' estrema miseria, *my mother, a younger brother, and myself, have been left in great distress.*
Sua Eccellenza le baciò la mano, *his Excellency kissed her hand.*
Egli adunque inteso il nobile atto di Filippo usato a salute di suo marito, *he then having heard of the noble action of Philip in favour of her husband.*
Venne sua Maestà accompagnata dal Duca d' Orleano, *his Majesty was accompanied by the Duke of Orleans.*

Rule 42.—When the possessive pronouns follow the above substantives, *padre, madre,* etc., or precede the same in the plural, then the article is used:—

Ho veduto la sorella vostra, *I have seen your sister.*
La madre mia è partita, *my mother has set out.*
Mi ricordo aver udito dire il padre mio, *I recollect having heard my father say.*
Finchè io possa farlo in persona, soffra la maestrà vostra, *as long as I can do it myself, allow me, sire.*
Prima che io ringrazio le loro signorie, *before I thank your lordships.*

Rule 43.—Speaking of any part of the body, whole, sick, or wounded, instead of the possessive pronouns as in English, the Italians use *il, lo, la*:—

Mi fate male al dito, *you hurt my finger.*
Gli hanno tagliato la testa, *they cut off his head.*
Lavatevi le mani, *wash your hands.*
Egli ha perduto lo spirito, *he has lost his senses.*

DEMONSTRATIVE PRONOUNS.

Rule 44.—The demonstrative pronouns *questo, quello,* and *cotesto,* used to show the proximity or distance of persons or things, must agree with their substantives in gender and number; as—

È capitato quest' oggi, *he has arrived this very day.*
Quando arriverà quel giorno sospirato? *when will that much-desired day come?*
Preferisco questa camera a quella, *I prefer this room to that one.*
Quelle donne sono graziose, *those ladies are graceful.*

Rule 45.—The demonstrative pronouns *he who, she who, they who,* are expressed by *colui che* or *chi, colei che, quelli che, quelle che,* and *that which* or *what* by *ciò che*:—

Colui che *or* chi tradisce l' amico suo è indegno d' amicizia, *he who betrays his friend is unworthy of friendship.*
Colei che *or* chi voi amate è un' amabile damina, *she whom you love is a charming young lady.*
Coloro che sembrano felici non sono sempre tali, *they who seem to be happy are not always so.*
Ciò che più mi piace è la campagna, *that which pleases me most is the country.*

RELATIVE PRONOUNS.

Rule 46.—The relative pronoun *who, that,* or *which,* is expressed in Italian by *che,* when it is the subject or regimen direct of a verb, or by *di cui, a cui, da cui,* when used in the genitive, dative, or ablative cases:—

L' uomo che vi parlò ieri, è il padroue di questa casa, *the man who spoke to you yesterday is the master of this house.*
Il paue che mangiate, *the bread that you eat.*
Ecco la persona che amate, *there is the person you love.*
Dio, di cui ammirasi l' opere, *God, whose works we admire.*
La cosa a cui meno pensa l' avaro, è di sovveuire i miseri, *the thing of which the miser thinks the least, is to help the poor.*

Rule 47.—The relative pronoun *quale,* used for persons or things, is declined with the article *il* or *la,* and agrees with its antecedent in gender and number:—

Ecco è l' uomo al quale sono più obbligato, *he is the man I am the most indebted to.*
Le scienze alle quali io mi applico, *the sciences to which I apply myself.*
Ho veduto questa mane il ritratto di quella dama, il quale vi piace tanto, *I saw this morning the portrait of that lady, which pleases you so much.*

INTERROGATIVE PRONOUNS.

Rule 48.—*Chi?* meaning *who?* is used in speaking of persons of both genders and numbers:—

Chi è là? *who is there?*
Chi siete voi? *who are you?*
Chi è vostro fratello? *who is your brother?*
Di chi parlate? *of whom do you speak?*
Chi son costoro? *who are those?*

Rule 49.—*Che?* signifying *what?* is used in speaking of things:—

Che ora è? *what time is it?*
Che volete? *what do you want?*
Che età avete? *what is your age?*
Che nuove abbiamo? *what is the news?*
Che intendete di fare? *what do you mean to do?*

Rule 50.—*Quale?* signifying *what?* is always joined to a substantive, and used in speaking of men or things of both genders:—

Qual bisogno avete? *what need have you?*
Di qual principe leggete voi l' istoria? *of what prince do you read the history?*
Quali affari avete? *what business have you?*
A qual casa appartiene? *which house does it belong to?*

INDEFINITE PRONOUNS.

Rule 51.—Alcuno, *some, any one, some people,* is sometimes used alone, and sometimes with a substantive; in the latter case it must agree with it in gender and number:—

Io veggo alcuno che ci sta ascoltando, *I see some one who is listening to us.*
Alcuni sono li quali, più che l' altre genti si credono sapere, e sanno meno, *there are some people who think they know more than other folks, when they know less.*
Egli è dimorato in Parigi alcun tempo, *he has remained some time in Paris.*
Vi sono andato con alcuni amici, *I have been there with some friends.*

Rule 52.—*Alquanto,* meaning *somewhat, several, some, rather,* is sometimes used alone, and sometimes with a substantive. When it is joined to a substantive, it agrees with it in gender and number:—

Ella uscita dalla camera, e stata alquanto tempo, tornò dentro piangendo, *she went out of the room, and, after some time, she came in with tears in her eyes.*
Alquante lagrime mandate per gli occhj fuori, cominciò ad attendere quello che la gentildonna gli rispondesse, *having shed a few tears, he waited for the lady's answer.*
Alquanti, che risentiti, erano all' arme corsi, n' uccisero, *they murdered several, who, being awakened, had taken up arms.*
Dopo alquanto spazio ella a me ritornò, *after a little time she came back to me.*
La Lauretta con maniera alquanto pietosa cominciò così, *Lauretta thus began, in a manner rather pathetic.*

Rule 53.—*Altro,* signifying *differently, something else, another,* etc., may be used alone, or with a substantive; in the latter case it agrees with the substantive in gender and number:—

Altro avresti detto, se tu m' avessi veduto a Roma, *you would have spoken differently, had you seen me at Rome.*
Sembiante facendo di rider d' altro, *feigning to laugh at something else.*
Altri tempi, altri costumi, *other times, other manners.*
Un altro non vi avrebbe perdonato così facilmente, come v' ho perdonato io, *another would not have pardoned you as easily as I have done.*
Datemi un altro bicchiere di quel buou vino, *give me another glass of that good wine.*

Rule 54.—*Ciascheduno* and *ciascuno,* meaning *every one, each,* etc., are used either alone or with substantives. When they are prefixed to substantives, they agree with them in gender, and seldom admit of a plural:—

Ciascun paese ha le sue usanze, *each country has its customs.*
Ciascuna scienza ha i suoi principj, *every science has its principles.*
Ciascuno ha i suoi difetti, *every one has his faults.*
Ciaschedun la voleva, *every one would have her.*
La reina comandò che ciascuno s' audasse a riposare, *the queen ordered that every one should go to rest.*

Rule 55.—*Nessuno* or *nissuno*, *niuno* or *nullo*, meaning *nobody, any one, no one, no*, etc., are employed alone or with nouns. If they are united to a noun, they must agree with it in gender:—

Nissuno vi vuol quel bene, che io vi voglio, *nobody loves you as much as I do.*
Niuna gloria è ad un' aquila aver vinta una colomba, *it is no glory for an eagle to overcome a dove.*
Non ho veduto nessuno, *I have not seen any one.*
Nessuno parlò meco, *no one spoke with me.*
Nissun uomo è infallibile, *no man is infallible.*

Rule 56.—*Ogni*, signifying *every, all*, is indeclinable. It is put before nouns in the singular, and seldom in the plural:—

Ogni uomo è soggetto alla critica, *every man is liable to censure.*
Ogni cosa è in Dio, e Dio è in ogni cosa, *all is in God, and God is in all.*
Ogni re, ogni reina, *every king, every queen.*
Ogni dì, ogni anno, ogni sei mesi, *every day, every year, every six months.*

Rule 57.—*Tutto*, signifying *every thing, all*, joined to a noun, is liable to gender and number:—

Gli uomini tutti più a dire che ad oprare son pronti, *all men are more ready to say than to do.*
Andate con tutta fretta, *go with all speed.*
La gente che aveva bontade veniva a lui da tutte parti, *good people came to him from all parts.*

VERBS.

Rule 58.—Every verb must agree with its subject, either expressed or understood, in number and person; as—

Voi parlate troppo forte, *you speak too loud.*
I sarti dicono spesso bugie, *tailors often lie.*
Io scrivo, *I write.*
Parli da sciocco, *thou speakest like a fool.*

Rule 59.—Two nouns or subjects in the singular, united by e, *and*, require the verb in the plural:—

L' Austria e la Prussia credevano di terminare da se la bisogna, *Austria and Prussia thought to terminate the affair themselves.*
Il padre, e la madre sono molto compassionevoli, *the father and mother are very compassionate.*

INDICATIVE MOOD.

Rule 60.—The Italians make use of the present to express that a thing is, or is doing, at the time in which we speak:—

Io scrivo una lettera, *I am writing a letter.*
Comparisce l' aurora, *the dawn appears.*
I fanciulli cantano quand' hanno paura, *children sing when they are in fear.*

Rule 61.—The imperfect is used in Italian to express a past action as present, or going on when another occurred, which is also past:—

Io leggeva quando voi siete entrato, *I was reading when you came in.*
Io udiva quando mia sorella cantava, *I was listening when my sister was singing.*

Rule 62.—We use the preterite in Italian to express a particular fact or event which happened at a time specified, and wholly past; as during a particular century, year, month, week, or day:—

Ho veduto vostro padre il mese passato, *I saw your father last month.*
Esse partirono la settimana passata, *they departed last week.*

Rule 63.—The future is used to denote that an action or event will take place at some future time:—

Noi lo faremo domani, *we shall do it to-morrow.*
Egli ritornerà al suo paese, *he will return to his country.*

Rule 64.—The conditional present denotes that an action or event would take place, if certain conditions are fulfilled:—

Se io avessi danari, comprerei un buon cavallo, *if I had money, I would buy a good horse.*
Tacerebbero, se potessero, *they would be silent, if they could.*

SUBJUNCTIVE MOOD.

Rule 65.—Verbs expressing command, desire, doubt, fear, ignorance, order, passion, surprise, uncertainty, etc., require the following verb in the subjunctive:—

Che vuoi tu che io le dica da tua parte? *what do you wish me to tell him from you?*
Consento ch' egli ami questa donna, *I permit him to love this woman.*
Supplico ch' egli mi legga questo *I entreat him to read me this.*
Vuoi tu che ti dica il vero? *do you wish me to tell you the truth?*
Io voglio ch' egli il faccia, *I wish him to do it.*

INFINITIVE MOOD.

Rule 66.—Italian infinitives are used as substantives or regimens of a verb, and as second person singular of an imperative negative, and may also be preceded by prepositions:—

È proibito il far male, *it is forbidden to do evil.*
Non è civile l' interrompere gli altri quando parlano, *it is not polite to interrupt others when they speak.*
Il suo fare mi piace, *his manners please me.*
Applicatevi allo scrivere ed al parlare, *apply yourself to write and to speak.*
Non avere, *have not (thou).*
Non essere, *be not (thou).*
Non amare, *love not (thou).*
Questo è un frutto da mangiare, *this fruit is good to eat.*

Rule 67.—The following verbs have no preposition after them before a following infinitive:—

Bisogna, *it is necessary.*
Convenire, *to agree.*
Dovere, *we ought.*
Fare, *to do.*
Intendere, *to intend.*
Lasciare, *to let.*
Osare, *to dare.*
Parere, *to seem.*
Potere, *to be able.*
Sapere, *to know.*
Sembrare, *to seem.*
Sentire, *to hear.*
Solere, *to be accustomed.*
Vedere, *to see.*
Volere, *to choose.*
Udire, *to hear.*

Here are some examples of this rule:—

Bisognò subito mandare a cercare il dottore, *it was necessary to send for the physician immediately.*
Possono andare al teatro, *they may go to the play.*
Io voglio leggere, *I will read.*

Rule 68.—The following verbs have *di* after them before a following infinitive:—

Abborrire, *to abhor.*
Accadere, *to happen.*
Accennare, *to show.*
Accertare, *to assure.*
Accomandare, *to recommend.*
Accordare, *to grant.*
Accorgersi, *to perceive.*
Affliggersi, *to grieve.*
Ammonire, *to admonish.*
Annojarsi, *to be weary.*
Ardire, *to dare.*
Arrischiare, *to venture.*
Assicurare, *to assure.*
Astenersi, *to abstain from.*
Attentarsi, *to attempt.*
Avvedersi, *to perceive.*
Avventurare, *to venture.*
Avvertire, *to admonish.*
Avvisare, *to inform.*
Badare, *to mind.*
Biasimare, *to blame.*
Bramare, *to wish.*
Cercare, *to seek.*
Cessare, *to cease.*
Chiedere, *to ask.*
Comandare, *to command.*
Commendare, *to commend.*
Commettere, *to commit.*
Concedere, *to grant.*
Conchiudere, conchiudere, *to conclude.*
Consigliare, *to advise.*
Contare, *to reckon.*
Contenersi, *to refrain one's self.*
Contentarsi, *to consent.*
Convenire, *to agree.*
Credere, *to believe.*
Curarsi, *to care.*
Degnarsi, *to deign.*
Deliberare, *to deliberate.*
Determinare, *to determine.*
Differire, *to defer.*
Dilettarsi, *to delight.*
Dimandare, *to ask.*
Dimenticarsi, *to forget.*
Dire, *to tell.*
Dispensare, *to dispense.*
Disperare, *to despair.*
Dispiacere, *to dislike.*
Dolersi, *to grieve.*
Domandare, *to ask.*
Dubitare, *to doubt.*
Esitare, *to hesitate.*
Evitare, *to avoid.*
Favorire, *to be so good as.*
Fermarsi, *to stop.*
Fingere, *to pretend.*
Finire, *to finish.*
Fissare, *to fix.*
Giudicare, *to judge.*
Giurare, *to swear.*
Gloriarsi, *to pride one's self.*
Godere, *to delight.*
Guardarsi, *to beware.*
Immaginarsi, *to imagine.*
Impedire, *to hinder.*
Imporre, *to impose.*
Incaricare, *to charge.*
Increscere, *to be sorry.*
Infingersi, *to pretend.*
Ingegnarsi, *to endeavour.*
Intendere, *to understand.*
Lamentarsi, *to complain.*
Lasciare, *to cease.*
Lusingarsi, *to flatter one's self.*
Mancare, *to fail.*
Meditare, *to meditate.*
Meritare, *to deserve.*
Minacciare, *to threaten.*
Mostrare, *to show.*
Negare, *to refuse.*
Negligentare, *to neglect.*
Obbligare, *to oblige.*
Offrirsi, *to offer.*
Ordinare, *to order.*
Omettere, *to omit.*
Osare, *to dare.*
Parere, *to appear.*
Pensare, *to think.*
Pentirsi, *to repent.*
Permettere, *to permit.*
Persuadere, *to persuade.*
Piacere, *to like.*
Pregare, *to entreat.*
Prescrivere, *to prescribe.*
Presumere, *to presume.*
Pretendere, *to pretend.*
Procurare, *to try.*
Professare, *to profess.*
Proibire, *to prohibit.*
Proporre, *to propose.*
Promettere, *to promise.*
Ricordarsi, *to remember.*
Ricusare, *to refuse.*
Rimproverare, rinfacciare, *to reproach.*
Rincrescere, *to be sorry.*
Ringraziare, *to thank.*
Riprendere, *to reprove.*
Risolvere, *to resolve.*
Scegliere, *to choose.*
Scommettere, *to bet.*
Scongiurare, *to conjure.*
Sconsigliare, *to dissuade.*
Scordarsi, *to forget.*
Scusarsi, *to excuse one's self.*
Sembrare, *to seem.*
Sospirare, *to sigh.*
Sostenere, *to support.*
Sperare, *to hope.*
Svolgere, *to dissuade.*
Supplicare, *to entreat.*
Temere, *to fear.*
Tentare, *to try.*
Tremare, *to tremble.*
Tralasciare, *to desist.*
Vergognarsi, *to be ashamed.*

Here are two examples of the above rule:—

Il padre cercò di dargli moglie, *his father sought to give him a wife.*
Non mi curo di vederlo, *I do not care to see him.*

RECREATIVE NATURAL HISTORY.

FIR-TREES AND PINE-CONES.

THERE is to me an inexplicable charm in the fir-needle-carpeted, cone-strewn, aromatic, and shaded glades of a pine forest; and I like to linger where the fresh breeze sings through the tufted pine needles. The crossbills, too, are in their element, when hanging, parrot-like, head downwards, amongst the ripe brown cones, they deftly wrench off scale after scale with their pincer-like mandibles, as they cull the sweet, oil-laden seed which lies hidden at the base of each plate of the cone's armour. It is not my intention here to attempt a description of the almost endless number of conifers which the labours and researches of botanists and explorers have brought to the knowledge of the scientific: I intend rather to endeavour to enlist the reader as a companion in a sort of gossiping ramble amongst some of the most familiar and noteworthy members of the pine family, gathering, as we go, such bits and scraps of pine lore as good fortune may cast in our way.

It would be difficult to find, even amongst the most beautiful of Nature's forest handiwork, a more graceful, widely-distributed, or generally useful tree than the larch (*Pinus larix*), the cone and foliage of which is represented at Fig. 1. By the Romans this tree was held in high esteem, and the larch forests, from time to time discovered by them, were made extensive use of. During their German wars vast quantities of larch timber were obtained. The trees, after being felled and trimmed in the Alpine fir forests, were sent, *viâ* the river Po, to Rome, where a great demand existed for larch for building purposes. Pliny, in writing of the larch, says: "This tree is the best of the kind that bears resin. It rots not, but endures a long time;" and there can be little doubt that the praise thus bestowed by the historian was just. There appears little reason to doubt the truth of the statement which has been made, that the Emperor Trajan's vast floating palace, which was constructed for him on a lake, as a place of resort during the heats of summer, was almost entirely composed of larch and cypress combined. We read that this extraordinary structure was built of cypress and larch, sheathed with lead, fastened with copper nails, doubly planked, and the seams caulked with linen rags, laid over with Greek pitch. After 1,400 years had passed away, some portions of the submerged palace were removed from the depths of the lake, when the fir timber of the building was found to be in an extraordinarily sound condition. We also find that Tiberius, knowing the remarkably durable qualities of larch timber, caused vast numbers of trees, brought from Rhætia, to be cut into planks, for the purpose of re-building the Naumachiarian bridge, which was originally built by Augustus, but met with destruction by fire. This so-called Rhætia larch appears to have been of remarkably good quality and luxuriance of growth; for we find it related that one pole reached 120 feet in length, and was of such perfect growth that all Rome flocked to examine it. For art purposes larch wood appears to have been held in high esteem from the very earliest periods. Some of the most admirable paintings executed by the masters who flourished between the periods when Pliny wrote and Raphael painted were executed on boards hewn from the substance of the larch; in fact, the term *immortale lignum* was applied to larch wood, on account of its extraordinary powers of resistance to deteriorating influences. Much of the picturesque beauty possessed by that land of fine landscapes, Switzerland, is more or less dependent on the larch. The wild crag, deep ravine, and brink of the foam-flaked torrent—each and all have their larch-plumes to break the monotony of rock scenery. Then, again, the peasants' châlets, perched on some wild ledge, or the frail-looking yet reliable mountain-bridge or chasm-guard rail, which, as though secured by industrious spiders of a larger growth, stretch across cliff-tracks and giddy passes, which would be well-nigh impassable, were it not for the light, straight larch-poles which, felled hard by, are made to minister to man's requirements; and it is most fortunate that in the very situation where there is exposure to alternate wet and dry, heat and cold, and the rough buffetings of the tempest, this timber, so admirably calculated to resist decay, should be so abundantly found. Lambert, when speaking of the strength of larch wood, expresses himself as follows:—"By observations made on the strength of timber, it appears that a beam of larch, clear and free from knots and every other imperfection, especially at or near the middle, eleven inches square and six feet and a half long, can bear, if placed horizontally on its two extremes, a weight of 200,000 lbs. suspended to the middle of it, and that it can bear a still greater weight in an oblique position." It was from the adoption of a system of analogical reasoning, that the constructors of the Royal Navy first turned their attention to the use of larch as a wood for ship-building purposes. The first larch-built ship we learn much about was constructed entirely from larch timber, furnished for the purpose by the Duke of Athol. This ship was called the *Serapis*. Then, for experimental purposes, the *Sibylle* frigate, the bottom of a lighter, and a number of piles for tidal use, were constructed at Woolwich dockyard. Quoting from the history of the experiments, we read that "the *Athol*, of twenty-eight guns, was built entirely of larch, of the same growth, whilst the *Niemen*, a ship constructed at the same time, was built of timber from Riga. At the expiration of their first course of service, both vessels were officially examined, when the *Niemen* was found so much decayed as to be condemned forthwith. The *Athol* was re-commissioned, completed her second term of service, provisioned, and made a store-ship of, when for a period of more than thirty years she was subjected to the wear and tear of almost every climate." It is somewhat curious, and not generally well known, that the larch, although so commonly met with throughout the length and breadth of Great Britain, is not one of our indigenous trees. We find that in the year 1629 Parkinson, in speaking of trees of this kind, refers to them as rarities, or out of the common order of trees. Evelyn, too, although perhaps possessed of more information regarding trees than any person who wrote in his time (1664), describes a larch tree of goodly stature, which grew at Chelmsford in Essex, and speaks of it as though he considered it a rare tree. Ben Jonson speaks of the juice of the larch as possessing some mystic virtues, but gives no information as to whether the tree yielding this sap was rare or not. Thus he writes:—

"Yes, I have brought to help your vows
Horned poppy, cypress boughs,
The fig-tree wild, that grows on tombs,
And juice that from the larch-tree comes."

It would be difficult to over-estimate the importance to be attached to the cultivation of this valuable tree in situations where little else could be grown. The Athol family have been celebrated for their zeal in the cause of larch growth. The extent to which their fir-tree cultivation has been carried on in Scotland will be best shown by a reference to the following statistics:—14,096,719 young larch trees were planted in the neighbourhood of Blair Athol and Dunkeld. The plantation covered a track of land 10,324 imperial acres in extent. The trees flourished and grew rapidly, and on felling one, at the ninety-fifth year of its growth, it was found to be 100 feet long, 10 feet 6¼ inches in girth, at five feet from the point at which it was cut through. It contained 368 cubic feet of timber. It has been truly said that the man who plants good trees abundantly stores up wealth for those who follow. An approximate calculation has been made as to the money value of the vast fir forests thus raised by one man's strong will and industry, and the sum arrived at is £6,500,000. In addition to this princely sum we must estimate the thinnings and trimmings as being worth about £7 per acre of forest. At the death of this noble pine-tree planter, a coffin was constructed from the wood of one of his forest favourites, which, on being felled, measured 106 feet in length.

Most of our readers will be familiar with a substance known as Venice turpentine, and sold by all druggists for a variety of medicinal and art purposes. This substance, although bearing the name of *Venice* turpentine, is not brought from Venice, but is simply the hardened sap of the larch. Considerable quantities are obtained in France, the Briançonnais being celebrated for the production of turpentine, which is obtained by tapping or perforating the trees with large augers. The first hole bored is commonly at about three feet above the ground-surface. Other holes, or outlets, are then made in the tree-trunk to a height of twelve or thirteen feet. A number of small wooden tubes, or spouts, are so cut as to fit these holes, just as a tap fits a barrel, and as the liquid resinous juice of the tree flows outwards through the spouts, it drips into a corresponding number of little pots, or other vessels, placed for its reception. The turpentine-gatherers say that the side of the tree facing the south yields a notable quantity of juice more than either the north, east, or west surfaces of the tree.

The manner in which fir-tree sap is collected appears to have undergone but little change since periods of remote antiquity. Ovid thus writes of turpentine-gathering as practised in his day—

> "The new-made trees in tears of amber run,
> Which harden into value by the sun."

Next to the larch in point of abundance in this country, and the freedom with which it yields its resinous juices, we may mention the *Scotch fir* (*P. sylvestris*). Fig. 2 represents the cone, foliage, and seed. This conifer is rich in a product, the loss of which would entail enormous inconvenience and difficulty.

There is perhaps no product yielded by the pine which, for importance and general usefulness, can be compared with tar. The rope-maker, the shipwright, the timber merchant, and the sailor are all debtors to it. Those wondrous cables which furnish a medium for the conveyance of messages and intelligence from pole to pole and sea to sea, owe much of their power to resist decay and deterioration to the tar used in saturating the yarns or hempen cords which, layer after layer, envelop both the electric and protecting wires used in fashioning these submarine ropes. We were much pleased a short time since, on visiting the submarine cable manufactory at Silvertown, with the ingenious manner in which an endless band of heavy chain-links were made to deposit, agitate, stir, and carry upwards to the rope, in the course of manufacture, a perfectly regular and uninterrupted stream of tar composition from the heating chamber in which it was prepared.

A great deal of tar is manufactured in the north of Europe, and a great portion of this is commonly known as Stockholm tar. Such supplies, however, as are furnished from the firs of this country are mainly obtained from the Scotch pine. The roots and other cuttings of old trees furnish the largest return on treatment. *P. sylvestris* is not, however, the only pine from which the tar of commerce is obtained. The tar of the North American botanists is obtained from a conifer known as *P. rigida*. *P. Treda* and *P. Australis* also yield it. Between four and five millions of barrels of wood tar are annually imported into this country.

The substance known as lampblack is, as most of our readers will be aware, extensively used in the arts. This is made in very large quantities from the waste products resulting from the manufacture of common tar, and it may not prove uninteresting to the reader to follow out the manner in which this soft, jet-black, and generally useful substance is prepared. The Germans manufacture lampblack extensively, and find it a valuable addition to the return from the tar-works, about which we shall have more to say as we proceed. When about to prepare lampblack, the manufacturer prepares for himself a sort of coffer or box. This is accurately closed at every joint, but at the top a sort of ventilated stopper-arrangement is placed. This is provided with a number of holes, over which a sort of cone or case of linen cloth is fastened. At a convenient distance from the box and cone a narrow-mouthed furnace is constructed in such a way that as the waste tar products are subjected to heat, the vapours given off from them find their way through a channel or passage up into the box and to the interior of the covered linen bag. Here the hot fumes, charged as they are with carbon, in a minute and in fact almost an impalpable condition, become condensed, and the rich black powder, resulting from the condensation, rapidly and thickly deposits itself on the interior of the linen cone or bag, and as continuous volumes of thick, heavy smoke, which are produced by the constant addition of fresh fuel to the furnace, flow outwards and upwards, they continue to contribute their quota to the deposit in the cone. This in time becomes so thickly coated with carbon that it becomes necessary to remove the contents. This is done by first thoroughly beating the outsides of the cones with sticks, and then passing the powder downwards through channels to barrels placed for the reception of the lampblack.

P. abies, or the Norway spruce, is remarkable as being one of the loftiest trees found growing in Europe, growing not uncommonly to a height of 150 feet. It is commonly straight and pyramidal in form. The cone, seed, and form of foliage are represented at Fig. 3. The timber from this tree is of excellent quality, and is especially well adapted for the manufacture of ladders and flag-poles. It is from the juice of this tree that the Burgundy pitch of commerce is made. This is not the description of spruce from which the drink made from essence of spruce and spruce loppings is obtained, *P. alba*, or the white spruce. For a description of the manufacture of spruce essence and bark bread, we must refer our readers to our next paper, in which we shall give an account of the trees of which the cones are shown in Figs. 4 and 5.

LESSONS IN GREEK.—L.

SYNTAX.

WE pass on to the consideration of Syntax. The word *syntax* comes from the Greek συνταξις, which signifies an orderly arrangement. Syntax, therefore, is the science which teaches the orderly arrangement of words. If the student analyse a proposition, he will find that in its simplest state a proposition or sentence contains a subject and something that is said of that subject. Take as an instance—

ἡ γυνη (or γυνη) εστι καλη, *the woman* (or *a woman*) *is fair.*

Here ἡ γυνη (or γυνη) is the subject. Of that subject it is said that it (she, ἡ γυνη) is fair (εστι καλη). We have, then, here two things to be considered—namely, ἡ γυνη and εστι καλη. The former is the subject of the sentence, inasmuch as it is that of which something is declared. The latter is called the *predicate* of the sentence, inasmuch as it is that which is predicated or declared of the subject.

The predicate consists of two words, namely, εστι καλη—a verb and an adjective. Two things are requisite in a predicate, namely, a verb and an adjective, participle, or other part of speech implying an attribute or quality ascribed to the subject; the verb performing the office of ascribing or referring the quality to the subject. The verb, as connecting the attribute with the subject, is called the *copula* or link.

	Subject.	*Predicate.*	
		COPULA.	ATTRIBUTE.
1.	ἡ γυνη	εστι	καλη.
2.	γυνη	τρεχει.	

The second sentence, you will see, is logically equivalent to the first. In consequence, τρεχει contains in itself a copula and an attribute, τρεχει (*runs*) being regarded as equivalent to εστι τρεχουσα (*is running*), and is in itself the predicate of the proposition.

Without these parts you cannot have a complete proposition; yet, especially in the Greek language, the copula is often understood—that is to say, it exists in the mind, and does not appear in the utterance or in the writing.

Instead of the intransitive verb τρεχει, we will put a transitive verb, and then you will see another element of thought appears :—

SUBJECT.	PREDICATE.	OBJECT.
ἡ γυνη (or γυνη)	τυπτει	τον υἱον (or υἱον),
the (or *a*) *woman*	*strikes*	*the* (or *a*) *son.*

Here you have to contemplate what we have termed *the object*, namely, τον υἱον. The object is so named because it is the object of the action of the verb, that thing or being on which the action of the verb falls; the object struck is here *the son.*

In these simple statements you have the essential elements, first, of all syntax, and, secondly and specifically, of all the Greek syntax. Syntax has nothing else to do than to show in detail what is here set forth generally. It is the office of Syntax to show how each part may be modified, and how the several parts must grammatically stand to each other.

Of Greek syntax the essential laws are implied in the sentences just given. It will be seen in the first sentence that the predicate is in one sense identical with the subject; for the attribute *fair* belongs to *the woman;* εστι is merely the connecting link. The copula identifies the two. Consequently καλη and γυνη refer to the same person, and, referring to the same person, they combine to describe that person. As they then agree so as to be one in fact or in thought, so must they agree so as to be one in form. Hence arises the first concord, namely, that

Adjectives must agree with their substantives in gender, number, and case.

Take gender first. Γυνη is of the feminine gender, therefore we write καλη. If we had written καλος, we should have connected a masculine adjective with a feminine noun, and committed the solecism of declaring *the woman* a fair *man.*

In the second place, they must agree in number. If we had written καλαι, then we should have made the woman at once singular and plural, intimating that she was one and more than one person. In the third place, had we written καλης, we should have produced a different sense, for, by disconnecting καλη from γυνη, the predicate from the subject, we should have said something of this kind, "the woman is (the daughter or the mother) *of* the fair one."

In the same way, the article (which is a qualifying, that is, determinative word) must also agree in form with its noun, seeing that it of necessity agrees in sense, both referring to the same object.

As adjectives and substantives which agree in sense must agree in form, so

The subject must agree with its verb in number and case.

(1.) *Number.*—If we had put before the verb εστι a plural subject, as αἱ γυναικες, saying the *woman is* fair, then we should have represented the subject as at the same time plural and singular. Similarly erroneous would it have been had we written εισι (*they are*) for εστι (*she is*).

(2.) *Case.*—Take the example ἡ γυνη τυπτει τον υἱον. In this example we know that τον υἱον is the object, or receives the action implied in τυπτει, because it is in the case of the object, the objective or accusative case. Instead of being τον υἱον, were it ὁ υἱος, we should not know which of the two, ἡ γυνη or ὁ υἱος, was the subject. And if ἡ γυνη were την γυναικα, then, ὁ υἱος remaining the same, the sense would be *the son struck the mother;* for in Greek the sense depends on the form of the words, not their arrangement.

Observe, moreover, that καλη is in the same case as γυνη, though a verb comes between them. That verb is εστι. Hence you may infer, as a general rule, that the verb εἶναι has the same case after it as before it. The reason is found in the fact already mentioned—that εἶναι, as a copula, merely unites the attribute with the subject.

The subject may be involved in the verb, being indicated by the person-ending, as τυπτω τον υἱον, *I strike my son*, where subject and verb blend together in τυπτω. Another change may be undergone, for the verb may contain the whole of the predicate as well as the subject, as τρεχω, *I am running.*

SIMPLE SENTENCES.

If, after these general explanations, we proceed to consider the particular parts of a simple sentence, we come first to the subject. The subject is commonly a noun or substantive, properly so called, since it is only of a substance or a reality that a statement may be made. But, instead of a substantive itself, we may have a representative of a substantive. A substantive may be represented by an adjective or participle used substantively. A substantive may also be represented by an infinitive mood with the article; also the personal pronouns or the demonstrative pronouns may be employed as subjects, instead of substantives. In short, any word or combination of words that have a substantive force may stand as the subject of a proposition.

The employment of adjectives in the sense of substantives is more common in Greek than in English. Adjectives are used as nouns—

(1.) To denote persons either with or without the article. Thus ξενος, *foreign*, may signify *a foreigner* and *a guest*; and ὁ ξενος, *the guest*; καλος, *a handsome man*; καλη, *a handsome woman*. A participle may also have the force of a noun, as ὁ μαθων, *he who has learnt*, that is, *the scholar*. Less frequently is the neuter used to describe a person; thus, however, το ἀῤῥεν, *the man*, is employed, and το θηλυ, *the woman*; or when a class or general idea is intended, as το Ἑλληνικον, *the Grecian people*; το ἱππικον, *the cavalry*, or *cavalry*; το νεον, *youth*.

(2.) The neuter of the adjective is often used to express relation of space, as το μεσον, *the middle*; το εσχατον, *the extremity, the brink*; also to express relations of time, as επι πολυ, *for a long while*.

The singular is often employed to signify a plural object when that object is considered collectively, and so presents to the mind the idea of *one, unity*. Thus, as we speak of *plate* for *silver utensils*, so the Greeks used αργυρος, *articles of silver*; χρυσος, *articles of gold*, "*gold plate*;" κεραμος, *earthenware*; πλινθος, *stoneware*; καραξ, *palisades*.

Sometimes the subject is not expressed by a separate word, as when the subject is a personal pronoun—for example, γραφομεν, *we write*. It is also omitted with what are called impersonal verbs, as νιφει, *it snows*; βροντᾳ, *it thunders*; αστραπτει, *it lightens*.

The subject has sometimes to be learnt from the connection, as in φασι, *they affirm*; λεγουσι, *they say*—ανθρωποι, or something of the kind, being implied.

If, however, it is intended to present the subject with any emphasis, then the subject, even if a pronoun, must be expressed. Consequently, when the personal pronoun is used, you may infer that emphasis is intended: thus, τι φῃς; is simply *what dost thou say?* but τι συ φῃς; is *what dost* thou *say?*

CONCORD OF THE PARTS OF A SENTENCE.

The form of the subject has great influence on the form of the other parts of a sentence. The form of the subject determines the form of the copula. The form of the subject determines also the form of the attribute, when that attribute is an adjective. That is to say, if the subject is in the first person, the copula or verb must be in the first person. The two must also be in the same number, and the attribute must agree with the subject in gender, in number, and in case. If, however, the attribute is a noun, then it may agree in case only, or in case and number, as παραδειγμα ειμι εγω, *I am an example*, where παραδειγμα is of the neuter gender, while εγω is masculine or feminine.

A subject in the neuter plural takes its verb in the singular, as ζωα παντα θνητα πεθυκε, *all animals are naturally mortal*.

With personal nouns, however, the plural is used when the idea of plurality is made prominent, as τα μειρακια επῃνεσαν τον λελοντα, *the young men (individually) applauded the speaker*.

If the subject is a collective word, and if its parts rather than its totality are regarded, then, though singular in form, it will take a verb in the plural; as το στρατοπεδον ανεχωρουν, *the camp (the soldiers) returned*.

When the subject consists of two or more nouns, the verb is in the plural. The rule remains if both nouns are of the singular number, though sometimes the verb agrees with the nearest noun, and is then in the singular; for example, ἡ μητηρ και ἡ θυγατηρ ησαν καλαι, *the mother and the daughter were fair*; φιλει σε ὁ πατηρ και ἡ μητηρ, *thy father loves thee, also thy mother*.

If the subjects are of one gender, then the predicate must be of that same gender; but if the subjects are in part masculine and in part feminine, then the predicate must be masculine; if, again, the subject is in the neuter gender, or has reference to things, then the predicate is neuter.

When subjects of several persons are united, the first person determines the person of the verb; if there is no first person, then the person of the verb is determined by the second person; any way the verb is in the plural.

When the subject is a general idea, the predicate may be in the neuter singular, whatever the number or gender of the subject; as αἱ μεταβολαι λυπηρον, *changes are a painful thing*.

With a dual subject the verb is in the dual if the two objects are considered specially as two, otherwise the verb may be in the plural; and thus a verb in the plural may follow a verb in the dual, because the idea of the duality is now lost. This is an instance of that agreement which is called κατα συνεσιν, *the agreement according to the sense*, in opposition to the agreement according to the sound or the form.

When a pronoun refers to a noun, it agrees with that noun in gender, number, and case; though sometimes a demonstrative pronoun is put in the neuter gender. If the pronoun is a personal pronoun, then the noun and the pronoun agree also in person.

The verbal adjectives in τος and τεος, when used, like the Latin gerund, impersonally, stand mostly in the neuter plural.

EXERCISE 135.—GREEK-ENGLISH.

1. Ολιγοι εμφρονες πολλων αφρονων φοβερωτεροι. 2. Οργη φιλουντων ολιγον ισχυει χρονον. 3. Των κακων, φασι, πλειω εστι κατα τον βιον η των αγαθων. 4. Ἡ χωρα πολλα εχει ορεινα. 5. Ἡ γεωργια ψυχη τε χειμωνος και θαλπη θερους εθιζει καρτερειν. 6. Αἱ μεν ευτυχιαι τας κακιας συγκρυπτουσιν, αἱ δε δυσπραξιαι ταχεως καταφανεῖς ποιοῦσιν. 7. Επει οἱ πολεμιοι ανηλθον, εκηρυξε τοις Ἑλλησι παρασκευασασθαι. 8. Τρεις ηλθον. 9. Ὁ σοφος ευδαιμων εστιν. 10. Οἱ παλαι ησαν ανδρειοι. 11. Οἱ περι Μιλτιαδην καλως εμαχεσαντο. 12. Το διδασκειν καλον εστιν. 13. Το ει συνδεσμος εστιν. 14. Αποκτενω σε· συ δε: ουκ εγω σε αποκτενω, αλλ' ὁ της πολεως νομος. 15. Παντες επαινουμεν ἁ συ λεγεις. 16. Σωκρατης αει ην εν τῳ φανερῳ· πρωῒ τε γαρ εις τους περιπατους και τα γυμνασια ῃει, και το λοιπον αει τῆς ἡμερας ην ὁπου· πλειστοις μελλοι συνεσεσθαι. 17. Αδηλον το μελλον. 18. Θεων δυναμις μεγιστη. 19. Θνητοι οἱ ανθρωποι. 20. Ἑλλην εγω. 21. Ουχ οἷον τε ανευ δικαιοσυνης αγαθον πολιτεν γενεσθαι.

EXERCISE 136.—ENGLISH-GREEK.

1. Six (persons) came. 2. We two came. 3. He and you are good. 4. My father and I are good. 5. Xenophon was chosen general. 6. Those two men were chosen generals, and they prepared to go against the enemy. 7. I say that thou art bad. 8. Thou (sayest so)? 9. I say it. 10. You are wise, not they. 11. We are Greeks. 12. Future things are uncertain. 13. Man is mortal. 14. My sister is mortal. 15. My brothers and sisters are mortal. 16. You and I are mortal. 17. That is folly. 18. To be sound-minded is wisdom. 19. The market and the whole city are filled. 20. We and they write. 21. He and I write. 22. Democracy is not a good thing. 23. The men, the women, the children have been prepared. 24. Are riches a sign of happiness? 25. Riches are not a sign of happiness.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XVII.—COMMERCE OF THE ARABS (*continued*).

AFRICA.

Barbary.—Barbary was the Arabic term vaguely used before the Saracen conquest to designate the Mediterranean States of Africa, from Egypt to the Atlantic Ocean. Part of this region was anciently known as Mauritania. The Saracens from Egypt overran these territories for a distance of 2,000 miles, and governed them by a viceroy from Damascus.

The breaking up of the first Caliphate induced the Barbary Arabs to imitate the invaders of Spain, and establish an independent sovereignty, under the Fatimite caliphs of Egypt. Kairwan, the capital, founded in 670, and situated twelve miles south of Tunis, was the residence of the viceroy. Though now a town but little known, it was then the nucleus from which radiated caravan routes to the east, west, and south. In the heart of the city was a grand mosque, 250 yards long by 150 broad. It was surmounted by a white marble cupola, supported upon 32 columns of the same costly material, while 414 stone pillars formed a portion of the general structure. From this centre led splendid streets, through which circulated a continual trade to the seven gates of the city. Of these streets, the one to the Spring Gate and that to the Tunis Gate were lined on each side for a length of over two miles with shops displaying the produce of every clime, from the distant Urals, and from the still more remote empire of China. Many flourishing towns were within easy reach of Kairwan, each boasting its marble palace and its market-place. Bakkadah was noted as the only town where palm wine was sold, and Kasseh numbered in its environs as many as two hundred castles. Sabrah, in the line of the grain trade, was connected with the capital by means of a long wall. Several busy harbours lay near Sabrah, as famous for their manufacturing industry as for their maritime trade. Susah wove a transparent tissue so exceedingly fine that it was designated "woven wind." Mahadiah and Safakus cultivated the white mulberry, and reared silkworms. Tarabolos was situated near a saline plain, from which the inhabitants obtained large supplies of salt. Every port on the coast carried on a vigorous trade, both inland and marine, the latter chiefly with Sicily and Spain, while caravans kept them all in connection with the capital.

The region of Mauritania, corresponding to Morocco, Fez, and western Algeria, attracted inhabitants from Arabia, as well as many of the Moors from Spain, who together founded the city of Fez in the eighth century. Fez became eminent for its manufactures, especially that of Fez caps, still worn by the Turks. Besides its looms and dye-works, it fabricated silk and gold thread, and possessed smelting furnaces and manufactories of soap. The fertile soil produced grain, dates, grapes, and olives. Rich meadow lands fed fine herds of horses, goats, camels, asses, and flocks of sheep. Iron, copper, and antimony held the chief place among its mineral produce. Commerce was carried on with Mecca by caravans, and with the Levant, Sicily, and Spain by the feluccas or Arab vessels. Central Africa (Soudan, Nigritia, or Negroland) was visited for black slaves, gold-dust, ivory, and feathers, for which Segel-Messa was made the emporium. From Segel-Messa, which was a manufacturing town, caravans struck off east and west to Egypt and the Niger. So important was this commerce, that the Arabs cut through a mountain pass fourteen leagues in length, in order to facilitate the traffic.

There is a marked contrast between the nearly arid strip of desert which now occupies its place and the fruitful land of Mauritania, which once boasted of numberless castles and villages, and was intersected by a network of aqueducts for irrigation. Is Nature less benign than aforetime? It is hard to believe that man's neglect has brought about the change; yet fertility is restored even now, wherever water is supplied; and with the renewal of industry and skill, the capabilities of the soil might be relied upon to sustain in comfort a thousand inhabitants for every ten who at present exist half-famished on its produce.

Under Arab rule the commerce of Egypt rose to a high degree of prosperity. Syene was the emporium of the caravan trade. Tennis and Damietta stood nearly on an equality as the principal industrial towns. Caravans going to the East met at Fostat, then the capital of Egypt. Many advantages resulted to the town from this arrangement, and it became the centre of Oriental riches and splendour. Fostat was burnt to the ground in 1167.

SICILY.

From A.D. 832 to 1090, the Arabs held possession of the delightful island of Sicily, where winter is as delicious as spring, and summer is tempered by the sea-breezes. As conquerors, they conciliated the Sicilians, and added to their native productions cotton and sugar from Egypt, and manna from Persia. Immense crops of corn, especially wheat, had long made Sicily the granary of the ancient world. Vines, olives, and many kinds of fruits abounded; its minerals were also rich and varied. Sicilian embroidered works and tissues were highly esteemed, and were, it is said, always in request at the coronation of the German emperors.

Everything connected with the Arab system of trade indicates a highly advanced and noble-minded race. Their commercial laws, even when violating the principles of political economy, were framed in a spirit of humanity. They regulated the price of the necessaries of life in the interest of the poorer classes, so that the burdens of these should be light; and they forbade the over-lading of sea-going vessels, so that merchants over-eager for profit should not freight their ships at the risk of seamen's lives.

The maritime commerce of the Arabs was extensive, yet insignificant compared with their caravan trade. Travelling by sea was a power for which their antecedents had not prepared them. Considering, however, the poor craft to which they entrusted their lives and goods, the extent of their maritime commerce may well excite our astonishment.

Eastward they started from Bassorah for Muscat, at which place they had before them the south-east coast of Africa on the one hand, and India on the other; both of these regions they visited, for the purposes of trade. Nearly every place now existing on the east coast of Africa had an Arab origin. Gold-dust, ostrich and peacock feathers, leopards' skins, elephants' tusks, amber, and tortoise-shell, were brought to these marts or depôts by the inhabitants of the interior. Similar stations were established on the Malabar coast of India, whence they pushed their trade to still more distant parts—the Maldive Islands, Ceylon, Sumatra, Further India, and the Nicobar Islands. The Arab merchants were welcomed in China on their first arrival, in 787, and although the Chinese imposed upon them strange modes of selling the goods, yet the founding of agencies was permitted, the traders were exempted from fiscal burdens, and justice was permitted to be administered by their own judges. Few ships, however, ventured on a voyage so full of risk as that to the distant seas of China: still even when the merchandise of India, after Vasco de Gama's discovery of the passage round the Cape, was diverted to Portugal, the Arabs, as agents and interpreters between the Portuguese and Hindoos, regained much of the importance they lost as active merchants.

In these voyages they used a piece of floating wood, furnished with a needle, which had the curious property, under all circumstances, of pointing northward. Such an instrument is still used by the Chinese. It is needless to say that an improved form of this instrument is used by ourselves, under the name of the "mariner's compass."

CHAPTER XVIII.—COMMERCE OF THE ITALIAN REPUBLICS.

VENICE.

VENETIA, on the mainland of Italy, had for many generations been a flourishing province of the Roman empire, when Attila, King of the Huns, with his fierce hordes drove the inhabitants from their homes, to seek shelter in the lagunes at the head of the Adriatic Sea. These lagunes, about four miles in breadth, lay within a long, narrow, insular belt of sand, having several openings to the sea, and were so shallow that a considerable part of their bed was laid bare at every ebb-tide. Here the city of Venice was slowly reared. The difference between the conditions of their old and their new habitations was as great as can be conceived. The generous Italian soil, which had heretofore lavishly supplied them with oil and honey and wine, and whose meadows had given sustenance to fine breeds of cattle, was exchanged for flats of mud and sand—the deposits of the southern Alpine streams. Little of the ground was capable of producing more than a stunted vegetation, and its possession was disputed by sea-fowl. Upon so unpromising a foundation the Venetians built their commercial greatness. Their natural resources were salt, in exhaustless quantities, from the lagunes, and equally unlimited supplies of fish from the sea. These were their earliest articles of trade, and they obtained in exchange from the neighbouring shores greater variety of food, articles of clothing, and timber for their galleys. Life on the water was as natural as that on land to such a race, and they became expert and daring sailors. Their obscure position caused them to be overlooked while the Goths were paramount, and each succeeding age their vessels increased in number and in size. With their growth in power and wealth, the Venetians re-possessed themselves of their ancient territories.

The foundation of Venice was laid in 452, ere Genoa and Pisa had entered upon mercantile pursuits, or even emerged from obscurity. Commerce must have made considerable progress before the end of the fifth century, when the Venetians are referred to in history. In the latter part of the seventh century their government assumed the form of a republic, citizenship in which was easily obtainable. It was not, however, till the time of the Saracens that Venice attained its greatest power, ruling territories on the mainland of nearly 20,000 square miles in area. Their ships made them the chief carriers of Europe, and they were called upon to convey the crusaders to the Holy Land. Venice was aggrandised by this traffic, not only getting rich freight from passengers, but bringing costly cargoes home from the East; her merchants, too, were ever ready to take possession of trading stations wrested from the infidels by the soldiers of the Cross, and even to trade with the Saracens.

The horizon of commerce spread to its widest circumference when a great armament, starting in 1204 for the recovery of Jerusalem, took advantage of factions in Constantinople, and turned out of its route to seize that city. Blind old Dandolo, the Doge of Venice, headed this enterprise, in which a French contingent had been persuaded to take part. In the division of the spoil the Venetians looked chiefly to themselves. Henry Dandolo took the curious title, accurately descriptive of the Venetians' share, of "Lord of Three-eighths of the Roman Empire." They also made bargains with the needy crusaders, and thus increased their share of the capital and its provinces. In this way they became possessed of the Peloponnesus, Cyprus, Candia, and the Ionian Islands—places which they long retained.

The revolution brought about by the Genoese and Greeks in 1261 led to the banishment of the Venetians from Constantinople and the Black Sea. Venice now turned her attention to Alexandria, with which port so profitable a trade was carried on that the merchants were able to disarm ecclesiastical threatenings by large bribes, and yet to enrich themselves. But a few years later the Venetians again asserted their pre-eminence over the Genoese in a great naval battle, and once more opened to themselves the trade with the Black Sea. The fruits of this victory were subsequently lost to them, for the Turks took Constantinople, and with their chilling apathy deadened at once every form of industry and enterprise. Yet the Venetians were left supreme in the Mediterranean. Alexandria, the rendezvous of their Barbary fleet, received olive-oil, fruits both fresh and dried, and honey; cloths, velvet, and furs; copper, lead, vermilion, and quicksilver; giving in return the products of Africa and Asia. From Dalmatia, which under Doge Orseolo II. (997) became a possession of Venice, were obtained timber, wines, oil, flax, hemp, grain, and dried fruits; fat cattle, wool, and furs; lead and quicksilver; and finally, slaves. Orseolo II. gave a new impulse to navigation. He formed trade relations with distant parts, farmed out the customs, and obtained the abolition of inland duties in Germany.

Commerce is so identified with the history of this aristocratic republic, that an account of its government throws light upon its trade and advancement. There were, at the end of the fourteenth century, 1,000 nobles—a number which subsequently increased to 1,500—who grew so haughty that the saying went round on the birth of a son, "A lord is born into the world." At the head of the government was the Doge, and under him six lords (signoria) or councillors. A senate, often chosen from the citizens, formed a permanent council, and under them three inquisitors completed the legislative and executive power. The policy of the government was to extend trade. A powerful navy was formed for defence, for war, and for colonisation. Industry was encouraged, so that the city at length prospered as much from manufactures as from commerce. A quarter of a million of people crowded its thoroughfares. The mud hovels built at first were transformed into marble palaces, and the few poor shrinking fishermen hiding for their lives became the wealthiest people in Europe; masters, for a time, of Candia, Greece, and Constantinople; celebrated for their treasures of art, the perfection of their manufactures, and the vastness of their commerce. Hotels arose for the accommodation of strangers, and the boundaries expanded to meet the wants of the growing population. Water-highways, skimmed by gay gondolas and lined with princely residences, intersected the city everywhere. The flags of every nation waved at the quays, and the merchants who met on the Rialto eagerly offered enormous rents for the smallest vacant counter. The very first bank guaranteed by a state was an institution founded in this "City of Waters," in 1157. Pope Innocent IV. made use of it to pay 25,000 silver marks to a Frankfort burgher. Venice coined large amounts of money for its trade, and for that purpose received at its mint gold and silver bars from various countries.

In the fourteenth century Venice had 3,000 merchantmen manned by 25,000 sailors. A tenth part of these were ships exceeding 700 tons' burden. There were besides 45 war-galleys manned by 11,000 hands; and 10,000 workmen, as well as 36,000 seamen, were employed in the arsenals. The largest of the war-galleys was called the Bucentaur: it was a state or municipal barge of the most gorgeous description. Every year the Doge of Venice, seated upon a magnificent throne surmounted by a regal canopy, dropped from this vessel a ring into the Adriatic, to symbolise the fact that land and sea were united under the Venetian flag. This ceremony commemorated the victory gained over the fleet of the Emperor Frederick Barbarossa in 1177, when the Venetians obliged him to sue for peace. Ascension Day was selected for its celebration, and the Bucentaur, glorious with new scarlet and gold, its deck and seats inlaid with costly woods, and rowed with long banks of burnished oars, for many years bore the Doge to plight his troth with the words, "We espouse thee, O Sea! in token of true and eternal sovereignty."

The merchant fleet of Venice was divided into companies sailing together according to their trade. Their routes, and the days for departure and return, their size, armament, crew, and amount of cargo, were all rigidly defined. In those times the seas were as much infested with pirates as the deserts with robbers; each squadron therefore hired a convoy of war-galleys for its protection on the voyage. There were six or seven such squadrons in regular employment. The argosies of Cyprus and Egypt, and the vessels engaged in the Barbary and Syrian commerce, concentrated their traffic chiefly at Alexandria and Cairo. The Armenian fleet proceeded to Constantinople and the Euxine, visiting Kaffa and the Gulf of Alexandretta. A Catalonian fleet traded with Spain and Portugal, and another with France; while the most famous of all, the Flanders galleys, connected the seaports of France, England, and Holland with the great commercial city of Bruges.

Great as was the attention paid to the maritime trade, the internal traffic with Germany and Italy was just as carefully encouraged. Oriental produce arriving from Constantinople and Egypt, and many other commodities, were distributed throughout Germany, at first by way of Carinthia, and afterwards by way of the Tyrol. Germans, Hungarians, and Bohemians conducted this distribution. In Venice a sort of bonded warehouse (Fondaco dei Tedeschi), or custom-house, was accorded to the Germans, where they were allowed to offer their wares for sale, though only to Venetian dealers. Similar privileges were granted to the Armenians, Moors, and Turks, but not to the Greeks, against whom a strong animosity prevailed, and who were only tolerated for the sake of the profit they brought.

From a state paper of the Doge Moncenigo, we learn some particulars of the inland trade with Italy. All the towns of Lombardy were active buyers of Eastern commodities and Venetian manufactures, but Florence was the best customer. Ten million sequins (zechins) were thus annually brought into circulation. Addressing the Venetians, the Doge Moncenigo warily dissuades them from war, by describing the value of their trade. "Ye are the channel," he says, "through which all riches flow. Ye provide for the whole world. Everywhere men have a common concern in our welfare, and gold from every source flows hither. Through peace, our noble city has yearly 10,000,000 ducats employed as mercantile capital in different parts of the world; the annual profit of our traders amounts to 4,000,000 ducats. Our housing is valued at 7,000,000 ducats, its rental at 500,000; 3,000 merchant ships carry on our trade; 43 galleys, and 300 smaller vessels, manned by 10,000 sailors, secure our naval power; our mint has coined 1,000,000 ducats within the year. From the Milanese dominions alone we draw 1,000,000 ducats in coin, and the value of 900,000 more in clothes; our profit upon this traffic may be reckoned at 600,000 ducats. Proceeding as you have done, you will become masters of all the gold in Christendom; but war, and especially unjust war, will infallibly lead to ruin."

It was not until 1272 that the citizens were permitted to become merchants on their own account. Foreign trade till then had been the sole prerogative of the nobles. Now, however, permission was given for voyages to Marseilles, Montpelier, and Aigues-Mortes, for the disposal of Venetian goods.

Venetian commerce was very soon greatly enlarged by the enterprise of the citizens. Wool was brought by the Flanders galleys, and made into black cloth for inland trade, and into scarlet textures for the Levant. This branch of industry was protected by the prohibition of French and Flemish cloth, as soon as the superior cheapness of the last threatened the home produce. Manufactures of linen, cotton, and camels' hair employed many of the inhabitants. Silk-weavers, ostracised from their native city of Lucca for political reasons, found refuge in Venice, and repaid their welcome by introducing an important branch of industry. Charlemagne usually wore a Venetian robe, and his courtiers were filled with wonder at the richness of the fabrics brought by the merchants of Venice to the mart of Pavia. The ancient preparation of salt and the curing of fish were never disregarded. The Adriatic sands supplied material adapted for a glass of rare beauty and value. Mirrors and other articles of Venetian manufacture were highly prized. Venetian goldsmiths' work was universally famed. Brass and iron foundries prepared the raw material for the armourers, whose weapons, helmets, and bucklers were unsurpassed for strength and beauty. Ship-building, with a people whose principle it was always to have more ships than any other state, was necessarily a very important branch of industry.

Not satisfied with penetrating to every part open to enterprise, the Venetians travelled into regions before unknown, and gave to the world the record of their daring adventures. Maffeo and Nicolo Polo spent fifteen years visiting Egypt, Persia, India, the Khan of Tartary, and the Grand Khan or Emperor of China. Marco Polo, son of Nicolo, as well as Barthema and Joseph Barbaro, extended the knowledge obtained by their precursors in Northern Europe and Asia; Nicolo and Antonio Teno reached Greenland and Iceland, and Quirini wrote an account of his travels in Norway.

It was by such energy of character, directed to commerce and adventure, that the Venetians gained their vast wealth. With the erroneous ideas of their age, however, they were jealous of the prosperity of the other commercial states of Italy, and were not happy till Genoa had been crippled. The same impolitic spirit led their rulers to fetter manufactures with restrictions intended to benefit the citizens at the expense of foreign states, but really injuring both, by preventing competition, and thus lessening the production of wealth. Duties were laid upon almost every article of home and foreign trade, and state monopolies of salt and other substances were established. The revenues of Venice were raised almost exclusively by these impolitic modes. For a while the facilities afforded by their splendid mercantile fleet, and by the accumulation of capital, enabled the Venetians to defy competition, but in the end they were scarcely able to hold their own, either in manufactures or commerce. The Flanders argosies were prohibited from returning with money in exchange, but were required to bring merchandise, such as amber and English wool, by which the Venetians thought to secure a double profit. It led, however, to the northern nations abandoning the trade with Venice, and dealing elsewhere. Forgetful of the sources of their wealth, the Venetians went so far as to forbid their nobles to trade.

Nevertheless, Venice might have outgrown a bad policy, had not a sudden and unexpected blow laid her commerce prostrate. The Venetian ambassador at the Court of Lisbon informed his government that Portuguese vessels had arrived in the Tagus, direct from India, after having colonised several places and established factories in that country. The full import of this intelligence was understood at St. Mark's. The first thought of the Senate was to crush the Portuguese commerce. Finding it impossible to prevail upon the Egyptian Sultan to assist them with a fleet in blockading the Indian coasts, they now sued for a treaty of commerce with Portugal, offering to become the sole purchasers of Indian commodities, but were refused. Venice declined, therefore, not through conquest, like the great commercial cities of antiquity, but from the diversion of trade into new routes, which were the result of increased geographical knowledge.

The later history of the city is comparatively unimportant. The Venetians acquired fresh inland territory, but the golden period of their commerce had passed away. Within narrower bounds, they preserve their old forms of industry even to this day.

LESSONS IN GERMAN.—LXXII.

SYNTAX.

§ 119.

SYNTAX is that part of Grammar which unfolds the relations and offices of words as arranged and combined in *sentences*.

The essential parts of every sentence are the *subject*, which is that of which something is affirmed; and the *predicate*, which is that which contains the affirmation.

The subject is either a noun or that which is the representative or equivalent of a noun; the predicate is either a verb alone, or a verb in conjunction with some other part or parts of speech. All other words entering into a sentence are to be regarded as mere *adjuncts*. The following sentences exhibit the subject and the predicate under several varieties of form:—

Subject.	*Predicate.*
God	exists.
Man	is mortal.
Throwing the stone	was his crime.

In the sentence *God exists*, the verb *exists* is the predicate, affirming, as it does, existence of the Almighty. But in the sentence *man is mortal*, *mortality* is what is affirmed of man, and the verb (*is*) is the mere link that connects the subject and the predicate together. It is thence called the *copula* (§ 158).

Sentences are either *simple* (*i.e.*, contain a single assertion or proposition) or *compound* (*i.e.*, contain two or more assertions or propositions). Of the various parts of a sentence, whether principal or adjunct, we come now to speak more in detail, so as to show the relation, agreement, government, and arrangement of words in construction.

§ 120.—THE ARTICLES.

RULE.

The article in German, whether definite or indefinite, is generally employed wherever the corresponding article would be used in English.

OBSERVATIONS.

This rule is, of course, founded upon the presumption that the student is familiar with the usage of the *English* in respect to the article. In the specifications that follow, therefore, he is to look only for the points in which the German *differs* from the usage of our own language.

(1.) The Germans insert the *definite* article—

(*a*) Before words of *abstract* or *universal* signification; as, der Mensch ist sterblich, man (*i.e. every* man) is mortal; das Gold ist dehnbar, gold is ductile; das Leben ist kurz, life is short; die Tugend führt zum Glücke, virtue leads to happiness.

(*b*) Before the names of certain divisions or periods of time; as, der Sonntag, Sunday; der Montag, Monday; der Dezember, December; der August, August; der Sommer, summer.

(*c*) Before certain names (*feminines*) of countries; as, die Türkei, Turkey; die Schweiz, Switzerland; die Lombardei, Lombardy.

(*d*) Before the names of authors, when used to denote their works; as, ich lese den Lessing, I am reading Lessing.

(*e*) Before the proper names or titles of persons, when used in a way denoting familiarity or inferiority; as, grüße die Marie, greet (or remember me to) Mary; sage dem Luther, daß ich ihn zu sehen wünsche, tell Luther that I wish to see him: also when connected with *attributive* adjectives; as, die kleine Sophie, little Sophia.

(*f*) Before words (especially proper names of persons) whose cases are not made known either by a change of termination or by the presence of a preposition; as, das Leben der Fürsten, the life of princes; die Frau des Sokrates, the wife of Socrates; der Tag der Rache, the day of (the) vengeance.

(*g*) Before the names of ranks, bodies, or systems of doctrine; as, das Parlament, Parliament; die Regierung, government; die Monarchie, monarchy; das Christenthum, Christianity: also in such phrases as in der Stadt, in town; in der Kirche, at church; die meisten Menschen, most men.

(*h*) Before the words (signifying) *half* and *both*; as, die halbe (not halbe die) Zahl, *half* the number; die beiden (not beide die) Brüder, *both* the brothers.

(*i*) Before words denoting the *limit* within which certain specified numbers or amounts are confined, wherein in English the *indefinite* article would be used; as, zweimal die Woche, twice *a* week.

(*k*) Before a past participle joined with a noun which in English *precedes* the participle; as, das verlorene Paradies (*literally*, the lost Paradise), Paradise Lost.

(2.) *Note*, further, that the German differs from the English in *omitting* the definite article—

(*a*) Before certain law appellatives; as, Beklagter, (*the*) defendant; Kläger, (*the*) plaintiff; Appellant, (*the*) appellant; Supplicant, (*the*) petitioner.

(*b*) Before certain common expressions, such as in bester Ordnung, in (*the*) best order; Ueberbringer dieses, (*the*) bearer of this; and certain adjectives and participles treated as nouns; as, ersterer, (*the*) former; letzterer, (*the*) latter; besagter, (*the*) beforesaid (person).

(*c*) Before certain proper names of places; as, Ostindien, (*the*)

East Indies; Westindien, (*the*) West Indies; and before the names of the cardinal points; as, Osten, (*the*) east; Westen, (*the*) west; Süden, (*the*) south; Norden, (*the*) north.

(3.) *Note*, again, that the Germans, in using certain collective terms preceded by adjectives, employ the *indefinite* article where the English would use the definite, as ein hochweiser Rath, the (lit. *a*) most learned Senate; eine löbliche Universität, the (*a*) honourable University.

(4.) In German, also, the indefinite article stands *before* (not *after*, as in English) the words *such, half:* thus, ein solcher Mann (not solcher ein Mann), such *a* man; ein halbes Jahr (not halbes ein Jahr), half *a* year. In questions, direct or indirect, like the following: Einen wie langen Spazierritt hat er gemacht? how long a ride has he taken? it must be noticed that the article stands *before* wie: thus, einen wie langen (a how long), and not, as in English, *how long a*.

(5.) The German differs again from the English in not using an article at all in the phrases answering to the English: *a* few; *a* thousand; *a* hundred.

KEY TO EXERCISES IN LESSONS IN GERMAN.

Exercise 184 (Vol. IV., page 13).

1. In human life there are sometimes cloudy moments. 2. Now and then one must give the mind relaxation. 3. He has frequently been here. 4. I have frequently said this. 5. Sometimes, too, it goes wrong. 6. There is not time now to take a walk. 7. He has still sufficient time to finish this work to-day. 8. He will have more time another day to visit you. 9. This house is worth a thousand dollars. 10. My coat is worth ten dollars. 11. That man is worth five hundred dollars. 12. He is worth ten thousand dollars. 13. This family has a good competency. 14. That poor day-labourer has only a scanty subsistence. 15. There came so many political fugitives that all of them could not find shelter. 16. All the soldiers found shelter in the barns and stables of the peasants. 17. Yesterday I paid the merchant his bill. 18. He has not yet paid the tailor for the coat. 19. He forgot to pay the shoemaker for the boots. 20. The sick person asks for a glass of water. 21. I long to know the truth of this matter. 22. I wish to spend a cheerful hour in the circle of my dear family. 23. I wish for the book that lies there. 24. One thing I beg of you, be careful in the choice of your friends. 25. The man asked for patience and forbearance. 26. As he begged his pardon, he could not be angry any longer. 27. I ask you for a glass of wine.

Exercise 185 (Vol. IV., page 13).

1. Mein Haus ist tausend Franken werth, aber das meines Bruders fünfzehnhundert. 2. Jenes Banquiers Vermögen ist tausend Pfund größer als jene Summe. 3. Zufriedenheit ist von größerem Werthe als aller Reichthum der Erde. 4. Wir konnten bei unserer Ankunft in Amerika nirgends ein Unterkommen finden, denn alle Gasthäuser waren voll. 5. Jeder, der nach Australien geht, kann ein Unterkommen finden. 6. Diejenigen, welche ein nothdürftiges Auskommen haben, sind zuweilen die Werkzeuge der größten Verbrechen. 7. Mein Bruder bittet mich, geduldig und nachsichtig zu sein. 8. Er sucht meine Vergebung, und deßhalb kann ich ihm nicht länger zürnen. 9. Die Nothwendigkeit erfordert, daß wir unserm Körper zuweilen Erholung gönnen. 10. Da er seinen Rock zu bezahlen vergaß, so ersuchte ihn der Schneider, denselben zu bezahlen.

Exercise 186 (Vol. IV., page 13).

1. At the outbreak of the revolution in Berlin there was fighting till late at night. 2. He gave him the book, with the request to keep it clean. 3. A letter was sent to him yesterday. 4. I showed him the new paintings which I had bought at the auction. 5. Music is his most favourite pastime. 6. He sings, jokes, and laughs for pastime, instead of occupying himself with serious matters. 7. I often take a walk in the morning, at noon, and in the evening. 8. They pursued the enemy as far as the frontiers of the country. 9. She had perused the book up to this passage. 10. They ventured out as far as this place, but not farther. 11. He tried in vain to solve the question. 12. They took pains to gain the good-will of their master. 13. He strives to get wealth. 14. I have been here (in this town) about five years. 15. I have been here this half-hour (in this room). 16. Has anybody been here during my absence? 17. Mr. N. has been here and wished to speak to you. 18. A Berlin paper gives us the following interesting communication. 19. The Nuremberg gingerbread is celebrated through all Germany. 20. The Heidelberg cask is known on account of its size. 21. Good-bye, sir. 22. Remember me to your family. 23. He took leave of the company. 24. As the old huntsman could not otherwise give vent to his fury, he beat his dogs.

Exercise 187 (Vol. IV., page 13).

1. Mein Freund schickte mir ein Buch mit der Bitte, es durchzulesen. 2. Ich habe Ihr Buch bis zum zweiten Kapitel durchgelesen. 3. Ein Packet wurde mir gestern zugeschickt 4. Studieren ist mein liebster Zeitvertreib. 5. Des Morgens studiere ich, und des Abends unterrichte ich meine Schüler. 6. Unseres Freundes wegen brauchen wir uns nicht zu bemühen, er bedarf unserer Hülfe nicht. 7. Während der Abwesenheit unseres Lehrers spielten wir, anstatt zu lernen. 8. Wie lange sind Sie in London gewesen? 9. Ich bin beinahe drei Jahre hier. 10. War mein Bruder während meiner Abwesenheit hier? 11. Nein, er war nicht hier. 12. Darf ich Sie bemühen, mir diesen Brief zu schreiben? 13. Ein fleißiger Knabe bemüht sich, Kentnisse zu erlangen.

VOLTAIC ELECTRICITY.—XVII.

THE TELEPHONE—PAGE'S GALVANIC MUSIC—REISS'S TONE TELEPHONE—THE THREAD TELEPHONE—GRAHAM BELL'S MAGNETIC RECEIVER.

We have seen in a previous lesson that the electric telegraph, in its various forms, makes certain signs which can afterwards be readily translated into letters and words. Some systems, indeed, print the words automatically. In the telephone we have quite another instrument to consider—for it actually reproduces speech—although the talker and listener may be separated by some hundreds of miles. Before we can readily understand how this marvellous result is achieved, we must call to mind the manner in which sound generally is produced and conveyed to our sense of hearing.

Sound has been defined as vibration appreciable by the ear. More broadly, we might say that all sound is caused by vibration. Let us take the case of a glass tumbler struck with the finger-nail. It will give a bell-like note which gradually dies away. To prove that this sound is caused by the vibration of the elastic glass, we may suspend a pith ball or a hollow bead by a piece of silk, and hold it against the sounding glass; we shall then find that the vibrations are made evident to our sight; for the little ball or bead will dance away from the side of the vessel, and will refuse to come to rest until the sound ceases. If we pluck a violin-string and then let it go, its vibrations as it sounds are plainly evident. A sounding tambourine or drum will likewise show its vibration if we scatter sand on the parchment surface. The buzz of the fly and the hum of the bee are familiar instances of sound produced by the rapid vibration of membranous wings.

There is another important point belonging to the acoustical part of the subject, which we must consider before proceeding to the electrical phenomena, and that is the physical difference between mere noise and music. Many readers will be inclined to think that the distinction is obvious, but they will perhaps find some difficulty in stating why vibration in one case should produce mere noise and in another case should result in music. A large bird by flapping its wings will simply make a noise, a bee by exactly the same movement gives us a musical note. Why is this? Simply because the bird's wings do not move with sufficient rapidity to produce vibrations which we can recognise as a musical note. Vibrations which follow one another with less rapidity than sixteen a second reach our ears as distinct beats, but if they are more frequent than this, and if they follow one another periodically, we recognise them as a musical note. The pitch of the note depends entirely upon the number of vibrations per second. Thus the lowest note upon a musical instrument may have perhaps 32 vibrations per second, and the highest 4,000 or more.

Remembering these facts, we shall be able to understand how Professor Page, many years ago, produced what he called galvanic music. He found that when an electro-magnet was magnetised, or demagnetised, it gave forth a kind of metallic click. (This is most likely due to the particles of metal being individually magnetised, and setting themselves parallel to the bar of iron. Indeed, Joule proved that such a bar when magnetised increased in length to a certain degree.) Now it was only necessary to make these clicks follow one another quickly, and to make them strictly periodic, to combine them into a musical note. The greater or lesser number of clicks per second, the higher or the lower the note produced. Thus by varying the number of electrical contacts with the battery employed to magnetise his iron bar, Professor Page was able to produce any note he wished.

Acting upon these experiments, Reiss, in Germany, made, in the year 1852, the first instrument called a telephone; which, however imperfect when viewed from a modern standpoint, must ever be regarded as the pioneer of telephony. Reiss's telephone consisted of a box, with a mouthpiece at one side, through which a person might sing, and with a hole at the top filled in with a parchment membrane which vibrated in sympathy with the singer's voice. To the centre of this parchment was attached a small metallic wafer, in connection with one pole of a battery. Exactly over this wafer, and nearly touching it, was a wire leading to one of Page's electro-magnetic bars, and thence to the other pole of the battery. We may suppose that the bar was in an apartment far away from the parchment-covered box; indeed, we may look npon one as the transmitter of sounds, and the other as receiver. The operator singing a note into the box—say a note giving 500 vibrations per second—would cause the parchment to vibrate at the same rate. So the wafer wonld be brought against the wire above it 500 times per second, and consequently the electrical contacts would be the same in number. The bar would, therefore, give 500 metallic clicks per second, which would resolve themselves into the same note sung to the transmitter. In this way any note or song could be accurately reproduced at a distance from the singer. Such a telephone may now be regarded as a very interesting curiosity; bnt let it be remembered that it would only reproduce a mnsical note; it wonld not transmit articulate speech. It may be described as a tone telephone, to distingnish it from an articulating telephone.

By a very simple contrivance we can easily prove that a vibrating plate of metal, parchment, or even paper, can reproduce speech in a most perfect manner. We merely want two round boxes with thin metal bottoms, or, better still, boxes with bottoms formed of parchment, or parchment-paper, and, say, 50 feet of fine twine. The ends of this twine are securely fastened to the parchment bottoms of the boxes by boring a hole in the centre of each and knotting the string. Now let two persons stand each with a box in his hand, and as far distant from each other as the string will allow, taking care that the line is kept taut. If one person now speaks into his box, the sonnds are exactly reproduced in the other one.

Now let us briefly consider the theory of this simple form of telephone, which has been called the "thread-telephone," also "the lovers' telegraph." The sound-waves created by the speaker's voice throw the parchment of the transmitter into active vibration; in other words, the parchment execntes a rapid to-and-fro motion. The tight string leading to the other parchment diaphragm on the distant box canses that also to be pnlled into exactly the same movements, so that the same impulses are given back to the air, and the sonnds are reproduced. It is quite evident that this form of instrument must be of limited application, for the communicating cord or wire mnst be kept straight and tight, and must be made of some material not liable to change from heat, cold, moisture, etc. But it affords proof of the phenomenon that a vibrating plate will take up and give back all kinds of sounds, and even the wonderful complexities involved in articulate speech. It follows that if we can by any means canse the movements of one plate to be repeated at any distance by another one, we shall at once have an improvement on the ordinary telegraph. We look to electricity as the most probable means of accomplishing such a result, for by it distance and time seem to be annihilated.

To Professor Graham Bell is due the invention of the first articulating telephone; and it speaks much for the perfection of the instrument when we state that it is now in common use all over the world, in the same form as it originally left its discoverer's hands. Like the little "thread telephone" above described, it will act both as transmitter and receiver; but, unlike it, its carrying power is not limited to a few yards, for it has maintained commnnication between two places one thousand miles apart.

In actual practice Bell's telephone is not used as a transmitter, although it is almost exclusively used as a receiver, for the sounds given are very weak. But by employing an independent transmitter, of which there are many different forms, and a battery, the sounds given are mnch amplified. A battery, too, is essential for giving a warning signal by means of an ordinary electric bell. However, to make our description of Bell's telephone clear, we shall treat it as if it were worked between two stations, both as transmitter and receiver, and shall leave out all consideration of the usual supplementary apparatus.

Bell's telephone consists essentially of three parts—a magnet, a coil, and a vibrating diaphragm of metal. These are enclosed in a case about eight inches long—somewhat of the form of a skipping-rope handle—which can be conveniently held in the hand and placed to the mouth or ear according as it is used as transmitter or receiver. The magnet is of the bar form, abont six inches long by three-eighths of an inch in diameter. One end is surrounded by a coil of silk-covered copper-wire—the ends of which are carried to the end of the case for ready connection with the line wires. Facing the coil-crowned end of the magnet, and all bnt touching it, is a diaphragm of thin iron enamelled plate, such as is used by itinerant photograpers for the production of those portraits known as "ferro-types." The forward end of the case, where this diaphragm is placed, is trnmpet-mouthed, and through the small orifice in the centre is seen its surface. Let us suppose now that two such instruments are at a distance of about one mile apart, joined up with wires ready for operation. A person speaking into one will be readily heard by a person listening at the other, and the explanation of the working of the instrument can be thus explained.

The speaker canses the diaphragm of his instrument to vibrate. Immediately nnderneath this diaphragm is a magnet, surrounded by a coil of wire. Now we have learnt in a previons lesson that a magnet so sitnated will induce currents of electricity in snch a coil, if it be moved backwards and forwards. We can, therefore, readily understand how a piece of iron moving in close proximity to such a combination will cause rapid alternations in the strength of the currents flowing through the system, which will affect the distant receiver. The distant magnet will also be subject to these variations of strength, with the result that its iron diaphragm will be thrown into the same vibrations as that of the transmitting agent. Therefore, as in the thread telephone, the original sounds are reproduced. Fig. 89 shows Professor Graham Bell's telephone in elevation and section, and the position of the varions parts will be readily understood from what has gone before.

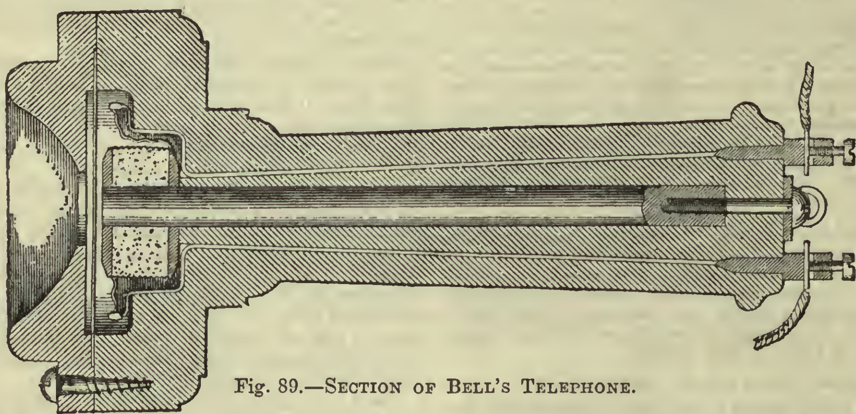


Fig. 89.—Section of Bell's Telephone.

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THE STEAM-ENGINE.—I.

HEAT THE SOURCE OF ITS POWER—THE BOILER—WAGON BOILER—CORNISH BOILER—FEED APPARATUS—SAFETY-VALVE.

THE present might not inappropriately be termed the age of steam. To its agency we are in a greater or less degree indebted for the manufacture of a large proportion of the articles we daily employ; in almost every factory it is now employed as the prime mover, and fresh applications of its power are continually being made. It is very necessary, therefore, for all to be acquainted with the construction and mode of action of the steam-engine; and we shall accordingly endeavour in these lessons to convey briefly such a general idea of it as will enable the student, by a little observation, to understand the principle of any engine he may meet with. To explain fully the details of construction, and the almost endless modifications which have been made, would require several volumes instead of a few pages.

At the outset it is of the utmost importance clearly to understand that no machine can create force—it can only modify its action. The original source of the power of the engine is in the fuel which is consumed in the furnace. When coal, or any other substance, is burnt, a certain definite amount of heat is produced, and this heat, as is explained in our lessons on that subject, is capable of performing a definite amount of work. Theoretically, the combustion of one pound of coal evolves sufficient heat to raise a little over 11,000,000 lbs., or abont 5,000 tons, to the height of one foot. It is found, however, that even in our best constructed engines scarcely more than one-eighth of this is practically turned to account, and usually the proportion is smaller. In this respect there has been a most remarkable absence of improvement during the last fifty years, and any person who could devise some plan for utilising the greater portion of the heat actually produced would effect one of the most important discoveries ever made in connection with the steam-engine.

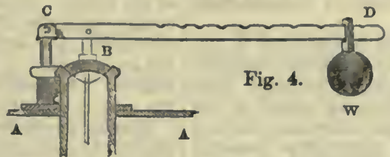

Fig. 4.

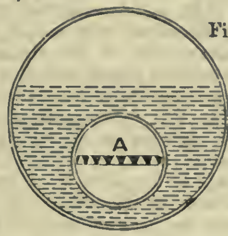

Fig. 2.

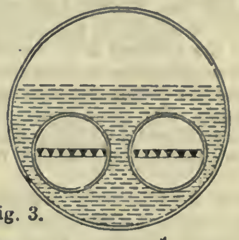

Fig. 3.

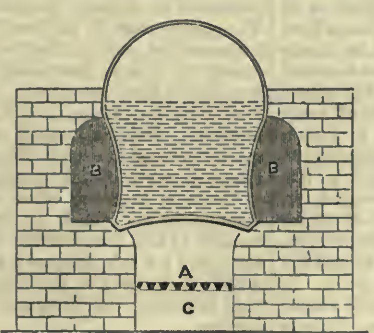

Fig. 1.

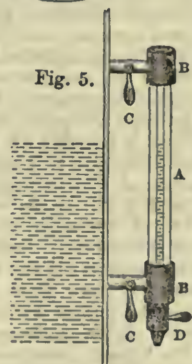

Fig. 5.

In the steam-engine heat is employed by virtue of its power in the conversion of water into steam. If we take a cubic inch of water, and apply heat to it, it will first boil, and then gradually become converted into steam. If this steam be carefully collected in a vessel, and the space it occupies at the usual pressnre of the air be measured, it will be found to be about 1,700 cubic inches, or nearly one cubic foot. Its bulk has therefore been increased to this extent by the influence of the heat applied. To make this quite clear, let us suppose that we have a tube of indefinite length, and having a sectional area of exactly one square inch. Put one inch of water in the bottom of this, and on it place a piston moving easily in the tube, but fitting it air-tight. The air, as we know, presses on this piston with a force of fifteen pounds. Now let us apply heat to the water, as before, till the whole of it has become converted into steam; the piston will have been raised 1,700 inches, since the steam occupies that space. It is clear, therefore, that the work thus accomplished by the evaporation of a cubic inch of water has been to raise a weight of fifteen pounds to a height of 1,700 inches, or nearly 142 feet. This is equivalent to raising 142×15, or 2,130 lbs., 1 foot. Speaking roughly, then, we may say that the evaporation of a cubic inch of water produces power enough to raise a ton weight to the height of one foot. This general statement should be remembered as it will frequently be useful.

If the steam in the tube be now re-converted into water by being condensed, a vacuum will be produced, and a precisely similar amount of force will be called into action.

We understand clearly, then, our source of power, and we are thus in a position to inquire into the two essential points of a steam-engine, which are—

1. The Boiler (with its furnace), in which the water is converted into steam.

2. The Engine itself, or the mechanism by which the force of the steam is made to accomplish the required work.

These we must consider separately, as in reality they are quite distinct. The boiler, in fact, is not unfrequently placed at a considerable distance from the machinery, the steam being conveyed to it by suitable pipes.

It consists essentially of a large metal vessel to hold the water which is to be converted into steam. This must be sufficiently strong to withstand the pressure of the steam, and must be so arranged as to allow of the fire being conveniently and economically applied to it. If the fire is merely placed nnder the metal vessel, and the heated air at once allowed to escape, a great loss is sustained, as the smoke and burnt air that ascend the chimney are still at a high temperatnre. A flue is therefore usually arranged, so that the hot air from the furnace, after passing along nnder the boiler, retnrns and passes round its sides before entering the chimney.

There is an almost endless variety in the forms given to boilers, sometimes one being considered preferable and sometimes another, according to the special circnmstances of the case. The two most general forms, however, are those distinguished as the *wagon-shaped* and the *cylindrical.*

The wagon boilers have somewhat the shape of a covered wagon; the bottom is concave, so that the section of the whole resembles Fig. 1. The sides are also bulged slightly inwards, to aid in the construction of the side flues, B, B. A is the furnace, with the ash-pit, C, under it. Boilers are now always constructed of iron plates riveted together. These are bent to the required shape, and holes are drilled or punched in them to receive the rivets, which are inserted while red-hot, and at once hammered down. In cooling they contract, and force the plates into steam-tight contact. Sometimes the seams are caulked by hammering the edges of the plates with a punch.

In cylindrical boilers the furnace is usually internal, as represented in Fig. 2. The boiler, in fact, consists of two tubes, one within the other. The water occupies the space between them. The furnace-bars, A, on which the fire is kindled, occupy one end of the inner tube; the heated air then passes along this tube, returning by flues which surround the boiler, as in the former case. This form is generally known as the Cornish boiler, and not unfrequently two internal furnaces or flues are employed in place of one (Fig. 3). The advantage of this construction is that all the heat from the furnace and ash-pit is imparted directly to the boiler, whereas in other forms a considerable portion is absorbed by the brickwork.

Sometimes, especially in locomotive or marine engines, where space is an important object, multi-tnbnlar boilers are employed. In these there are a large number of internal flues or pipes, nsnally two or three inches in diameter, through which the heated air passes. It is in this way broken np into a nnmber of small streams, which, as they travel along these tubes, give up to them the greater portion of their heat. In fact, so mnch of the heat is thus imparted to the water, that there is little need for external flues. The water is also kept in this way in more constant circulation, which is a very important thing. In this form of boiler there is a much larger amount of "flue surface," as that portion which is directly exposed to the hot air is called, and more of the heat is consequently utilised. There are many other forms of tubular boilers, but we cannot specify them here.

In the construction of any boiler it is very important to take care that the flue surface is always below the level of the water, as then it is kept from attaining too high a temperature. If the fire or hot air acted on any part of its surface which was above the water level, the plates would become unduly heated, and could not withstand the pressure, but would bulge or give way.

A very large amount of heat is often lost by radiation from the surface of a boiler; to guard against this waste, it is sometimes covered with felt, or surrounded by a jacket filled with sawdust, which is a good non-conductor. Locomotive boilers and the cylinders of engines are also frequently covered with wood for the same purpose.

In order to maintain a sufficiently high temperature in the furnace, it is necessary that there should be a powerful draught. Some means of regulating it is also requisite. The latter may easily be provided by means of suitable dampers placed in the flues, so as partly to stop the current of air. For fixed boilers a tall chimney is often erected, and a sufficiently powerful draught may usually be secured in this way. Artificial expedients are, however, frequently resorted to, especially in the case of a locomotive or marine boiler, where the chimney is of necessity short. The most common of these expedients is to place a small steam-jet in the chimney, and the force of the steam escaping from this creates a powerful draught. The waste steam, after leaving the cylinder, is usually thus employed, and this produces the succession of puffs which are so often observed issuing from the funnel of a railway-engine.

If the fire be made too fierce, or the machinery stopped, so that no steam is drawn off from the boiler, it soon accumulates, and its pressure would in a little time become so great as to burst the boiler with terrific violence, were not some means provided for allowing it to escape. This is accomplished by means of a safety-valve, the action of which will easily be understood by reference to Fig. 4. A A represents a portion of the upper surface of the boiler; in this is inserted a short tube of small dimensions, the upper end of which is bevelled off so that a plate, B, may fit it accurately, and close it, so as to prevent the escape of the steam. A spindle attached to B causes it to rise and fall vertically, and it is pressed down by the weight, W, acting on the end of the lever, C D. The pressure on it can be adjusted by altering the position of this weight. Sometimes, instead of a weight, a spiral spring is placed at the end D, and the pressure is then altered by means of a screw fitted to it. In most boilers two safety-valves are used, one of which is locked so as to be quite out of the control of the engineer. This is adjusted so as just to open with the highest pressure which the boiler will safely bear. The other is adjusted by the engineer, so as just to sustain the pressure at which he is working.

As the boiler is used, a portion of the water in it becomes converted into steam, and consequently the level falls. Were this allowed to continue, it would soon become so low that the flue surface would not be protected by being covered with water, and the result would be that the plates would be softened by the intense heat, and thus be unable to withstand the pressure of the steam. Some contrivance is therefore required to maintain the water at a uniform level, and also to indicate at once if by any accident the water sinks below this level. The pressure on the surface of the water in the boiler is, however, very considerable, and the fresh water to be supplied must, therefore, be forced in with a greater pressure.

Now, as we shall see shortly, there are two classes of engines, known respectively as low-pressure and high-pressure engines. In the former the pressure in the boiler is usually not more than from eight to twelve pounds to the square inch; in the other it is very much greater.

A low-pressure boiler is easily kept supplied with water by placing a cistern at such a height above it that the column of water from it to the boiler is longer than can be sustained by the pressure of the steam. From this cistern a pipe, closed by a valve at the top, leads to the bottom of the boiler. A float in the boiler is then attached to one end of a lever, the other end of which moves this valve, so that as soon as the float falls the valve is opened, and a fresh supply of water is admitted to the boiler till the level is restored. In high-pressure engines a small force-pump is added, by means of which water can be injected into the boiler when required. This can easily be thrown out of gear when not wanted.

Two cocks are usually placed in one end of the boiler, one at the highest, and the other at the lowest level which the water may safely reach. When there is any doubt about the quantity of water in the boiler, the engineer opens these. Steam ought to issue from the upper one, and water from the lower one. If steam comes from both, it is a sign that the water has been allowed to sink too low, and a fresh supply should immediately be admitted.

In addition to these, a glass water-gauge (Fig. 5) is usually placed in the boiler. This consists of a tube of stout glass, A, fitted into brass caps, B, B, which communicate with the interior of the boiler. Cocks, C, C, are provided, by means of which connection with the boiler can be cut off at pleasure. When these are opened, the level of the water in the tube will, of course, be the same as that in the boiler, and hence it can be seen at a glance. The water can be emptied out of the gauge by opening the cock D, placed below the glass tube.

Usually the boiler is fed with the condensed steam which is allowed to accumulate in the hot well. The temperature of this is high, and a considerable saving in fuel is effected by using it instead of cold water. A very important thing in the management of the steam-engine is to secure the greatest amount of power with the least expenditure of fuel, and many alterations have been suggested with a view of attaining this end. The dark smoke which may often be seen issuing from the chimney is in reality unconsumed fuel, and therefore, besides being a nuisance, is a positive loss. Many different kinds of furnaces have been tried, with a view of completely consuming the smoke; a very great deal, however, depends upon the mode in which the fresh fuel is supplied. When it is shovelled in in large quantities, smoke is sure to be produced. The proper plan is to press back the fire a little way from the furnace-door, and lay the fresh fuel in front. The smoke produced has then to pass along the surface of the intensely-heated fire, and is thus consumed. By carefully feeding in this way, and introducing the fuel in small quantities and at frequent intervals, almost all smoke is avoided. In self-acting arrangements the coal is usually thus introduced, and the furnace-bars travel slowly backwards, carrying the fire with them.

There is only one other adjunct of the boiler to which we need now refer. It is an important thing for the engineer to be able to tell the pressure of the steam on the boiler at any time, and for this purpose a small pressure-gauge is attached to a convenient part of the boiler. A hand on the dial-plate of this indicates the pressure in pounds on the square inch of surface.

LESSONS IN SPANISH.—XXII.

IDIOMATIC USE OF CERTAIN VERBS.

Volver á, *to return, to repeat*, is used before an infinitive when it is required to repeat the action denoted by the infinitive, in which case the adverb *again* would be used in English, and the infinitive be rendered in the same tense as *volver;* as—

Volví á verle, *I saw him again* (literally, *I returned to see him*).	Volvió á escribir la carta,* *he re-wrote* (or *wrote again*) *the letter.*

Acaber de, *to finish from*, is used before an infinitive in the sense of *to have just*, and the infinitive is rendered in English as a past participle; as—

Juan acaba de llegar, *John has just arrived.*	Acabo de verle, *I have just seen him.*

Estar para, *to be towards*, is used before an infinitive in the sense of *to be ready*, or *to be about to;* as—

Estaban para acabar sus estúdios,	*They were about to finish their studies.*

* Literally, *he returned* (or *repeated*) *to write the letter.* It must be kept in mind that this is the usual mode in Spanish of expressing the repetition of an action, instead of using a word corresponding to *again* in English.

Estar por, *to be for*, is used before an infinitive to show that the action implied in this infinitive is not yet performed, but that there is a disposition to accomplish it; that is, in the sense of *to be not yet*, or *to have a mind to*; as—

La casa está por acabar, *the house is to finish*, i.e., *the house is not yet finished.*

Estoy por ir á verle, *I am for going* (or *have a mind to go*) *to see him.*

Quedar por, *to remain for*, is used before an infinitive in the same manner as *estar por*, in the sense of *to remain yet*; as—

La carta queda por escribir, *The letter remains yet to write* (*remains to be written*).

Haber de, *to have of*, is used before an infinitive in the sense of *to be to*, or *must*; as—

No han de hacer uso de ellos, *they are not to* (*must not*) *make use of them.*

He de trabajar, *I am to* (*I must*) *work* (or *I have to work*).

Tener que, *to have what*, is used before an infinitive in the sense of *to have to*, or *must*; as—

Tiene que levantarse al romper del dia, *He has to rise by break of day.*

Llegar á, *to arrive at*, is used before an infinitive in the sense of *to come to*, or *to succeed in*; as—

Cuando el hombre llega á gustar los encantos de la virtud, la prefiere al vicio, *When man comes to taste the delights of virtue, he prefers it to vice.*

Venir á, *to come to*, is used as *llegar á*, in the sense of *to come to*; as—

Los dones vienen á ser perjuiciales, *Gifts come to be injurious.*

Hacer is used impersonally before nouns referring to the weather, and is to be rendered by the verb *to be*, and sometimes with the adjective; as—

Hace calor, *it is hot.*

Hace buen tiempo, *it is fair weather.*

Tener is used in the sense of *to be* before nouns of measurement, with the preposition *de* in the sense of *in*; as—

Goliáth tenía de altura seis codos y un palmo, *Goliath was in height six cubits and a span.*

Gustar, when it is to be rendered in English by *to like*, has for its nominative case in Spanish what is the objective in English, and its objective in Spanish is the nominative in English, preceded by the preposition *á*, the sentence generally containing what in English would be regarded as a redundant pronoun; as—

¿ Le gustan á vmd. patatas ? *do you like potatoes ?*

Ella me gusta á mí, *I like her.*

Faltar, when it is to be rendered in English by *to want*, or *to have need of*, requires the same idiomatic construction of the sentence as *gustar*; as—

Á Pedro no le falta dinero, *Peter wants* (or *needs*) *not money.*

Le faltan tres vasos, *he wants* (or *needs*) *three tumblers.*

Hacer falta, *to make need*, is used in the same manner as *gustar* and *faltar*, in the sense of *to have need of*, *to stand in need of*; as—

Me hace mucha falta el consejo de vmd., *I stand in much need of your advice.*

Pesar, when it is to be rendered in English by *to repent of*, *to be sorry for*, is subject to the same peculiarity of construction as *gustar* and *faltar*, except that it is used before an infinitive with the preposition *de*, which infinitive would in English be used as a participle; as—

Á Dios le pesa de haber hecho rey á Saul, *God repents of having made Saul king.*

"It repents God for having made Saul a king," would be a more literal rendering of this last example.

THE ADVERB.

Adverbs are either derivative (or primitive) or adverbial phrases.

The simple adverb, when it qualifies a verb, generally comes after the verb; as—

La religion expresa sublimemente esta verdad, *Religion expresses this truth sublimely.*

There can be no regular rules given for the position of the adverb; in most instances it may vary according to the taste of the writer. Some adverbs generally precede the verb: such are cuando, *when*; luego, *immediately*; apénas, *scarcely*; cuanto, *as much*; donde, *where*; and negative and interrogative adverbs.

Ella es muy ignorante, *she is very ignorant.*

He obrado muy neciamente, *I have acted very foolishly.*

Adverbs, like adjectives, admit of comparison; as—

Alaban mas á los muertos que á los vivos, *they praise more the dead than the living.*

Reciben mas alegremente que dan, *they receive more gladly than they give.*

The adverb *no* is sometimes used in comparisons in a manner that does not imply a negation, in which case it would be redundant in English, and might be properly omitted in Spanish; as—

Mejor es el buen nombre que no las riquezas, *Better is the good name than the riches.*

Muy, *very*, *very much*, is used to qualify adjectives, participles, and other adverbs, but is never used to modify verbs. Mucho, *much*, *very much*, is used to qualify verbs and sometimes adverbs of comparison; as—

Ella es muy rica, *she is very rich.*

Para amar mucho al hombre, preciso es estimarle mucho, *in order to love a man much, it is necessary to esteem him much.*

Lucía lee muy bien, *Lucy reads very well.*

Te has hecho mucho mas poderoso que nosotros, *thou hast made thyself much more mighty than we.*

Muy sometimes is employed to qualify nouns, especially at the beginning of a note or letter addressed to any person; as—

Muy amigo mio, *very much my friend* (*dear friend*).

Muy señor mio, *very much my gentleman* (*dear sir*).

Bien, joined to adjectives or adverbs, is equivalent to *very*: as, bien rico, *very rich*; and to verbs, *much*; as, él bebió bien, *he drank much.*

Negative adverbs and all negations generally precede the verb; as—

Á ninguno dió el libro, *to no one gave he the book.*

No puede escribir, *he cannot write.*

If a word implying negation come after the verb, the adverb *no* must precede the verb; as—

No dió el libro á ninguno, *he gave the book to no one.*

No tiene nada, *he has nothing.*

From the last two rules it will be seen that in Spanish it can be said, nada tiene, *or* no tiene nada, *he has nothing*; á ninguno habló, *or* habló á ninguno, *he spoke to nobody*; ella nunca ha hablado, *or* ella no ha hablado nunca, *she has never spoken.*

Nunca, *never*, and jamas, *never*, are sometimes both used in a sentence to give additional force to the negation; as—

Nunca jamas tendrá sed, *Never, never will he be thirsty.*

Jamas, *never*, is used with siempre, *always*, in the sense of *ever and ever*; as—

Dios reina por siempre jamas, *God reigns for ever and ever.*

In interrogative sentences, *jamas* is rendered by *ever* in English; as, ¿ ha jamas hablado ? *has he ever spoken?*

Si, *yes*, and no, *no*, when used after verbs in such sentences as *he replied no*, *they answered yes*, *I believe not*, take *que* before them in Spanish; as—

Respondió que si, *he replied yes.*

Creo que no, *I think not.*

Me dijeron que no, *they told me no.*

Si, *yes*, and no, *no*, serve to affirm or deny what is predicated in a preceding verb without repeating the verb; as—

Yo no sé nadar, y Juan si, *I know not how to swim, and John does* (*yes*).

Ella pueda cantar, pero yo no, *she can sing, but I cannot* (*no*).

Derivative adverbs are nearly all formed from adjectives, by suffixing *mente*, which in Spanish corresponds to *ly* added to adjectives in English; as—

Cierto; ciértaménte, *certain; certainly.*

Bastante; bastánteménte; *sufficient; sufficiently.*

When more adverbs than one ending with *mente* qualify the same verb, the suffix *mente*, for the purpose of preventing a disagreeable repetition of sound, is placed to the last adverb only; as—

Mi ánimo es explicar lisa y llanamente, *My intention is to explain clearly and plainly.*

In all languages there are certain phrases used adverbially, the words of which, taken collectively, have an idiomatic meaning, but taken separately would make no sense. Thus in English the adverbial locutions *by-and-by*, *at least*, *none at all*, would signify nothing intelligible if taken literally, word by word; but as adverbial phrases, they are very expressive. It is often thus in Spanish: a mere literal translation of the words will do little or nothing toward assisting us to comprehend the meaning. Such phrases will generally be found explained in their adverbial sense in dictionaries. Some of the most common are given in the following list:—

A conciéncia, *conscientiously.*
A la verdad, *truly.*
A vista de ojos, *evidently*, *at a glance.*
A sabiendas, *knowingly.*
Al seguro, *securely.*
Á buen seguro, *certainly.*
Antes con ántes, *as soon as possible.*
Ahora, ahora, *just now.*
A mas correr, *with the utmost speed.*
A mas tardar, *after great delay.*
A la improvista, *unexpectedly.*
A trechos, *at intervals.*
A una, *together*, *in company.*
A la continua, *continually.*
A hecho, *indiscriminately.*
Al paso que, *in proportion as.*
A pié, *on foot.*
A buen hora, *early*, *seasonably.*
A la hora, *at the nick of time.*
Algun tiempo hace, *some time since.*
Al revés, *wrong side outwards*, *on the contrary way.*
A mas no poder, *with all one's might.*
A la sordina, *noiselessly*, *slyly.*
A escondidas, or a escondidillas, *secretly*, *stealthily.*
Al buen punto, *pointedly*, *opportunely.*
A saltos y córcovos, *by fits and starts.*
A la corta ó á la larga, *sooner or later.*
Al ojo, *at sight.*
Al punto, *instantly.*
A tientas, *in a groping manner.*
A mas tirar, *to the utmost.*
A tuerto ó á derecho, *right or wrong*, *hit or miss.*
A secas y sin llover, *without preparation or advice.*
A solas, *by one's self*, *in private.*
A buena luz, *carefully*, *with due examination.*
A dos luces, *ambiguously.*
A trompa y talega, *helter-skelter*, *confusedly.*
Baxo mano, *in an underhand manner.*
Bien como, *just as.*
Casi casi, *very nearly.*
Cuanto ántes, *as soon as possible.*
Cuanto tiempo, *how long.*
Cuando ménos, *at least.*
Cuando mucho, *at most.*
De contado, *readily*, *immediately.*
De seguro, *of course.*
De cuando en cuando, *from time to time*, *now and then.*
De improviso, *unexpectedly*, *on a sudden.*
De aquí para allí, *to and fro*, *here and there.*
De ántes, *of old*, *of yore.*
De contínuo, *continually.*
De intento, *purposely.*
De proposito, *on purpose.*
De hecho, *in fact*, *actually.*
De noche, *by night.*
De dia, *by day.*
De salto, *suddenly.*
De por sí, *by one's self*, *apart.*
De silla á silla, *face to face.*
De tropel, *in confusion*, *pell-mell.*
De lance, *cheaply*, *secondhand.*
De consiguiente, *consequently.*
En conciéncia, *in good earnest.*
En especial, *especially.*
En seguida, *afterward.*
En tanto or entre tanto, *in the meantime*, *whilst.*
En alguna parte, *somewhere.*
En ninguna parte, *nowhere.*
En otra parte, *elsewhere.*
En alguna otra parte, *somewhere else.*
En ninguna otra parte, *nowhere else.*
En cualquiera parte, *anywhere.*
En adelante, *forward*, *in the future.*
En lo sucesivo, *afterward*, *hereafter.*
El año que viene, *next year.*
En derechura, *by the most direct way.*
En resúmen, *in short*, *briefly.*
Hasta no mas, *to the highest pitch.*
Hasta que, *as far as.*
Hoy dia or hoy en dia, *now-a-days.*
Hoy por hoy, *this very day.*
La semana pasada, *last week.*
La semana que viene, *next week.*
Mucho tiempo ha, *long time ago.*
Mañana á la noche, *to-morrow night.*
No bien, *no sooner*, *scarcely.*
No mucho ha, *not long since*, *a short time ago.*
Por atras, *behind.*
Poco ha, *of late*, *lately*,
Poco á poco, *by degrees.*
Por el tanto, *on that ground*, *for the reason.*
Por entónces, *at that time.*
Por supuesto, *of course.*
Por puntos, *from one moment to another.*
Por salto, *on a sudden.*
Por lo largo, *along.*
Por razon, *consequently.*
Por fin, *finally.*
Por instantes, *incessantly.*
Por poco, *but little*, *nearly.*
Por acá ó por allá, *here or there.*
Por encima, *superficially.*
Pocas veces, *seldom.*
Rara vez, *not often*, *seldom.*
Rato ha, *short time ago.*
Sin suelo, *without bounds*, *to excess.*
Sobre seguro, *confidently*, *securely.*
Sin ton y sin son, *without rhyme or reason.*
Sobre manera, *excessively.*
Sobre sí, *separately*, *selfishly.*
Tal vez, *perhaps*, *once at a time.*
Una vez, *once.*
Ya ha rato, *some time ago.*

POLITICAL ECONOMY.—II.

BY J. E. THOROLD ROGERS, M.A.

PURPOSES OF THE SCIENCE—FEUDAL SYSTEM—EFFECTS OF DEBASED CURRENCY—INFLUENCE OF COMMERCE ON NATIONAL WEALTH.

POLITICAL ECONOMY proposes to determine the causes which assist or retard the progress of a people in material wealth. No community stands still, for an exact equilibrium in social philosophy—a condition in which society is neither progressive nor retrograde—is a mere mathematical point, theoretically conceivable, but practically incommensurable. The problem which Political Economy attempts to solve, as was said in the previous lesson, is, how the greatest number of persons can live with the least labour in the greatest possible affluence; and, if such a result can be arrived at, how persons and affluence may increase, and labour may decrease in quantity. As a matter of fact, this prosperity is always at the flow or the ebb; individual societies are going forward or backward.

A hundred examples may be cited in illustration of the fact, that communities wax and wane in wealth or prosperity. Twenty-five centuries ago, the southern part of Central Asia was a garden, occupied by thriving nations; it is now a desert, in which a few savage tribes live the life of nomads or banditti. Twenty centuries ago, Asia Minor was full of populous and wealthy cities; it is now almost desolate. Greece was the cradle of the arts—of poetry, of philosophy, of political science; until recently it was the lowest state in Europe. Italy was the centre of the world, the ruler of the largest and most compact empire that ever was bound together by military supremacy and vigorous government; it has but recently succeeded in effecting political unity. Rome, Carthage, Venice, Genoa have all been leading cities in the history of the world. Nor has the northern ocean been without its representatives in this rise and fall of material prosperity. Before the beginnings of modern history, a league of trading towns on the shores of the Baltic, and the Norwegian coast of the German Ocean, entered into a league of amity and commerce, and were conspicuous for their wealth, under the name of the Hanse Towns.

Once, and once only, however, has the *general* progress of the human race been arrested and driven back. The conquest of the nations exhausted Rome and her subjects. The world fell back into barbarism, when the tribes who inhabited the German swamps and forests, the Russian steppes, and the great plateau of Central Asia, pressing westward from their homes, overran the ancient civilisation of Europe. And in every one of these cases, in the numerous examples of national decline, and in this solitary example of the retrogression of the whole civilised world, every circumstance which has led to these phenomena is capable of easy explanation by an investigation of definite economical causes. It is because other economical causes have become overwhelmingly powerful, that we need not, humanly speaking, fear lest hereafter civilisation will ever be overrun by barbarism. Modern society has become strong, because it has obeyed, imperfectly indeed, but in some particulars implicitly, the laws which Political Economy has discovered and expounded.

I stated in my first lesson that Political Economy is an inductive science. It gathers, in logical language, its conclusions from concrete cases, not from abstract principles or imaginary classifications. It relies on experience, not on hypothesis. It does not deal with an ideal state of things, but it analyses society as it is. And in particular, it finds out what is true and right, by watching the consequences of what it knows to be false and wrong, because the consequences are mischievous or unfair. Now I know no better instance by which I can exhibit the economical progress of society than that which is contained in the economical history of our own country. I will, therefore, attempt to trace an outline of its progress, and occasionally its retrogression, from the earliest times in which we can discover something of its economical condition, down to the period in which we are living now. We shall, I think, find no difficulty in explaining every circumstance which has characterised its history as a community, earning its existence by labour, and seeking to make progress in wealth and material power, if we put the facts before the light of a few economical laws.

I will take for the period at which my account commences, the close of the thirteenth century, because it is at this time that we get the clearest insight into the social condition of the English people; and I can, perhaps, speak with more confidence than most people on this subject, because I have made it a special study.

In those days there were not more than half-a-dozen laws on the statute book, and such laws as did exist were either declarations of existing customs, or were enacted with peculiar and limited objects. The country was governed by traditional rules, very few and very simple, and justice, in accordance with these rules, was administered in every town and every parish, or manor, as parishes were generally called. The process by which justice was done, was by a local judge, known as the lord's seneschal or steward, and a jury, who punished offences committed within the boundaries of the parish, or manor, determined rights by evidence, and prepared the machinery for the registration of all transactions, completed in court, on the parish or manor roll.

In those days, again, everybody owned land, and no land was without an owner. A man who had no land was an outlaw or vagabond, to whom the law afforded little or no protection, because he was not registered in the record of those courts in which alone the protection of law was ordinarily accorded. Hence the police of the time was very strict and searching. However, as those who formed the police were subject to the effect of their own regulations, the machinery of local self-government, though searching, was not oppressive. In brief, the country was universally under municipal government, and government was carried on by a system in which very considerable authority was exercised under the control of very effectual checks.

The highest landowner was the king. Everybody was supposed to hold under him, and he could and did, in his capacity as an individual, hold land under himself as monarch. All that was meant by this rule of law was, that since no land was without an owner, the extinction of any owner involved an immediate reversion to the crown. The great barons held their land from the king. Other barons held from the king or the greater barons. Other tenants held from the inferior barons, the greater barons, or the king. There might, in short, be any number of persons interposed between the king and the person who actually occupied the soil; though ultimately, and just before the date which I have taken, this power of creating under-tenants was controlled, chiefly for political reasons.

As all land was held from some superior, a licence to use land was necessary. The terms of this licence constituted the *rent* of land, and the rent might be paid in money, in produce, or in labour. But if the rent was paid, no person could be ousted from his tenancy, or, at least, could not be ousted unless the jury which I have referred to above were willing to agree that he should be ejected. I need hardly say that they would be very unwilling to agree to such a process, as it would tell against themselves, and that, therefore, unless a tenant became an intolerable nuisance to his neighbours as well as to his landlord, he ran no risk of losing his holding. Nor could the lord get rid of him by raising his rent. The peculiarity of all these ancient rents was, that they were a fixed quantity. The rent which the greatest baron paid to the king's exchequer was invariable, and the same security which he had against an arbitrary increase of rent, was accorded to the poorest tenant in a manor. It did not follow that, considering the times, these rents were low. In point of fact they were frequently as high as the tenant could afford to pay. But they were paid, and therefore gave the tenant a sense of security that his enterprise and diligence, if he had them, could not be used against him. And I may add that there was, at the time I speak of, no slavery. There was a class of cultivators who went by the name of villains, and who were in theory serfs; but they had gained all the solid advantages of free men, a few traces only being left of the condition which their ancestors had probably occupied. Thus they generally held their land by payment of labour rents, were liable to a fine when their daughters married, or their sons became monks or clergymen, and were obliged to get a licence in order to live away from the manor, which free tenants could leave at their discretion.

Scattered over the country were the towns, most of which had endured from the days of the Roman occupation, if, indeed, they were not occupied originally by the ancient British tribes. These towns carried on a few manufactures, besides holding markets for country produce, and fairs for the sale of such merchandise as our forefathers bought. They had generally obtained charters from king or baron, or bishop or abbot, and invariably secured by such charters that self-government which the manors or parishes had, together with the right of electing their own magistrates. Particular towns had special manufactures for which they were famous. Thus, at the period which is before me, I find from a contemporary document that Shoreham, Blyth, Beverley, and Colchester were known as manufactories of cloth; Lewes and Aylesham, for linen; Wilton, for needles; Gloucester, for iron; Shrewsbury, for furs; Bridport and Warwick, for cord and rope; Haverhill, for gloves; Coventry, for soap; Banbury and Ely, for beer; and other towns for other articles.

The population of England was, in all likelihood, not more than two millions, and nearly all the inhabitants were engaged in agriculture. During the harvest time the whole town and country folk were occupied in the fields. In the winter, the town population betook themselves to manufacturing their goods, and the country folk busied themselves with such domestic work as the firelight would enable them to do. Candles were far too dear for ordinary use.

The success with which agriculture is practised is the measure of the population which can exist in a country. In those days, this art was practised with very moderate success. Our forefathers had no winter roots. Turnips, carrots, and, of course, potatoes were unknown to them, and unknown for many a long year after the period whose economical condition I am sketching. Our ancestors knew nothing of those artificial grasses which constitute the richness of a modern pasture, and give a deep swarth to hay. Clover, trefoil, sainfoin, and lucerne were undiscovered wealth.

As there was no stock of hay for winter food, other than that which could be got from the coarse and innutritious pasture of the time, there was little winter stock kept. As manure was scanty, the dressing of the farm was insufficient. As the rotation of crops was unknown, and indeed impossible, the land which had been exhausted by grain crops lay in fallow. As ploughing was shallow, partly because cattle were weak, partly because iron was excessively dear, the exhaustion of the soil was still more rapid. Seven bushels of wheat to the acre were held to be an average crop. At present the yield on well-tilled land of ordinary quality is four times that amount.

My readers will now see why it was that the population was, as compared with that of our day, so scanty. Take one-fourth of the wheat now produced in England, and recollect that this little crop could only be got half as frequently as the present crop now is, and it is easy to see that a rate of production which can keep sixteen millions now, could only maintain two millions nearly six centuries ago. And what held good in the case of corn, was equally true in that of meat. I have said that there was little or no winter feed. The stock which survived the winter was half-starved, and needed most of the summer in order to get into moderate condition. The greater part was killed in November, and salted for winter use. Our forefathers found salt mutton and beef very indifferent fare in winter, and therefore longed earnestly for spring. Nobles and great landowners had still less relish for this kind of food, and we know how savagely they protected such game as their estates furnished. Nothing gives a better insight into the social economy of England five centuries ago, than the fact that fat was six times as dear as meat, and that the price of a pound of candles would have taken the wages of a whole day from a labourer.

Still, though our forefathers lived without the possession of many among those conveniences which are familiar to the poorest among us, and though their condition was almost stationary, they were far from unprosperous. The excellence of the village police made crime comparatively rare. As a rule, the tenant was not only secure of his holding, but his property was safe. Hence, other European nations not being possessed of so effectual a police, English people alone could keep sheep to advantage. English wool was the principal article of English wealth six centuries ago, not because Continental farmers could not keep sheep, but because they were far from being safe that they should shear them when shearing-time came. This English wool enabled the warrior-monarchs, Edward III. and Henry V., to effect the temporary conquest of France.

If they who carry on agriculture can earn by their labour more than is necessary for their subsistence, other people can exist, either in idleness, or devote themselves to different kinds of labour. These can increase the comforts of their fellow-countrymen by satisfying their wants, or can obtain the products of foreign countries, by exchanging what they produce with the merchant. In times of peace, English wool and some few English manufactures were the means by which the people of this country were supplied with the fine cloths and fine linen of the Low Countries, the silks and velvets of Genoa and Florence, and those precious spices which Venice procured by the sea passage of the Red Sea and the Nile, or over the plains of Central Asia.

There were very few persons, however, who could afford to live on their own resources, that is, upon the rents which their tenants paid them. There was hardly an English nobleman who did not farm his own land. Roger Bigod, the great Earl of Norfolk, who at the close of the thirteenth century was the richest subject in England, cultivated at least forty of his own manors in the eastern counties and in Ireland by his own bailiffs. The English monks worked in the main with their own hands. All the labour which could easily be spared from the cultivation of the soil (and it seldom could be spared all the year round), or from the necessary manufactures of the towns, was given to architecture. It was at or about this period that those magnificent cathedrals, abbeys, churches, and castles were built, the ruins even of which are full of beauty, and prove how general was the architectural genius of our forefathers.

During the three centuries which followed the date which I have taken, two circumstances occurred which contributed to raise the condition of the mass of the people—*i.e.*, the agricultural population—and two or three others which helped to powerfully depress them. All these circumstances have a purely economical interpretation, and their effects have an easy explanation.

The rate of wages (whether we take the money a man earns, or the articles which he can purchase with what he earns) depends on the proportion which there is between those who seek for employment, and the employment which they can obtain; between labourers for hire, and the work to be done. And generally the number of people living in a fully settled country is equal to the amount of subsistence which the country supplies in average years. The amount of subsistence is determined by the average quantity of that particular food on which the mass of the community lives, and which each requires. Thus the English people, fortunately for them, have generally lived on wheaten bread, the Hindoos on rice. Now, if each Englishman, woman, and child consumes annually a quarter of wheat, it will be found that the population of England is proportionate to the average number of quarters of wheat which the soil of England produces, or the labour of Englishmen can purchase. Population, in short, grows with the means of subsistence. I shall have occasion hereafter to point out the real significance of this law.

Now, if the number of persons seeking employment is suddenly diminished, they who remain can get better terms from their employers, and may materially elevate their condition. And this was what actually happened. In the middle of the fourteenth century a deadly plague attacked this country, the ravages of which have had no parallel before or since. Multitudes perished, but the survivors prospered. Their prosperity impelled them to attempt a political revolution. They nearly succeeded, for the boors' war of 1381 was only just unsuccessful. Though they were defeated, they were too strong and too numerous to be punished. After the great plague the wages of every kind of labour were nearly doubled.

The other cause which assisted the progress of the people during the period referred to was the civil wars. The English nobility committed suicide, so to speak, during that long dynastic quarrel, and the people succeeded to their inheritance. The waste and cost of war brought many an ancient estate into the market. The general abundance of the harvests during the fifteenth century enriched the agriculturist; he became the purchaser of land, and that race of yeomen arose whose opulence is commented on by writers of the day, and especially by Chief-Justice Fortescue. In the beginning of Henry VIII.'s reign England was rich and powerful.

Towards the close, however, of this monarch's reign, this prosperity was suddenly arrested, and England sank rapidly in material wealth. The destruction of the monasteries removed a race of easy landlords; the appropriation of the abbey lands by Henry's courtiers, who were needy, led to extensive sheep-farming, and the abandonment of arable cultivation. The price of food rose, that of labour remained stationary. Thousands were thrown out of employment, and became banditti or beggars. After the severest measures of repression were attempted in vain, the establishment of a poor law became inevitable.

A far more potent cause of the misery of the sixteenth century is, however, to be found in the fact that Henry and the Protector Somerset issued base money in vast quantities. It is impossible for us to estimate the evils which such an expedient induces: all confidence is destroyed, trade is rendered almost impossible, and the weight of the suffering invariably falls on the wage-earning classes. The effect of a debased currency—by which I mean a coinage of metal which falls markedly below the standard of fineness—is as fatal a blow to credit and security as the occupation of a country by an invading army.

I have spoken at length on the social state of England during this period, because a clear comprehension of it renders the account of its revival and progress intelligible. At the beginning of the seventeenth century, English farmers commenced the introduction of winter roots. The turnip and carrot—two plants which have been improved by assiduous labour from valueless weeds into invaluable articles of food—were first cultivated by the Dutch. During the seventeenth century, in the course of which their use became general, the population of England was certainly doubled.

At the beginning of the eighteenth century agriculture made still more rapid progress. The *London Gazette*, almost the only newspaper of that time, frequently contains advertisements of new grasses. Roots and grasses together made a rotation of crops possible. The effect was speedily seen, for favoured, no doubt, by a succession of abundant harvests, the population of England was again nearly doubled between the beginning of that century and the sixty years at the conclusion of which George III. began his reign.

The next fifty years, however, were a period of retrogression. The nation was engaged in costly and disastrous wars, and the seasons were unfavourable. But at the conclusion of the great Continental war England again made progress, and during the seventy years of the present century her population has again been doubled, improvements in agriculture having permitted fifty per cent. of this increase. The remainder is supported by foreign corn, imported in exchange for British manufactures.

I must conclude my lesson with a short sketch of British commerce and manufactures, and point out how they have aided the acquisition of wealth.

Foreign trade is the means by which the labour of man is rendered as effectual as possible. At great cost and labour, wine could be produced in England. Perhaps at still greater cost we might supply ourselves with tea. At a still heavier charge we might grow cotton. Increase the cost, and we might obtain tropical produce under glass and by great artificial heat. By foreign trade we obtain all, or nearly all, which these expensive processes could supply us with at the least possible outlay. We need not be told that everything which diminishes labour and increases harmless enjoyment is an addition to human happiness.

A nation whose commerce supplies not only its own people but other nations with these conveniences, adds to its wealth as well as to its enjoyment. As in the case of other kinds of outlay and labour, it gets a profit on the transaction, and so increases its power of purchasing. The growth of English trade has been effected by the nearly continuous progress of two centuries and a half.

It was more than a hundred years after the discovery of the New World, and the passage to India round the Cape of Good Hope, that England attempted to appropriate any of the benefits of trade by long sea voyages. I have already indicated the cause of this delay in the mischief caused by the financial expedients of Henry VIII. and his son's guardians. When the trade to the East was entered on, it took, after the fashion of the time, the form of a chartered company, and the English nation gained very little by this branch of its commerce. In other directions, however, this country did appropriate to its advantage a considerable portion of the carrying trade.

It made infinitely greater progress by its success in manufacture. The world was cleared of rivals, and the inventiveness of the British race occupied the opportunity. The great Spanish empire was lost in its vast Transatlantic conquests. France was crippled by the bigotry of her princes, who expelled the useful arts of the country, because the artisans were suspected of heresy, was hampered by Colbert's scheme for encouraging manufactures, and was deprived of the carrying trade by the Seven Years' War. Holland had ceased to be a manufacturing country.

The discoveries of Watt, Crompton, and Arkwright created a revolution in manufacture, and a monopoly of production for foreign trade. The great Continental war, disastrous as it was to the British labourer, was a stimulus to the British manufacturer, and raised the condition of the artisan. A nation which produces useful articles in excess of its own wants, and which can satisfy the demand of foreign nations, can, in proportion to the fulness with which that demand is exhibited to it, increase both its population and its wealth. It becomes, so to speak, if it adopts free trade in food, like a huge town, to which the agricultural regions of the earth are as the country from which it can draw its supplies.

To sum up, the first cause of the progress in wealth which this country has made, is to be found in the success with which it has developed agriculture. It has thus been able to devote the largest part of its population to the industries of manufacture and commerce. It has not only supplied itself with commodities produced in foreign countries, but it has created a vast mercantile marine, by means of which it is the carrier to half the world. Lastly, it has manufactured for the whole world, and has been able, therefore, to make the world work for its subsistence, in exchange for the conveniences which it has supplied.

In my next lesson I shall treat of wages.

TERMS USED IN COMMERCE.—X.

SCIRE FACIAS.—A writ most commonly issued to call a person to show cause to the Court issuing it why the execution of judgment previously passed against him should not be made out.

SCRIP CERTIFICATE.—A certificate given in receipt for money paid for shares in public companies preliminary to the registration of subscribers; or of instalments paid towards public loans previous to the issue of the bonds.

SCRIVENER.—A negotiator of monetary transactions, acting as a middle-man between borrower and lender. Also one who is employed to draw up and engross deeds, conveyances, and securities for money.

SEARCH WARRANT. — A warrant granted by a magistrate, directing any given premises to be searched—generally for stolen goods.

SEAWORTHY.—A term indicating that a vessel is in a proper state of repair, and in every way fitted for her contemplated voyage.

SECURITIES.—Documents representing or securing a right to money or property of any kind, such as bills of exchange, warrants, deeds, bills of lading, policies of insurance, leases, and bonds.

SEISIN.—The ownership and possession of freehold property.

SEQUESTRATION. — The course by which the estates of insolvent traders and others in Scotland are realised and divided amongst their creditors. Equivalent to the term *Bankruptcy*.

SET-OFF.—A counter claim by the person on whom a demand is made; the sum due by one operating as payment or part payment of the sum due by the other.

SETTLEMENT.— The adjustment of an account or claim. Generally applied to the payment of accounts in full of all demands.

SHARE—SHARES.—The proportion of interest in any undertaking or company.

SHIPMENT.—A quantity of merchandise sent by a vessel to either a foreign port, or one in the same country.

SHIP'S PAPERS generally consist of the certificate of registration, manifest, muster-roll of crew, and log-book, with sometimes a charter-party and bill of health.

SHORT EXCHANGE.—Bills of exchange drawn for short payment, at sight, or three days after sight.

SIC.—A Latin word signifying "thus," or "after this fashion."

SIGHT.—Presentment of those bills of exchange whose due dates are determined by the period at which they are first seen, or sighted, by the persons on whom they are drawn.

SINE DIE.—Signifying "without fixing any day for re-assembling;" thus, "to adjourn *sine die.*"

SINKING FUND.—An accumulative fund set apart for the extinguishment of a debt.

SLEEPING OR DORMANT PARTNER.—A partner who does not assist in the management of a business, but who receives a share of the profits, and is also liable for a share of the loss.

SOLVENCY.—The state of being able to pay all debts in full. The adjective description of this state is *Solvent*.

SPECIE.—Coined money of any description.

SPECIFICATION.—The distinct expression of the items or details of a matter.

SPECULATION.—An incurring of heavy risks with the view of obtaining a more than usual profit.

STANDARD.—A fixed or determined point by which certain things are adjusted, as a standard of value, quantity, or quality.

STAPLE.—The chief article or articles of a country's production and commerce.

STATISTICS.—A collection of facts relating to the condition and progress of the whole or part of a state or its commerce.

STATUS.—Used commercially to imply a man's position and condition with regard to money matters.

STERLING.—The denomination given to English money.

STOCK.—Accumulated goods or money. By dealers, goods in possession are spoken of as stock on hand. By commercial men and bankers, their amounts of capital are called stock. The term also applies to any of the various capital debts of different countries, which are termed collectively *Stocks*.

STOCK BROKER.—See *Brokers*.

STOCK EXCHANGE.—A building where stock brokers and jobbers meet to transact their business. The members of the London Stock Exchange number about 900.

STOCK-JOBBER.—A member of the Stock Exchange, and dealer in stocks and shares, carrying on operations with other dealers and with the public through the medium of the stock brokers.

STOPPAGE IN TRANSITU.—The right of a seller of goods to recover them while in course of transmission to the buyer or his agents, if, since their purchase, the buyer has become bankrupt or insolvent.

STRANDING.—The running of a ship on shore or on the rocks, and leaving it stationary there for any length of time.

SUBPŒNA.—A writ calling upon a person to appear at the day and place named in the writ, under a penalty.

SUPERCARGO.—See *Cargo*.

SUSPENSION OF PAYMENTS.—A trader ceasing to pay any of his debts on becoming aware of his inability duly to discharge the whole.

TACK.—See *Lease*.

TARE is a deduction for the weight of a package in which goods are secured. It is of three kinds—actual, average, and estimated. *Actual tare* is where each package is weighed separately from its contents; *average tare* is where the packages are numerous, and of a similar size and character, and a few are weighed so as to form an average for the whole; and *estimated tare* is where packages in particular branches of commerce are so invariably alike as to warrant a fixed per-centage allowance for them.

TARIFF.—A table of charges. Also an enumeration of articles on which duty is levied, with the various rates charged, as well as the articles that are prohibited or exempt.

TENDER.—An offer in writing to supply certain goods, money, ships, or articles that may be required upon specified terms and conditions. Also a presentment or offer of money in satisfaction of a debt or claim.

TONNAGE.—A ship's carrying capacity. Registered tonnage and actual capacity sometimes differ considerably, owing to the peculiar build of certain vessels.

TONTINE.—The system of raising money by granting life annuities to a number of persons with benefit of survivorship as the lives fall in, until at last a single survivor becomes entitled to the whole.

METEOROLOGY.—IV.

LIGHTNING—ST. ELMO'S FIRE—AURORA BOREALIS—OZONE—RAINBOW.

Clouds are usually charged with electricity, sometimes positively and sometimes negatively. When two clouds charged with different electricities meet one another, the fluid will dart from one to the other in the form of lightning. If a cloud highly charged be suddenly condensed into vapour, the electricity in it will be set free in a similar way, and a thunder-storm will be produced. These are most common in tropical regions, and, in general, the air is noticed to be peculiarly heavy and close before their occurrence.

Flashes of lightning most commonly pass from one cloud to another, or else into the air. It is comparatively seldom that they strike the earth. Four distinct classes of lightning have been observed, viz., forked lightning, sheet lightning, summer lightning, and ball or globular lightning.

The electric fluid always selects the path which offers the least resistance to its passage, and hence, when the flash is powerful, it is frequently seen to assume a zigzag appearance, or even to divide into branches, and is then said to be forked. The sheet lightning is the most common form; in it the flashes are usually shorter and more rapid. Frequently they appear to be within the cloud, and light up its whole surface. The thunder which follows this is usually low and distant, and falls on the ear in a long and muffled peal. Summer lightning is closely allied to this, and is frequently seen at intervals during the long summer evenings, illuminating the horizon with repeated flashes, unaccompanied by thunder. It is probably caused in general by the reflection of a distant storm, and in some places is regarded as a precursor of unsettled weather.

The last form of lightning is by far the most dangerous, but fortunately it is very rare. The lightning in these cases appears to assume a globular form, and moves much more slowly than usual. Sometimes the ball comes in contact with some object, and explodes with a loud report, at the same time doing considerable damage to everything near.

Thunder is the noise which is heard after a flash of lightning. It is caused by the concussion of the air, as it rushes in and fills the vacuum caused by the passage of the electricity. Flashes of lightning frequently extend several miles in length, and are quite instantaneous; the thunder is therefore produced at the same moment at every part of its path. The sound vibrations, however, only travel about 1,100 feet a second, and therefore the sound from the further end will reach the ear several seconds after that produced at the nearer end. The continued peal is thus accounted for.

By observing the interval between the occurrence of the flash and the commencement of the thunder, the distance of the storm can be easily estimated. A little over a mile should be allowed for every five seconds. The duration of the peal is frequently increased by reverberations and echoes from the clouds or mountains near by.

The mode of protecting lofty buildings from injury, by the erection of lightning-conductors, has been explained in our Lessons on Electricity.

The remarkable appearance known as the Mariner's Lights, or St. Elmo's Fire, which is frequently observed during storms at sea, is another of the electrical meteors. A bright, flame-like light is seen at the top of the masts, and sometimes at the ends of the spars. This flame often points towards an approaching cloud, increasing in length as the cloud passes over it; at times it has been seen as much as two or three feet long.

The appearance is easily accounted for, and a good illustration of the same effect is seen by holding a sharp point near the conductor of an electrical machine. The electricity from the cloud, instead of passing off in the form of a flash of lightning, is in this way silently carried off by induction. In mountainous regions travellers have occasionally noticed a somewhat similar appearance at the end of their sticks or umbrellas, and a faint hissing sound usually accompanies it. The air in this case is highly electrical, and the pointed ends of the sticks have served to attract the fluid and discharge it.

Fig. 12.—THE AURORA BOREALIS OR NORTHERN LIGHTS.

Perhaps the most beautiful of all the luminous meteors is the Aurora Borealis, or Northern Lights (Fig. 12). This is not unfrequently seen in our own latitudes, but as we travel into polar regions it appears in greatly increased splendour, and much more frequently. Its form varies very greatly. When most perfectly developed, an arch of light appears to cross the sky a little way above the horizon, and from this quivering streamers dart upwards continually towards the zenith, giving rise to the name of "the merry dancers," by which the phenomenon is sometimes known. Frequently several auroral arches are seen at once, and the effect is then very grand. At other times the streamers appear to shoot up from behind distant hills. It has been known also to assume the form of a huge curtain suspended in massive folds, which reflect various colours. When seen in England the aurora is almost always far less distinct and perfect than any of these: at times its ruddy glow has been mistaken for that of a distant fire.

Various hypotheses have been started to account for these appearances. The fluctuations of the magnetic needle which occur during their continuance indicate an electrical origin, and this is further confirmed by the fact that telegraphic messages have been interrupted, and the alarums rung, by the auroral currents. Earth currents are also much stronger during the aurora, and hence it is now generally attributed to the discharge of electricity in the upper regions of the air.

After a thunderstorm a peculiar smell is sometimes noticed in the air, similar to that which is observed near an electrical machine in full work. This is due to the production of a substance discovered by Schonbein, and named by him *ozone*. It is now believed to be merely oxygen gas in an allotropic form. This substance exerts a powerful and beneficial influence on the air, and being a good disinfectant, accounts mainly for the purifying effect of a storm. When, however, it is present in very large quantities, certain classes of disease are found to be more prevalent than usual.

Ozone possesses the property of discolouring a piece of paper prepared with iodide of potassium and starch, and the quantity present in the air is estimated by the extent of this discolouration.

When rain is falling from the clouds opposite to the sun, while it is shining, a rainbow is produced. This consists of two concentric arcs, which are composed of the seven prismatic colours in just the proportions in which they combine to form white light. In the *primary* or inner bow, the violet is on the inner side, and the red on the outer; in the *secondary*, this order is reversed. Sometimes only one arc is visible.

The elevation of the bow depends upon the altitude of the sun. If it be near the horizon, the bow will be nearly a semicircle; but as the sun's elevation increases it sinks and becomes smaller, till it disappears when the sun attains 42° altitude. For this reason rainbows can only be seen at morning or evening.

The phenomenon is a purely optical one; we will, however, explain briefly the cause which produces it. When the rays of the sun strike on the falling drops of rain, they are first of all refracted, or bent out of their course. Some of them pass out at the further side of the drop, but the remainder are reflected from its inner surface, and again refracted as they issue into the air. In Fig. 13 two large drops are represented, one in the middle of each bow. In these the course of the rays can be distinctly traced, and it will be seen that for the primary bow they only suffer one reflection; in the outer one they are twice reflected; hence its greater faintness.

The different rays which compose white light differ in the degree to which they can be refracted, or bent out of their course. Hence they are separated; the red, being the least refrangible, appear at the top in the inner bow.

In the spray of a waterfall, or even of a fountain, a rainbow may often be seen when the sun is behind the observer. Its rays are, in this case, decomposed by the fine spray, in the same way as they are by the falling drops of rain.

A lunar rainbow is occasionally seen, and presents a very beautiful appearance; but unless the moon happens to be near the full, the prismatic colours are scarcely distinguishable.

Weather prognostics may sometimes be drawn from the appearance of the rainbow. One of these has passed into the proverb—

> "A rainbow in the morning
> Is the shepherd's warning;
> A rainbow at night
> Is the shepherd's delight."

A rainbow in the morning must, of course, appear in the west, since it is opposite to the sun, and therefore shows that the clouds are advancing from that quarter—which is the damp one—while it is clear in the east. The fall of rain, too, at this time of the day, when the temperature is increasing, shows a great humidity of the air, and thus much wet may be expected. The appearance of the bow towards evening shows, on the other hand, that the rain-clouds have passed away to the east, and that it is clearing up in the west; fine weather is therefore to be looked for.

Fig. 13.—CAUSE OF THE PHENOMENON OF THE RAINBOW.

LESSONS IN LATIN.—LVI.

QUALIFICATION.

QUALIFICATION takes place between two words when the one modifies the acceptation without changing the form of the other. Thus if I say, scribis bene, *thou writest well;* scribis optime, *thou writest excellently*, I give two instances of qualification. Of each of these pairs of words, one is a *verb*, the other is an *adverb*. The *adverb* is the *qualifying* word, the *verb* is the *qualified* word. The adverb modifies the verb, for it shows the manner of the action of the verb. The kind of qualification depends in all cases on the import of the adverb. While the adverb modifies the meaning of the verb, it does not alter its form. In the last particular, qualification differs from government; for government modifies the form as well as the acceptation of the word or words that are under its influence. Qualification differs also from agreement in the fact that it involves no change of form in either the qualifying or the qualified word; whereas, in agreement, inflection produces changes.

Instances of qualification have been already given. The limits of these lessons leave little space for additions on the subject; which, indeed, are the less necessary, because the subject is free from difficulty. Qualification, however, runs through the whole texture of the Latin, as of every other language. Its extent, as well as its nature, may be learned by the study of the following, in which the chief adverbs are arranged in classes according to their signification :—

I. INTERROGATIVE. — Ubi? *where?* unde? *whence?* quo? *whither?* quâ (viâ)? *in what way? where?* quando? *when?*

II. DETERMINATIVE.—Ibi, *there*; ibidem, *in the same place*; hic, *here* (where I am); istic, *there* (where thou art); illic, *there* (where he is); inde, *thence*; indidem, *from the same place*; hinc, *hence*; istinc, *thence*; illinc, *thence*; eo, *thither*; eâ, *in that way, there*; eadem, *in the same way*; hâc, *in this way*; istac, *in that way*; illac, *in that way*; tum, *then*.

III. RELATIVE.—Ubi, *where*; ubiubi, ubicunque, *wherever*; unde, *whence*; undeunde, undecunque, *whencesoever*; quo, *whither*; quâ, *in which way? where?* quaqua, quacunque, *every way*; quandoquum, *when*; quandoque, quandocunque, *whenever*.

IV. INDEFINITE.—Alicubi, *somewhere*; alicunde, *from some quarter or other*; aliquo, *somewhither, somewhere*; aliquâ, *in some way, somewhere*; aliquando, *at some time*.

V. GENERAL.—Ubique, *everywhere*; ubivis, ubilibet, *where you will, everywhere*; undique, *on every side*; undevis, undelibet, *whencesoever*; quovis, quolibet, *whither you will*; quavis, qualibet, *in any way you please*; quandoque, quandocunque, *when you please*.

Among qualifying words an important position is held by the adverbs which are employed in negations, affirmations, and questions.

NEGATIONS.

Negation is made in Latin by non, ne, and haud, *not*. Non denies in relation to the subject the act set forth in the verb, converting an affirmative into a negative proposition; as—

Affirmative.—Frater meus timet mortem, *my brother fears death.*
Negative.—Sapiens *non* timet mortem, *a wise man does not fear death.*

Two negatives in form produce a positive in idea; thus, non nemo, *not nobody*, is *somebody*, that is, *many a one*; nonnulli, *several*; nonnihil, *somewhat*; nonnunquam, *occasionally*; non ignoro, *I am well aware*; non nego, *I admit*.

Non modifies the word before which it is placed, and therefore *non* should be placed before the word which it is intended to modify. Thus very different are the meanings of these three sentences :—

1. Non possum legere, *I cannot read.*
2. Possum non legere, *I am able to not read.*
3. Non possum non legere, *I am unable to not read.*

Sentence 1 declares, I have not power to read; 2, I may discontinue reading; and 3, I have not power to discontinue or leave off reading.

For *non*, *nullus*, in agreement with a noun, and particularly with the relative pronoun, is sometimes used in Latin; as—

Misericordia, quæ tibi *nulla* debetur, *pity which is not due to thee.*

Observe that the adjective *nulla*, in the Latin, goes with the pronoun *quæ*. In translating, the adjective *nullus* may often be best rendered by an adverbial phrase, as here: *pity which is not at all, or in no way, due to thee.*

Instead of our form *and not*, the Latins employed *neque* or *nec*. For example :—

Tullius me non convenerat, *nec* erat jam quisquam mecum,
Tully had not met me, and there was no one with me.

Vix, *scarcely*, may, as a softened or modest negative, hold the place of *non*, especially with the subjunctive perfect, a form which is employed to express the fact or idea in a gentle and courteous manner; thus, instead of barely saying, non credidi, *I did not believe*, politeness suggested non crediderim, *I could not persuade myself*, or vix crediderim, *scarcely could I believe.* The present subjunctive has a similar force, but in a less decided degree.

Ne, when used by itself, is prohibitive, being employed before an imperative mood, or a subjunctive having the force of an imperative; for example :—

Tuâ quod nihil refert *ne cures*,
Do not trouble yourself with what does not concern you.

In combination, *ne* is found with a general negative; for example, *nemo*, that is, *ne* and *homo*; *nullus*, that is, *ne* and *ullus*; *nihil*, that is, *ne hilum* (not the least); *nunquam*, that is, *ne* and *unquam*.

Haud denies rather an idea or a quality than a proposition; thus, haud æquus, *not equal*, is the same as iniquus, *unequal* or *unjust*; for example—

Haud mediocris vir fuit, *he was no common man;*

a different statement from

Mediocris vir *non fuit*, *he was not a man of moderate ability.*

INTERROGATIVE PARTICLES.

The interrogative particles qualify either sentences or ideas.

Interrogations are made in Latin in various ways. In order to ascertain what the answer in each case should be, you must consider where the question lies, as well as the nature of the question. For instance, you may ask, Cinnane es? or esne Cinna? *art thou Cinna?* To the first question, the answer is Cinna sum; to the second, sum Cinna; for, in the first, the question is whether thou art Cinna or Dolabella; in the second, whether thou art Cinna or not. These modifications of meaning, which in Latin are expressed by position, we in English express by emphasis, and accordingly in pronunciation we should throw the stress of the voice, in the first sentence, on the word *Cinna*, and in the second on the word *art*. If we wished to ask whether the person before us, and not another person, was Cinna, then in Latin we should use the pronoun *tu*, placed at the head of the sentence, and in English we should make *thou* emphatic: thus, tune es Cinna? answer, Ego; art *thou* Cinna? *I* am. I will place the three examples with their answers together.

1. Cinnane es? Cinna sum. | 2. Esne Cinna? Sum Cinna.
3. Tune es Cinna? Ego.

The negative *non* may become an interrogative particle, and, on the part of him who employs it, expects an answer in the negative. A man was brought before Augustus, charged with having murdered his father. The emperor, actuated by disbelief or clemency, asked him: Certe patrem tuum non occidisti? *surely you have not killed your father?* He thus, as it were, put into the man's mouth the answer: non occidi, *I have not.* Observe that, in Latin, the important word must be repeated or given in the answer. The answer to the question now before us is, in English, *no!* or *I have not;* but in Latin, non occidi, the verb of the question being employed in the answer.

By studying the foregoing, you will learn that an interrogation with *non* is little else than a rhetorical negative.

The interrogative *ne* simply asks a question without in any way prejudging the answer; as, Esne bonus? *art thou good?* Here, it is supposed that the questioner is ignorant whether the person questioned is *good* or *not*. The *ne*, which is an enclitic, should be subjoined to the emphatic word. Thus, if you wanted to ask whether a *father was good*, rather than some one else, then the question would stand, paterne est bonus? If the point at issue lay in the quality *good*, then the arrangement would be, bonusne est pater? Should the words stand thus, estne pater bonus? then it would be intimated that the question referred to *est*, and the answer would be, *No, he* IS *not, but* WAS *good.*

Non and *ne* are united and form *nonne*. On the principle that two negatives make an affirmative, *nonne* expects an affirmative answer; for example, nonne sol lucet? *does not the sun shine?* the answer is lucet, *it shines.*

Num is another interrogative adverb, and is used to draw forth an answer in agreement with the mind of the questioner. It may often be rendered into English by *surely not;* as, num negare audes? *surely you do not dare to deny?* The answer is, non audeo, *I dare not*, or non nego, *I do not deny.*

I will put down in several forms of interrogation the affirmative proposition *sol lucet*, together with the proper answers :—

Sol lucet? non, luna lucet.	Nonne sol lucet? immo vero.
Lucet ne sol? lucet.	Num sol lucet? non nego.
Non lucet sol? certe lucet.	An sol lucet? tu negas.

The last particle *an* requires explanation. *An* asks a question which the questioner himself denies, the object being to confirm or prove what has gone before; for example—

Quis neget omnes improbos esse servos?
Who can deny that all bad men are slaves?
An ille liber cui mulier imperat?
Is he free whom a woman commands?

Non, united with *an*, reverses the meaning; for example, an omnis motus servitus? *Is every (kind of) fear slavery? No;* an non omnis motus servitus? *Is not every fear slavery; Yes.*

Ne is subjoined to *an* to strengthen the question; as in the following example:—

Anne de nobis trahere spolia fœderatis licebit, de hostibus non licebit? Will it be lawful to spoil us your confederates and not to spoil the enemy?

An interrogative sentence may be disjunctive, involving an alternative, *this* or *that*; as, sunt hæc tua verba, necne? *are these thy words, or not?* There are several cases of the kind:—

1. In the second member there is merely a denial of the first; as in this example:—

Is ambition a virtue or not?

2. In the second member there is a contrast; as—

Is ambition injurious or useful?

The first member of the sentence is in these cases introduced by utrum, *whether*, num, or ne; or is wholly without an interrogative particle. The second member is, in general, preceded by an (*or*), also by *ne*, *ne* being used only when the first clause has no interrogative particle. The *an* may become *annon*, and the *ne* may become *necne*. Mark these forms:—

1st Member.—Num; utrum (utrumne); ne; ne.

2nd Member.—An (annon); an, also anne (annon); an (annon); ne (necne).

The forms *dubito*, *dubium est*, take *an;* and these, with *haud scio an*, *nescio an*, denote an inclination towards the thing mentioned in the sentence, of which they may be considered as a modest affirmation. The phrases may be rendered by *probably; I am inclined to think; it may be*, and similar forms of somewhat qualified declaration. A *non* may be found in the second member; as, haud scio an non possis, *I conjecture that you are unable;* without the *non*, the words would signify *I suppose that you are able.*

LESSONS IN FRENCH.—XCIII.

§ 147.—Anglo-French Homonyms and Paronyms (*continued*).

English Words.	French Equivalents.	French Words.	English Equivalents.
Plant,	*plante, plant; matériel (fixtures and tools for mechanical business).*	**Plant,** *nm.*	*set, twig; plant, young plant, sapling, slip; plantation, nursery.*
to Plant,	*planter; fonder, établir, poser, placer;* (artil.) *pointer, braquer.*		
Plum,	*prune.*	**Plume,**	*pen; feather; quill.*
Pope,	*Pape; priest (of the Greek Church).*	**Pope,**	*priest (of the Greek Church).*
Porter, *n.*	*portier, concierge; porteur, commissionnaire, crocheteur, portefaix;* (liquor) *porter.*	**Porter,** *v.*	*to carry; to bear; to wear; to support; to convey; to yield, to produce; to induce; to prompt; to excite; to import; to contain.*
Poster, *n.*	*courrier; affiche.*	**Poster,** *v.*	*to station, to place, to post.*
to Pour, *v.*	*verser, répandre; couler; se précipiter; pleuvoir à verse.*	**Pour,** *prep.*	*for, in order to.*
Prejudice,	*prévention; préjugé; (injury) préjudice, tort, dommage.*	**Préjudice,** *n.*	*hurt, detriment, injury, prejudice (harm).*
to Prejudice,	*prévenir; inspirer des préventions, des préjugés; faire tort, nuire, porter préjudice.*		
Premises,	*local; lieux; établissement;* (jur.) *intitulé;* (log.) *prémisses.*	**Prémisses,**	(log.) *premises.*
Preparer, *n.*	*apprêteur; préparateur.*	**Préparer,** *v.*	*to prepare, to fit, to provide;* (agri.) *to till.*
Prime, *adj., n.*	*principal, premier; de premier ordre; de première qualité; précoce;* (arith.) *premier. Aurore, aube; commencement; printemps; fleur, élite;* (Cath. relig.) *prime; beauté, force, fraîcheur.*	**Prime,** *nf.*	*premium, bounty;* (Cath. relig.) *prime;* (fenc.) *prime;* (cards) *primero;* (com.) *prime wool;* (jewel.) *pebble; agio;* (customs) *drawback.*
to Prime, *v.*	*amorcer (a gun, a musket);* (paint.) *imprimer; servir d'amorce.*		
Primer, *n.*	*premier livre de lecture;* (Cath. rel.g.) *livre d'heures, heures canoniales;* (print.) *romain;* (milit.) *épinglette.*	**Primer,** *v.*	*to play first, to lead (at cards); to take the lead; to excel, to surpass.*
Property,	*propriété, biens.*	**Propreté,**	*cleanliness, neatness.*
Propriety,	*convenance, convenances, bienséance.*	**Propriété,**	*property; ownership.*
to Prune, *v.*	*élaguer, tailler, émonder; rogner; arranger, ajuster; (jest.) s'ajuster, s'attiffer.*	**Prune,** *nf.*	*plum.*
Prune, *n.*	*pruneau, prune sèche.*		
Pupil,	*(school boy or girl) élève, écolier, écolière; (of the eye) pupille.*	**Pupille,**	*ward (minor under a guardian); apple, pupil of the eye.*
Raisin,	*raisin sec.*	**Raisin,**	*grapes.*
Ram, *n.*	*bélier.*	**Rame,** *nf.*	*oar; ream (of paper); prop (for peas); tenter-frame.*
to Ram, *v.*	*enfoncer; battre à la hie, damer, tasser; fourrer.*		
Ranger, *n.*	*officier forestier; chien courant.*	**Ranger,** *v.*	*to range; to put in ranks; to arrange, to set in order;* (milit.) *to draw up soldiers.*
Rape,	*rapt, enlèvement;* (jur.) *viol;* (bot.) *navette, colza.*	**Râpe,**	*grater; rasp; stalk, stem (of grapes);* (vet. pl.) *malanders.*
Rate,	*prix, taux, cours; degré; rang, ordre; quantité; vitesse, train; impôt, contribution.*	**Rate,**	*spleen, milt.*
to Recoin, *v.*	*refondre* (money).	**Recoin,** *nm.*	*nook, corner.*
Redresser, *n.*	*redresseur, réparateur.*	**Redresser,** *v.*	*to straighten, to make straight again; to set up again; to put to rights.*
Regard,	*égard; considération; respect; rapport; (forests) inspection.*	**Regard,**	*look, gaze, stare, glance;* (plur.) *eyes; attention, notice; draft-hole.*
Regarder, *n.*	*regardant; (of forests) inspecteur.*	**Regarder,** *v.*	*to look at, to look on, to look into; to consider, to mind; to face, to be opposite.*
Rein, *n.*	*rêne, bride.*		
to Rein, *v.*	*brider; conduire par la bride; conduire, gouverner.*	**Rein,** *n.*	*kidney.*
Relief,	*soulagement, adoucissement; secours; relever (of a sentinel); sentinelle qui en relève une autre; réparation; relief.*	**Relief,**	*relievo, embossing, relief, set-off.*
Relier, *n.*	*celui, celle qui a confiance.*	**Relier,** *v.*	*to bind (books); to connect.*
to Relieve,	*soulager, adoucir, alléger, délivrer; relever (a guard, a sentinel); redresser; donner du relief, relever.*	**Relever,** *v.*	*to raise again; to restore; to set off; to give a relish to; to recover (from disease); to relieve (guards, sentinels).*

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English Words.	French Equivalents.	French Words.	English Equivalents.
Rent, *pp.*	*déchiré.*	**Rente**, *nf.*	*yearly income; revenue, annuity, pension; stock, funds.*
to Rent, *v.*	*louer, donner à loyer, à ferme;* (*to take*) *louer, prendre à loyer, à ferme.*		
Rent, *n.*	*déchirement; déchirure; fente; accroc; schisme; fissure.*		
Report, *n.*	*rapport; compte-rendu; rumeur, ouï-dire; on dit; récit; réputation; détonation;* (law) *procès-verbal, rapport.*	**Report**, *nm.*	(*book-keeping*) *carrying over; sum carried over;* (*exchange language*) *to make a continuation.*
to Report, *v.*	*rapporter, raconter, dire; faire un rapport.*		
Resort, *n.*	*recours; fréquentation; concours, affluence; assemblée; rendez-vous;* (jur.) *ressort.*	**Ressort**, *nm.*	*spring; elasticity, energy, activity, force, means; extent of jurisdiction, department, province;* (law) *resort.*
to Resort, *v.*	*recourir, avoir recours à; aller; fréquenter.*		
Rest, *n.*	(*remainder*) *reste, restant; repos; appui;* (mus.) *pause;* (*of a lance*) *arrêt; support.*	**Reste**, *nm.*	*rest, remainder, remnant; remains, residue;* (pl.) *mortal remains.*
to Rest, *v.*	*se reposer; reposer; dormir; s'appuyer, s'arrêter; se fier; s'en tenir;* (*to remain*) *demeurer, rester.*	**Rester**, *v.*	*to remain; to be left; to stay, to stop;* (mus.) *to hold;* (nav.) *to bear.*
to Resume, *v.*	*reprendre, recommencer; renouer; continuer.*	**Résumer**,	*to recapitulate; to sum up.*
Revolter, *n.*	*révolté, rebelle.*	**Révolter**,	*to cause to revolt or rebel; to stir up, to rouse; to shock, to be revolting to.*
Ride, *n.*	*promenade à cheval, en voiture;* (*in a cab, omnibus, etc.*) *course;* (*place*) *promenade.*	**Ride**, *nf.*	*wrinkle; ripple* (*of water*); (nav.) *laniard.*
to Ride, *v.*	*se promener à cheval, en voiture; monter à cheval; être à cheval, en voiture;* (print.) *chevaucher; flotter, voguer.*	**Rider**, *v.*	*to wrinkle; to shrivel;* (*of water*) *to ripple; to corrugate.*
Rocker, *n.*	*berceur, berceuse; bascule.*	**Roquer**, *v.*	*to castle, to rook* (*chess*).
Roman, *n.*	*Romain;* (print.) *romain.*	**Roman**, *adj., n.*	*Romanic; Romance* (*language*); *novel; romance; tale.*
Romance, *n.*	*roman, fiction.*	**Romance**, *nf.*	(mus.) *ballad.*
Rot, *n.*	*pourriture; clavelée, claveau.*	**Rôt**,	*roasted meat, roast.*
Rout, *n.*	*réunion nombreuse, rout; foule, multitude;* (milit.) *déroute.*	**Route**, *nf.*	*road, horseway, route; course* (nav.) *track;* (*of planets*) *path.*
to Rue, *v.*	*se repentir; regretter.*	**Rue**, *nf.*	*street;* (bot.) *rue.*
Rue, *n.*	(bot.) *rue; chagrin, repentir.*		
Sable, *n., adj.*	*martre zibeline;* (her.) *sable; vêtement de deuil. Noir, sombre; de deuil.*	**Sable**, *nm.*	*sand; gravel;* (her.) *sable.*
		Sale, *adj.*	*dirty, nasty, foul; filthy, low, coarse.*
Sale, *n.*	*vente, débit.*	**Salle**, *nf.*	*hall; large room;* (*in hospitals*) *ward;* (thea.) *house.*
Salve, *n.*	*onguent, remède, baume, pommade.*	**Salve**, *nf.*	(artil.) *salute, volley, salvo.*
to Salve, *v.*	*guérir avec des onguents; remédier à; secourir.*		
to Scorch, *v.*	*roussir, brûler, rôtir.*	**Écorcher**, *v.*	*to flay, to skin; to gall, to peel off; to rub off the bark; to take off the skin; to fleece.*
Scythe, *n.*	*faux.*	**Scythe**, *n.*	*Scythian.*
Sentence,	(gram.) *phrase, période;* (*maxim*) *maxime, sentence;* (law) *jugement, sentence.*	**Sentence**,	*sentence* (*maxim*); *judgment; decree.*
Servant,	*serviteur, servante, bonne, domestique.*	**Servant**,	(artil.) *gunner.*
Sink, *n.*	*évier; cloaque, égout;* (print.) *tremperie.*	**Cinq**, *adj.*	*five.*
to Sink, *v.*	*s'enfoncer; baisser, diminuer; périr; couler à fond; tasser.*		

VOLTAIC ELECTRICITY.—XVIII.

THE TELEPHONE (*continued*)—EDISON'S TRANSMITTER—EDISON'S RECEIVER—THE TELEPHONE EXCHANGE—PROFESSOR HUGHES' MICROPHONE—ITS CONSTRUCTION AND USES—MR. MONRO'S EXPERIMENTS—THE ELECTRIC PROBE—THE AUDIOMETER—THE SPHYGMOPHONE.

THE indefatigable Edison has constructed two forms of telephone—the one serving as a transmitter and the other as a receiver. The transmitter is otherwise known as the carbon telephone (see Fig. 90), and must be used with a battery in circuit with it. It consists of a diaphragm which is made to press upon a little disc, or button, of lamp-black, the electrical resistance of which varies with the amount of pressure to which it is subjected. As these variations of pressure are regulated by the vibrations of the diaphragm when thrown into movement by the action of the sound-waves, variations of the current are created which will affect a suitable telephonic receiver. This form of transmitter is most efficient when used with Bell's instrument as receiver, the sounds given being powerful and very distinct. But the form of receiver adopted by Edison—although now, for several reasons, of no practical importance—was most ingenious in design, and of peculiar interest in exhibiting phenomena of a totally new character. The action of the apparatus will be best understood by describing an experiment which can be easily performed with very simple materials. A piece of blotting-paper moistened with a solution of phosphate of soda is laid upon a metal surface which is in communication with one pole of a battery. A small strip of brass is fastened by flexible wire to the other pole of the battery. The strip is then pressed upon the paper, and dragged over it. So long as the battery current flows, all friction between the paper and brass strip seems to have been destroyed, and the two surfaces glide over one another as if they were ice. But directly the current is broken the friction immediately becomes apparent.

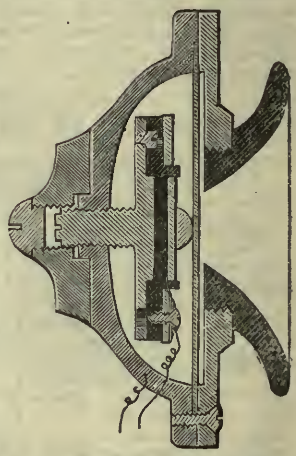

Fig. 90.—SECTION OF EDISON'S CARBON TRANSMITTER.

In Edison's receiver—which has been called the loud-speaking or shouting telephone in compliment to its extraordinary power—this curious action is utilised in the following manner. The blotting-paper is represented by a chalk cylinder which is kept in rotation by a handle outside the instrument. Pressing upon this cylinder is a strip of brass, the friction of which against the moving surface of the chalk varies according to the variation of the electric current; and supposing a carbon transmitter is in the circuit, such variations will be produced by the action of the voice. These variations are translated into little slips of the brass on the chalk surface, and as the other end of the brass strip is fastened to the centre of a flexible diaphragm of mica, it is thrown into vibration and gives out the original sounds. A large number of telephones on this principle were, a few years back, imported into England from America by the Edison Telephone Company, but it was soon found that the atmosphere acted upon the porous chalk, so as to render the instrument at times almost useless. The effects given by an instrument in good order were most surprising, the sounds being loud enough for several hundred persons to hear at the same time. This form of receiver has long ago given place to the original Bell telephone.

The telephonic system is far more used in America than it is in Great Britain; but in London and other large centres of industry it is extensively employed. In London alone the Telephone Company numbers some thousands of subscribers, who each pay so much for the privilege of being in communication with the Telephone Exchange. The wires from the different subscribers meet at a central office, where, by simple mechanical arrangements, any two can be put in direct communication. Each subscriber has a number, and a directory giving the names and numbers of all the others. Supposing, now, that Brown, at one end of London, wishes to ask a question of his solicitor, Smith, at the other end of the city. He first of all looks out for Smith in his directory, under the heading "Solicitors," and notes his number. He next touches his telephone bell, and immediately from the exchange comes an answering inquiry as to what he wants. "Put me into communication with number so and so," he replies, quoting Smith's number. This is at once done, and lawyer and client have a little conversation together, quite unheard by the clerk at the exchange, or any one else. In a busy city office the saving effected by this wonderful instrument must be immense —while the total cost of the convenience is calculated to be something under one penny per message.

We have now to notice another curious contrivance, which, although of secondary importance from a practical point of view, is full of interest, and has already found useful applications. The microphone, which represents a discovery rather than an invention, was the result of some experiments conducted only a few years ago by Professor Hughes. It will be presently seen that this discovery depended upon the telephone for its realisation, for the phenomena exhibited can only be revealed through the medium of that instrument. If the one has benefited the other in this way, we must admit that the debt has been somewhat repaid, for until the production of the microphone no one was aware what a detector of minute variations in the strength of tiny currents of electricity the telephone really is.

It will be remembered that Bell's telephone receiver is quite independent of a battery. Its contained magnet arouses feeble currents of electricity in the coil of wire surrounding it, and these currents are sufficient to actuate the movements of the iron diaphragm which reproduces the original sounds. Professor Hughes, in experimenting with the instrument, was led to try the effect of including a battery cell in circuit with it. Keeping the telephone to his ear, he noticed that directly the circuit was made complete, the instrument recorded the fact by a loud click. The same thing happened whenever the circuit was broken by detaching the battery from it. Continuing his experiments, he submitted a thin wire, forming part of the circuit, to a gradual strain by adding weights to it until the breaking-point was reached. He noticed that just before this crisis occurred the telephone gave a warning sound, a kind of grating noise, as if the particles of metal composing the wire were dragged over one another previous to rupture. Subsequently he discovered that the broken ends of such a circuit, loosely connected together, would actually take up all kinds of sonorous vibrations, which were duly reproduced in the telephone.

It now became obvious to Professor Hughes that he had hit upon a most extraordinary detector of minute sounds, and he at once endeavoured to find the best form for it to take. It was clear that any loose contact between two conductors would serve to transmit sounds, if a telephone and battery were included in the circuit. A little heap of metal chain, a pile of nails or shot, different metallic powders, willow charcoal, the pores of which had been filled up with mercury, were tried, and gave varying degrees of success. But these were all gradually forsaken in favour of that form of carbon which is commonly used for electric lighting purposes.

There are several forms of microphone which produce extraordinary effects. Not only will the little instrument take up vibrations which are quite inaudible by any other means, but it will most strangely magnify them. Indeed, the microphone is to the ear what the microscope is to the eye. Further than this, it will act as a telephonic transmitter, and will convey the complex articulations of the human voice with surprising exactness. Not the least wonderful part of the instrument is its extreme simplicity. When Professor Hughes described his discovery to the several learned societies he produced a battery made of three little pickle-bottles, a few match-boxes, with carbon blocks fixed upon them with sealing-wax. A few yards of copper-wire, a home-made telephone, and a few other simple accessories, the entire cost of which would be dear at one shilling, completed his stock-in-trade. The extremely homely nature of the apparatus with which so much genuine work was accomplished might afford a useful lesson to those who think that nothing great can be done without the French polish and lacquered brass of the optician's shop.

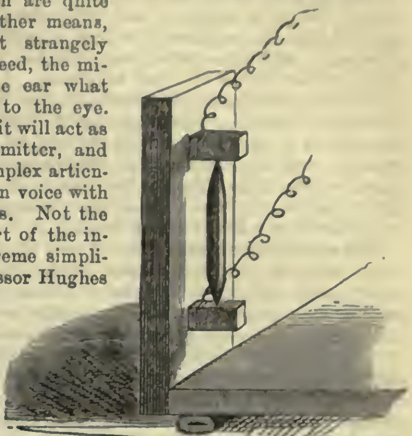

Fig. 91.

There are two forms of microphone, both of the most simple construction, but which give astonishing results. In one, which is illustrated at Fig. 91, a carbon pencil about an inch in length is pointed at each end like a cigar. These points fit loosely into hollows prepared for them in two little square blocks of carbon, which are fastened by cement to a vertical piece of board. A base board of the same material, or, better still, a box with an open end, supporting this upright, upon which the blocks are fixed, completes the instrument. The telephone and battery are placed in circuit with it by attaching wires to each of the carbon blocks.

In the other form of instrument the carbon rod is placed in a horizontal position (see Fig. 92). This rod has a hole drilled through its centre to make room for a short length of brass wire, which forms a balance-pin upon which it rests. One end

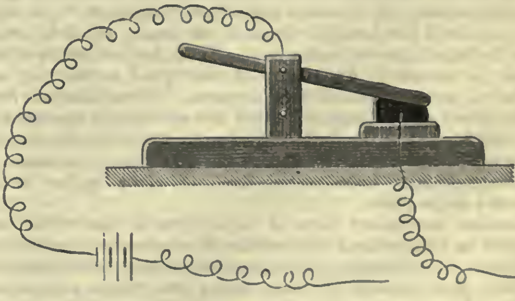

Fig. 92.

of the rod should slightly overbalance the other, so that the heavier end can just lightly rest upon a little block of carbon. The piece of wire upon which it is pivoted is hung in the centre of a U-shaped piece of brass. One of the current wires is attached to this support, and the other to the fixed carbon block. This last arrangement of the instrument will be found especially sensitive, and the base board can conveniently be prolonged, so that different things, which may from time to time form the subject of experiment, can be laid upon it. Thus a watch may be placed there, while the wires can be carried to a telephone in a distant room, in which case the ticking of it will be most plainly heard. Another favourite experiment, and one which at the time of its publication made somewhat of a popular excitement, is to listen to the foot-falls of a fly. This can be managed thus:—A match-box is furnished with an opening, covered with fine muslin. In this prison the fly is confined, and will naturally walk over every part of it in the endeavour to find a loophole for escape. Its "tramp," although quite inaudible to the unaided ear, is plainly heard in the attached telephone.

With a little trouble these sounds can be made audible to a roomful of people. The telephone should be supported in this case on an upright rod, and its end should be furnished with a cone of cardboard like a huge trumpet-mouth. If the instrument be carefully adjusted, the touch of a feather upon the carbon block will be heard all over a large room, and will be magnified into a loud rasping noise.

But a good microphone will not only transmit noises, but will make a most admirable carrier of the human voice—indeed, many most successful telephone transmitters are upon the microphonic principle. One of the first recorded experiments in this direction was described in a country newspaper, and we cannot better demonstrate the capabilities of the instrument in this respect than by quoting the paragraph referred to. "Last Sunday a microphone was placed in the pulpit of a chapel in this town, and connected by a private telegraph line running by with the residence of a gentleman over a mile distant. Every part of the service was distinctly heard at the gentleman's house, with the exception of a few words rendered indistinct by the preacher becoming a little excited and shaking the microphone, the presence of which he never dreamt of, or he might have been somewhat nervous at the idea that his sermon was being conveyed away he knew not whither. So faithfully did the microphone do its work, that the chapel-keeper was heard to close the doors after service, walk up the aisle, and up the pulpit steps, in conversation with some one else. During the week, experiments have been made in the schoolroom of another chapel, and the singing of the scholars was transmitted and retransmitted over a number of telegraph lines with remarkable clearness. The idea is about to be put to practical use, the gentleman already referred to having given instructions that his house should be connected with that of a gentleman near, in order that an invalid may hear the service from one of the churches in the town."

As already indicated, loose contact-points between metallic conductors will give the microphonic phenomena, but the carbon arrangements described are on the whole more satisfactory, and certainly are more easily arranged. But recently, Mr. J. Munro has been experimenting with metallic conductors, and has obtained remarkable results. In fact, he has produced on this principle first-class transmitting instruments. One of these we will describe, for it can easily be made, and gives capital results. It is called the "Lyre Telephone." It takes its name from the fanciful shape of its frame, which is formed of a U-shaped piece of mahogany. In the hollow centre of this frame is stretched, by means of two wires at the top and bottom, a square piece of metallic gauze. Immediately in front of this fixed gauze plate is another one of slightly smaller size, which is hinged at the bottom, and rests on the top against the other one. The pressure between the two can be regulated by a weight sliding upon a rod fixed at right angles to the movable gauze plate.

Another convenient form of microphone is that which acts without an independent battery, for it represents a battery cell in itself. It resembles in its arrangement that form described above. But instead of there being two little scooped-out blocks of carbon in which the ends of the pencil rest, as in the first kind of microphone described, there is only one. This supports the upper end of the carbon pencil, the lower end resting upon a plate of carbon. Underneath this carbon plate, which may be three or four inches square, is an amalgamated plate of zinc, the two elements being separated by a piece of blotting-paper which has been soaked in very dilute sulphuric acid. The whole arrangement rests upon the base board, and can readily be prepared for use by putting the wet blotting-paper in position.

When Professor Hughes brought his researches before the Royal Society some years ago, he said that it was impossible to indicate the applications or effects of his discovery, because the whole question had been studied with crude materials, and scarcely sufficient time had elapsed to enable him to consider its ultimate uses. As a telephone transmitter he did not claim that the microphone was superior to others already in use, but he considered it far more sensitive than any he had heard, and indicated that its power could be increased by multiplication of transmitting contacts in quantity or intensity; the loudness being at present limited by the capability of the receiver. The materials at his disposal, and the arrangement of them, had not yet been sufficiently studied. He merely wished to show that it was possible to transmit clear and intelligent articulate speech, and to render audible sounds which have hitherto been inaudible, by the mere operation of sonorous vibrations upon the conducting power of matter. With regard to his theory of the microphone, he reminded his hearers that if sand be sprinkled upon a membrane—such as a drum-head—it would be jerked up and thrown away from that membrane under the influence of sonorous vibrations. If by mechanical means it were prevented from being jerked away, either by being contained in a tube, or by being kept down by weight or pressure, the tendency of the movement of the vibrating body would be alternately to compress and relieve from pressure the substance so held upon it, and in so doing vary its resistance. This explanation was given merely as an analogy, and to illustrate the explanation of the phenomena.

We will now proceed to review some of the applications of this most interesting discovery, when it will be readily seen that the microphone is no mere toy, but is of practical importance as an instrument of physical research. In certain surgical operations, and notably in the case of bullet-wounds, it is of first importance to ascertain the exact position of a foreign body before proceeding to remove it. With an ordinary probe this can sometimes be effected without much difficulty; in other cases the patient is put to much pain and inconvenience. Now, if the searching-probe be furnished with a microphonic attachment and a telephone receiver, the surgeon, or his assistant, will hear a loud click in the instrument directly the bullet is touched by the probe. Without the microphone it can easily be passed over without recognition.

We may here mention another form of probe for hidden bullets, which was invented many years before the microphone. It is effective in action, but its accessories of a battery and electric bell, with connecting wires, are, perhaps, rather too formidable for the sick-room. It consists of two wires, forming part of the probe, their ends almost touching. Directly the bullet is touched by these wires they are bridged over by the metallic mass, and the circuit is completed, so that the bell rings.

To return to Professor Hughes' microphone. Hardly twelve months had elapsed since he first made his discovery public, when he handed to Dr. B W. Richardson a very clever and useful little instrument founded upon its principle, which he called the "Audiometer." Its use is to test the hearing of any particular person. When we remember the enormous prevalence of deafness even among one's circle of friends, together with the very few cases where recovery is attained, the importance of a means of measuring from day to day the progress of the malady under medical treatment will be at once conceded. The Audiometer places in the physician's hands the means of doing this, for he can tell by it how many degrees of hearing capability his patient has gained or lost since his last visit.

To describe this instrument is not so easy as to understand its principle from a rapid glance at the thing itself, for it is most simple in construction. A horizontal bar is furnished at each end with a flat coil of wire, one containing about 6 yards and the other 100 yards of wire. These coils are fixed in their places. Between them, and sliding on the bar, so that its position can be readily changed, is another coil of 100 yards of wire. The bar constitutes a scale, divided into 20 centimètres, and each of these parts is again subdivided into 10, so that the hearing can be tested from a maximum of 200 units to 0° zero. The sliding coil is really an induction coil, its ends being connected with a telephone, which the patient holds to his ear. The fixed coils are in connection with two Leclanché cells, and a microphonic key—that is to say, a little contrivance which the operator can depress, and so make a microphonic

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disturbance, which can, under certain conditions, be heard by the patient in the attached telephone. If the induction coil stand at the zero point, the current circulating in one of the fixed coils is exactly balanced by the one traversing the other fixed coil; therefore the effect is neutralised, and no induction effect is produced in the movable coil. Upon moving the coil from point to point along the scale, the sounds become louder and louder, until at last the patient says that he can hear it. The particular degree where audibility becomes possible is noted by the physician, and he is able to report progress by subsequent trials.

Another instrument in which the microphone plays a chief part has been designed by Dr. Richardson himself, who finds it a great aid in his daily practice. It is called the "Sphygmophone," and is founded upon that instrument which gives graphic tracings of the movements of the pulse. But the Sphygmophone—as its name implies—makes these movements audible. Indeed, so loud are they, that the beating of the pulse can be heard over a large room. The instrument is attached to the patient's wrist, and every movement of the pulse causes a corresponding movement in a small microphonic arrangement. It is said that the experienced ear can detect the state of the patient's heart by the nature of the sounds emitted, and that the sphygmophone forms a valuable addition to the resources of the physician in the treatment of disease.

ENGLISH LITERATURE.—XXII.

THE REVOLUTION AND THE AUGUSTAN PERIOD: PROSE WRITERS.

THE great Revolution of 1688 not only completed the great work of the Civil War and of many an earlier struggle by finally securing political liberty for England, but it also marks a great epoch in the history of free thought, free inquiry, and sound philosophy in this country. The great intellectual revival of the sixteenth century had never ceased to spread; the grand crusade against ignorance and superstition in which Bacon played so leading a part had never been abandoned, nor had English thinkers ever failed to take their part in it with more or less success and distinction. Even during the reign of Charles II., while the spirit of the Restoration was at the height of its influence, science and philosophy made much progress—a progress of which the establishment of the Royal Society is a notable evidence. But the social influences of the age were not favourable to freedom in any of its forms; and in the domain of thought England showed comparatively little of that energy and breadth which were displayed by Continental nations. But with the Revolution of 1688 a new set of influences prevailed. Political freedom brought with it its natural concomitants, boldness of thought and inquiry, and religious and intellectual tolerance—qualities which characterised this age to a degree never previously known in England.

The central figure in the world of thought and of letters in the years which followed the Restoration is that of John Locke. This great man was born in 1632. He was educated first at Westminster School, and afterwards at Christchurch, Oxford. At Oxford he spent many years after he had taken his degree, devoting himself mainly to the study of natural science, and especially of medicine, in which he became very proficient. After the Restoration, Locke was frequently employed in the public service abroad and at home; and was involved in the political conflicts of the time, attaching himself to the cause and following the fortunes of Lord Shaftesbury, the able but unscrupulous and ambitious leader of the Protestant party. After the final fall of Shaftesbury, and the triumph and accession to the throne of his enemy the Duke of York, Locke's position in England became unsafe, and he retired to Holland, where he remained as long as James II. occupied the throne. In 1688, immediately upon the change of government, Locke returned to England. He was soon appointed to an important and lucrative post in the public service, as a member of the Council of Trade, an office which he retained as long as his health allowed of his doing so. After leaving the public service, he passed the remaining years of his life in the country in learned retirement. He died in 1704.

The works of Locke are numerous, and their subjects somewhat various; but the same tone and spirit pervades them all—a spirit of earnest but temperate devotion to the cause of liberty in politics, in philosophy, and in religion. All show the same originality, vigour, and breadth of thought and clearness of reasoning; and in all his style is simple and nervous, though sometimes, perhaps, too idiomatic and too full of metaphor to be consistent with philosophical exactness or quite in keeping with the dignity of his subject.

Locke's "Letters on Toleration" constitute the most systematic and philosophical argument in favour of toleration which had as yet appeared.

His "Treatise of Civil Government" is an attempt to determine the true basis on which civil government rests, and the limits within which it ought to be restricted. A school of writers in his day had adopted, without much inquiry, a theory of the origin of government—which, however, modern inquiry has shown to be historically quite correct—that the family is the oldest of institutions, and the father of the family the oldest of rulers; that the family became the tribe, the tribe the nation; and that so the family organisation and the power of the father are the root from which have been developed the political state and the authority of kings. But not content with teaching this as an historical theory, in which aspect it is perfectly correct, these writers went on to make a most mischievous practical application of it. They taught that, by some divine right or inherent necessity, the power of a king must always remain as sacred and as unlimited as the power of the parent in its most primitive form. Hence they taught the duty of absolute obedience to kings, and denied the rights or liberties of subjects. To meet such views Locke's very powerful treatise was written. In it he places all government upon its only rational basis, the common benefit of all. But he sometimes fails to distinguish between the two wholly distinct questions, the question, How did governments in fact originate? and the question, Why ought they now to be maintained, and what limits ought to be assigned to them? And upon matters of history Locke is often less sound than his opponents. Very similar in spirit is the "Essay on Education," which shows much liberality of spirit and a strong desire to throw off the narrowness which distinguished the system of education prevailing then even more than it does in the present day. The "Essay on the Reasonableness of Christianity" is a calm and serious argument on the subject which its title expresses; and it gives a greater insight into Locke's religious views and feelings than any other of his works.

But the work which has secured for Locke his great and lasting reputation, and given him a place among the greatest thinkers, is the "Essay on the Human Understanding." A critical examination of this remarkable book would be out of place in these "Lessons on English Literature;" it belongs rather to the history of philosophy. Locke was not the first who attempted to map out with fulness and precision the field of the human intellect, and to trace our ideas to their sources. Many labourers in the same work had preceded him on the Continent, and some in England; but no writer had ever approached Locke in clearness of thought, soundness of method, or variety and originality of illustration. The truth of Locke's general theory has always been and will probably always be a matter of dispute, and those who agree with his general conclusions will always find something to dissent from among his detailed opinions. But even those most hostile to his philosophical system admit the power of his work and the value of his discussions of the most difficult questions. Few books have exercised so profound an influence upon European thought.

In the domain of mathematics and experimental philosophy the genius of Sir Isaac Newton stood supreme at the same epoch; nor did he stand by any means alone in the cultivation of these branches of science.

Nothing more plainly illustrates the spirit prevalent in England after the Revolution than the character of the churchmen and theologians, and the tone of the theological teaching of the period. The school of divines prominent after the Revolution was that which has been characterised as Latitudinarian—a school distinguished by learning, good sense, judgment, and tolerance; very free from bigotry, narrowness, and superstition; but falling short, perhaps, of that high standard of zeal and enthusiastic devotion which has sometimes prevailed among men intellectually inferior.

Among theologians of this class a high place must be assigned to Gilbert Burnet, Bishop of Salisbury. Burnet was the religious adviser of the Princess Mary in Holland, and came with her to England on the accession of herself and her husband to the throne; and was soon after raised to the episcopal bench. As a theologian he is best known by his "Exposition of the Thirty-nine Articles." But his most important contributions to literature are his two historical works—the "History of the Reformation" and "History of his own Times," both of them works of great value, though their historical importance is greater than their literary merit.

One of the most eminent and probably the ablest theologian of the school which became predominant at the Revolution was Isaac Barrow, though he himself died too soon to witness that great event. Barrow was born in London in 1630, his father being a linendraper in that city. He received his earlier education at the Charterhouse, and afterwards was entered first at Peterhouse and subsequently at Trinity College, Cambridge. Cambridge was thenceforth his home for many years; during which time his fame as a profound scholar and linguist, as well as a man of great scientific genius, especially in the department of mathematics, became widely known. He filled the post of professor of mathematics, and as such was the teacher of the great Newton, who succeeded him in his professorship. He was subsequently chosen as Master of Trinity College. During the latter years of his life he to a great extent forsook his purely scientific pursuits, and devoted his great powers to the duties of a preacher and religious teacher; and among English divines few have been his equals in genius. His learning was great, but is never obtruded upon the reader. His reasoning powers were of the highest order, and in his sermons sound reasoning and judgment always hold their legitimate supremacy; they are never subordinated either to feeling or to fancy. His style is characterised by a force and clearness, a manly dignity, and a severe purity of taste which, combined with his powers of thought, place him in the highest rank of orators. His sermons will always rank with the writings of Hooker and Jeremy Taylor, the great classics of the English Church. Barrow died, at a comparatively early age, in 1677.

Archbishop Tillotson enjoyed, during his life, a fame and estimation as a preacher surpassed by few, and was among the most influential churchmen of his day; nor has the popularity of his writings altogether passed away. He was a man of great liberality and tolerance, and was raised to the archbishopric of Canterbury by William III.

Of a very different school was Robert South. He was the son of a London merchant, and was born near London in 1633. Having received the rudiments of learning at Westminster School, he went to Oxford, and maintained his connection with that university for many years. He adopted the views of the courtly and anti-popular party, and took an active part in the conflicts of the time. After the Restoration he became chaplain to Lord Chancellor Clarendon, and partly through his influence received several successive preferments in the church from the Government of Charles II. The latter years of South's life were spent in retirement, and he died in 1716. His fame as a preacher was very great, and his sermons are still read with great pleasure for the force and beauty of his style. But as sermons his productions are to a modern taste deformed by what in his own day seems to have been regarded as a beauty, a vein of sarcastic wit, sometimes almost overstepping the limits of buffoonery.

The most eminent in literature of the churchmen of the next generation was Bishop Berkeley, a man equally distinguished for his genius in science and philosophy, and for the purity and nobility of his life and character. It was not without reason that Pope attributed

"To Berkeley every virtue under heaven."

George Berkeley was born in Ireland, in the county of Kilkenny, in 1684. He was educated at Trinity College, Dublin, of which college he in due time became a Fellow. He then commenced those philosophical writings which have secured his lasting fame; and upon his removing to London a few years later, he was eagerly welcomed by all those most eminent in the world of thought and literatnre. The lofty earnestness of his character impressed the most frivolous, while its beauty and gentleness conciliated the most hostile. But Berkeley was not one of those who sought to use their popularity to secure any personal advantage. Having been promoted to the deanery of Derry, a lucrative as well as dignified post, he resigned this office with all its advantages, and abandoned that position in society which he was so well qualified to adorn, in obedience to the guidance of conscience, and went out to the West Indies, to place himself at the head of a sort of missionary college, intended to facilitate the Christianisation of the natives of North America. But the miserable pittance which had been promised to Berkeley for the maintenance of his college and the support of himself by the Home Government, not being paid him, the enterprise failed, and he was forced to return home. He afterwards became Bishop of Cloyne, in Ireland. He died in 1753. Although it would be a grave omission in these sketches of literature if we were to omit so great a writer as Berkeley, it would not less be a departure from our plan if we were to attempt any analysis of his philosophical system, or any criticism of his writings. Those writings cover a very wide field, from the broadest speculations as to the nature and origin of our ideas, and their connection with an external universe on the one side, to the most exact and detailed investigation of the phenomena of physical science on the other. By the admission of opponents, no less than of those whose views are most in harmony with his own, few thinkers have surpassed Berkeley in boldness, acuteness, and originality, or have left a deeper impression upon the course of European thought.

Few careers have been more extraordinary in their vicissitudes than that of Henry St. John, Lord Bolingbroke. Born in 1678, the son of a baronet of ancient family and competent fortune, though he early gave proof of the possession of brilliant ability, he was in youth little distinguished except for his extravagance and dissipation. But having entered Parliament and devoted his great energies to politics, he was soon without a rival in eloquence and all the brilliant qualities which contribute to parliamentary success. He was a leader in that remarkable literary circle of which Pope and Swift were members. He had early allied himself with Harley, afterwards Earl of Oxford, and they soon became the leaders of the extreme Tory party. In the administration of Oxford, St. John, who had been raised to the peerage as Lord Bolingbroke, held the office of Secretary of State, and as such bore the chief share in bringing about the peace of Utrecht. On the death of Queen Anne and the accession of George I., Bolingbroke was disgraced and impeached, and fled from the storm. That he had been guilty of maintaining a treasonable correspondence with the exiled Stuart family, there can be little doubt, and the unpopularity of the peace which he had been instrumental in bringing about exposed him to the indignation of the country. He was condemned in his absence, and passed many years abroad, for some time being actually in the employment of the Pretender, though he soon quarrelled with him, and was ever after loud in his condemnation of Jacobites. After some years his attainder was reversed, and he was enabled to return to England. He strove hard to regain the political influence which he had once enjoyed, but in vain; and the closing years of his life were spent in retirement. He died in 1751.

Bolingbroke's works are numerous. Many of them were addressed to merely passing questions, and are now of little interest. A very large proportion consists of attacks more or less direct upon Sir Robert Walpole, Bolingbroke's great rival and enemy. Others again, and these were published after the death of the author, are attacks upon religion; for in matters of religion Bolingbroke was an avowed unbeliever. The most permanently interesting of his works are those which deal with historical questions and with political principles, such as his "Letters on the Study and Use of History," and his "Idea of a Patriot King." The last-mentioned is now, probably, more read than any other of Bolingbroke's writings; and it well deserves its popularity. This essay shows no profound knowledge of history, nor any very deep thought or subtle analysis; its views are for the most part tolerably obvious, and much of the essay is evidently of the nature of a party attack, rather than an impartial political treatise. But it contains, on the whole, a very noble picture of what a perfect king should be to his country; and it is an excellent example of Bolingbroke's sustained and impressive eloquence, his wealth of illustration, and beauty and harmony of language. It shows him as one of the greatest masters of English style; and for this reason no man of taste can read the essay without thorough enjoyment.

ACOUSTICS.—III.

RESONANCE—REFLECTION OF SOUND—ECHOES—REFRACTION OF SOUND.

We must now inquire as to the rate at which sound travels through the air, and we shall then be able to calculate the length of the waves produced by any given note. This inquiry is rather a difficult one, as there are many disturbing causes, such as the temperature of the air, the amount of watery vapour present in it, and the pressure as indicated by a barometer. A calm night is usually selected for the experiment, as the air is then much more quiet. Two stations of observation are chosen, several miles apart, but so situated that each can be seen from the other. Cannons or guns are then discharged at regular intervals of about ten minutes, and, since the passage of light is practically instantaneous, the moment of firing is thus seen, and the distant observers note very accurately, by means of a chronometer, the interval between seeing the flash and hearing the report. The true distance between the stations is then measured, and, dividing this by the number of seconds, the velocity of the sound is ascertained. In an experiment of this nature tried in France many years ago, the distance between the observers was 20,354 yards, and, as the mean of several observations, the time occupied by the sound in travelling this distance was found to be 54·6 seconds. This gives a velocity of 1,118 feet a second, when the air is at 60°, that being the temperature during the experiment. As the temperature increases, the speed increases likewise at about the rate of a foot a second for every degree. Generally, then, we may state the velocity of sound in the air at 32° to be 1,090 feet a second, and to increase one foot for every degree that the temperature is raised. In other gases the velocity of sound is somewhat different: we can, however, easily determine it, since it is found to vary inversely as the square roots of their densities. Hydrogen, for example, is sixteen times less dense than oxygen, and sound travels through it at four times the speed. An increase of density thus serves to diminish the velocity, and this is why sound travels more slowly in air at a low temperature.

Fig. 13.

In water, the sound-waves are propagated at a rate of about 4,700 feet a second, and many solids convey them much more rapidly; along an iron rod, they travel nearly 17,000 feet in the same time. A good illustration of the different rates at which gases and solids conduct sound may be observed by standing near a long iron railing, and getting a friend at a distance to strike it a violent blow. Two distinct sounds will be perceived, the first caused by the vibrations conducted along the railing, while the other has travelled through the air, and hence arrives considerably after the first. In blasting operations, two concussions are often heard, from a similar cause, the one being conveyed by the solid rock, and the other transmitted through the air.

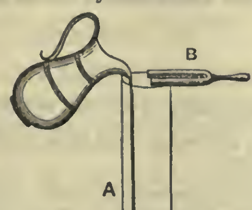


Fig. 12.

In substances which exhibit a fibrous or crystalline structure, the sound travels in different directions at different speeds. Along wood, for instance, it is conveyed in the direction of the fibres nearly four times as rapidly as across them.

Having now ascertained the velocity at which sound travels, we can easily determine the length of the sonorous waves. It is, however, important for us first of all to obtain a clear idea of their nature. In water, each wave consists of an elevation and a corresponding depression, and the length is measured from crest to crest. In sound-waves, we have in place of these an area of condensation and one of rarefaction, and the length is measured from one centre of compression to the next.

Now sound, as we have seen, travels 1,120 feet a second in air at the temperature of 60°, and a C tuning-fork—that is, one sounding the note an octave above middle C—produces 512 vibrations in the same time. Dividing 1,120 by this, we find the length of the waves produced by that note to be about 2 feet 2 inches. An octave lower, the waves are about double the length, or about 4 feet 4 inches.

This calculation may easily be verified by the student in a rather remarkable way, and in doing so he will obtain a good illustration of the manner in which a sound may be increased by resonance.

Take a tall glass jar, A (Fig. 12), and having struck the tuning-fork, B, hold it over the mouth of the jar, as shown. The sound will probably be unaffected. Now gently pour in water from a jug, making as little splash as possible; when it attains a certain height, the sound will be found to burst suddenly forth with greatly increased power. On pouring more water in, the sound sinks again to its former intensity. Ascertain, by repeating the experiment, the exact point at which the maximum intensity is attained, and then measure its depth from the top of the jar. If we are using a C fork, we shall find this depth to be 6½ inches, or just one-fourth the length of the wave. The return wave, therefore, is exactly synchronous with the return vibrations of the fork, and thus the sound is greatly increased and swells out with augmented intensity. When the water is at a different level the vibrations interfere with one another, and clash to a certain extent.

The manner in which the power of any sound is increased by resonance is well shown by an apparatus devised by Savart, and shown in Fig. 13. A large open-mouthed bell, A, is set in vibration by drawing a violin-bow across its edge. Close to it is a hollow cylinder, B, the length of which can be adjusted by means of a sliding tube. This cylinder is mounted on a universal joint, so that it can be turned in any direction, and its distance from A can be adjusted by means of the slide, C, on which it is carried. The intensity of the sound will now be found to be greatly affected by the position of B. When the vibrations have almost ceased, so that the bell is nearly inaudible, the sound will at once swell out, on properly placing the cylinder. The air contained in B is made to vibrate in unison with the bell, and hence the greatly increased power of the sound.

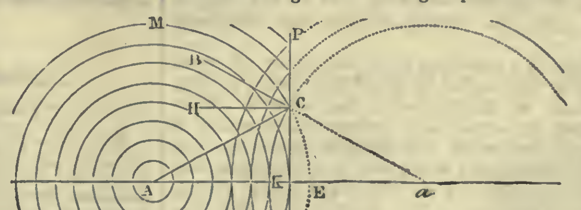


Fig. 14.

It is stated that in ancient times large metal vessels were placed in theatres upon the stage, in order to increase, by their resonance, the power of the actors' voices. In the present day care is taken, in the construction of large buildings, to give them such a form as to render the speaker's voice audible with the least effort to himself.

In many respects waves of sound are closely analogous to rays of light and heat; like them, they are capable of being reflected, and even refracted, by the employment of suitable lenses. A good and simple experiment, to illustrate the former of these facts, can easily be tried with an ordinary concave mirror. Having placed a bright light at one side of the room, place the mirror opposite it, and, by holding some object in front of it, ascertain the point where the image of the light is formed—that is, the focus of the mirror. Now remove the light, and in its place suspend a watch. Owing to the distance, its round will probably be inaudible to a person standing near the mirror; but let him place his ear at the focus, and he will at once distinctly hear it. As it is somewhat difficult to find the exact focus for the ear, the experiment will succeed better if a glass funnel be held at the focus, and the ear applied to the tube of this. The sonorous waves will thus be more fully collected and conveyed to the ear. The funnel in this case fulfils a similar purpose to a hearing trumpet, the waves being reflected from side to side till they travel down the tube.

If two concave mirrors be employed instead of the one, the watch being placed in the focus of the one, and the funnel at that of the other, the sound will be heard at a much greater distance. Curved roofs and ceilings sometimes act in this way, and reflect the sound, and hence the ceilings of large buildings have usually a vaulted form. The arch of a bridge acts similarly, and two persons, properly placed under it, may often hold conversation with one another in tones so low, that they are totally inaudible to a third individual standing between them.

In a similar way, two people situated in the foci of large concave mirrors may hold conversation with one another at a great distance. Two such mirrors, about six feet in diameter and about one hundred feet apart, were some time ago at opposite ends of the large hall in the Polytechnic Institution at London. It was found, however, that even when the hall was filled with people, and there was much noise, whispers uttered by those in the focus of one could be heard by a listener in the focus of the other.

The well-known whispering gallery of St. Paul's is another good illustration of the reflection of sound. The wall surrounding the gallery is circular and smooth, and hence the vibrations produced by the voice, instead of being dissipated in space, are reflected from spot to spot, till they reach the ear of the listener at the opposite side.

Fig. 14 will explain the manner in which the waves of sound are thus reflected by any smooth surface against which they strike. If the surface be rough or uneven, they will, of course, be irregularly broken up and scattered, just as the rays of light which fall upon an uneven surface are irregularly diffused.

If A be the position of a sounding body, the waves of sound produced by it will be represented by concentric circles, so long as nothing intervenes to interfere with their motion. They soon, however, reach the obstacle P Q, where their course is arrested. The sound first meets this obstacle on the line A *a*, and is thrown back, so that the wave, M C D N, has its middle portion deflected into the arc C K D. The wave which reaches any point, C, will have travelled in the direction A C; but since the angle of incidence is equal to that of reflection, it will continue its course in the direction C B, and, to an observer at B, will appear to have proceeded from the point *a*, situated as far behind P Q as A is in front of it. By considering in a similar way the waves that meet each portion of the obstacle, we shall find that the curve, C K D, in which the wave continues to move, after being reflected, is in reality an arc of a circle, whose centre is at the point *a*. The laws of the reflection of sound are thus exactly the same as those for the reflection of light, and need not, therefore, be further explained.

An *echo* is a repetition of a sound caused by the waves being reflected to the ear from some obstacle, as, for instance, a cliff or a lofty wall. If the reflecting surface be very near, a distinct echo will not be produced, as the sound will return so quickly as to mingle with the original one, and merely render it somewhat indistinct. This effect is well seen in speaking in a large empty room, where the reflection from the walls will frequently render the words almost unintelligible. When the room is filled, the sound-waves are so confused and absorbed, that this effect is much lessened. Curtains are frequently suspended in large rooms for the purpose of further damping the echo.

A sharp sound, like a blow, may produce an echo when the reflecting surface is about fifty or sixty feet distant. In order to produce a syllable, it should be nearly as far again, and in those cases where two or three syllables are repeated, its distance will be found much greater.

If there are two reflecting surfaces almost parallel—as, for example, two high walls sufficiently distant—the sound may be repeated many times. The waves are alternately reflected from one to the other, gradually becoming fainter and fainter, till the sound ceases to be audible. In some places, in mountainous regions, the report of a pistol or the sound of a horn is in this way repeated many times in a most marvellous manner. An echo in the chateau of Simonetta, in Italy, is said to repeat a sound twenty or thirty times.

When a long tube has a smooth interior, any sound uttered at one end is conveyed along it with little diminution—the waves are reflected from side to side, not being dissipated to any appreciable extent. M. Biot conducted many experiments of this nature, and found that a conversation might very easily be kept up through water-pipes upwards of one thousand feet in length. Advantage is taken of this fact in the construction of speaking tubes. In many business establishments metal tubes are laid down from one room to another; a whistle is usually placed in each end, and the person who wants to call the attention of the other first blows through his tube so as to sound the whistle, and then can converse with the other, applying his ear to the tube so as to hear the reply.

A somewhat similar apparatus is fixed in many churches and chapels to enable deaf people to hear. The tube, which is usually made of gutta-percha, ends in a large funnel-shaped mouth placed against the book-board of the pulpit, and the sound is thus conveyed through the tubes to any part of the building. A flexible piece is usually fitted to the other end to enable the deaf person to put it close to his ear.

The ordinary hearing trumpet acts in a similar way, the open end of it arresting a large number of the waves, and by its form concentrating them to a focus, and thus greatly increasing the intensity of the sound.

Waves of sound may be refracted by means of suitable lenses. A balloon of collodion or thin india-rubber, filled with carbonic acid gas, answers well for this purpose. It may be circular in form, or else composed of two segments fastened together at the edges, so as to resemble an ordinary lens. If a watch be held at a little distance from one side, a point may easily be found on the other side at which the sound will be collected to a focus, and where it will be distinctly heard. When the ear is removed from this spot, the ticks become much more faint.

LESSONS IN ITALIAN.—XLII.

VERBS WITH *A* AFTER INFINITIVE.

Rule 69.—The following verbs have *a* after them before a following infinitive :—

Accendere, *to excite.*
Accompagnare, *to accompany.*
Accostumarsi, *to accustom.*
Adescare, *to allure.*
Affrettare, *to hasten.*
Agevolare, *to facilitate.*
Ajutare, *to assist.*
Alletare, *to allure.*
Andare, *to go.*
Animare, *to animate.*
Arrivare, *to arrive.*
Aspirare, *to aspire.*
Attendere, *to apply one's self.*
Avere, *to have.*
Avezzare, *to accustom.*
Avvezzarsi, *to accustom one's self.*
Cominciare, *to begin.*
Condannare, *to condemn.*
Condescendere, *to condescend.*
Condurre, *to conduct.*
Consentire, *to consent.*
Consigliare, *to advise.*
Continuare, *to continue.*
Convenire, *to agree.*
Costringere, *to oblige.*
Darsi, *to addict one's self.*
Disporre, *to dispose.*
Eccitare, *to excite.*
Esortare, *to exhort.*
Esporsi, *to expose one's self.*
Farsi, *to become.*
Giungere, *to arrive.*
Imparare, *to learn.*
Impegnarsi, *to pledge.*
Incitare, *to incite.*
Incorraggire, *to encourage.*
Indurre, *to induce.*
Insegnare, *to teach.*
Intraprendere, *to undertake.*
Mettersi, *to set about.*
Obbligare, *to oblige.*
Obbligarsi, *to oblige one's self.*
Occuparsi, *to occupy one's self.*
Offrirsi, *to offer one's self.*
Ostinarsi, *to persist.*
Pensare, *to think about.*
Persuadere, *to persuade.*
Prepararsi, *to prepare one's self.*
Principiare, *to begin.*
Riuscire, *to succeed.*
Seguire, seguitare, *to continue, to follow.*
Spingere, *to urge.*
Stentare, *to work hard.*
Supplicare, *to entreat.*
Tendere, *to tend.*
Tornare, *to return.*
Venire, *to come.*

Here are some examples of this rule :—

Io mi affretto a partire, *I hasten to go away.*
Egli va a pranzare seco, *he is going to dine with him.*
Cominciarono a dire, Chi è là? *they began to say, Who is there?*
Niente facendo s' impara a far male, *by doing nothing, we learn to do evil*
A poco a poco si viene a sapere ogni cosa, *little by little we come to know everything.*

PARTICIPLES.

Rule 70.—The past participle, used without an auxiliary, must agree in gender and number with the substantive to which it refers; as—

Venne intanto l' ora fissata della partenza, *meanwhile the hour appointed for the departure arrived.*
Il padrone, tornato a casa, andassene a letto, *the master, having returned home, went to bed.*
Servitù offerta non è mai stimata, *offered slavery is never esteemed.*
Egli ha la mano tagliata, *he has his hand cut off.*
Vi furono molte teste tagliate, *there were many heads cut off.*

Rule 71.—The past participle, being used with the verb essere, *to be*, must agree with its subject in gender and number :—

Tuo nonno è morto, *your grandfather is dead.*
Mio genero è partito, *my son-in-law is gone.*
Le mie zie sono generose, *my aunts are generous.*
Le foglie son cadute, *the leaves have fallen.*
Bacco era coronato di pampini, *Bacchus was crowned with vine leaves.*

Rule 72.—The past participle, used with any tense of the verb avere, *to have*, is indeclinable :—

La regina ha cenato col re, *the queen has supped with the king.*
Ella ha dormito bene, *she has slept well.*
I gran principi hanno sempre protetto le persone sapienti, *great princes have always protected learned men.*
Ha preso la cosa sul serio, *he has taken the thing seriously.*
I lupi han divorato la sua greggia, *the wolves have devoured his flock.*
Le mie sorelle non hanno ancora desinato, *my sisters have not dined yet.*

Rule 73.—The past participle used with *avere*, and preceded by the pronouns *che, cui, il, quale, mi, ti, lo, la, ci, vi, li, gli, le, quali, quanti*, must agree with them in gender and number :—

La casa che ho comprata, *the house which I have bought.*
Voi vi dovete chiamar contento della giustizia che avete ottenuta da' vostri giudici, *you must be satisfied with the justice which your judges have rendered to you.*
Le lettere che io aveva ricevute, *the letters which I had received.*
Elle son più belle che gli agnoli dipinti che voi mi avete più volte mostrati, *they are handsomer than the painted angels which you have oftentimes shown me.*
Gli ho veduti a spasso, *I have seen them walking.*

ADVERBS.

Rule 74.—The Italian adverbs are generally placed after the verb in its simple tenses, or between the auxiliary and the past participle in its compound tenses; as—

Ella m' amerà sempre, *she will always love me.*
Camminate piano, *walk gently.*
Ha quasi finito, *he has almost done.*
Non voglio assolutamente che voi sortiate oggi, *I will not absolutely suffer you to go out to-day.*
È già partito, *he has already gone.*

There are many exceptions, for the Italians place sometimes the adverbs in the beginning, in the middle, or at the end of a sentence :—

Ben sai, che io verrò, *you know very well that I shall come.*
Il quale prestamente s' avventava alla gola di costei, *which hastily seized her by the throat.*
Il quale aperse la porta prestamente, *who quickly opened the door.*
Io te l' ho detto cento volte, *I told it to you a hundred times.*

PREPOSITIONS.

Rule 75.—In Italian, prepositions are commonly placed before the words which they govern; as—

Venite a Cambrigge, *come to Cambridge.*
Fatelo per me, *do it for me.*
Passate da me, *call upon me.*
Vicino al fonte, *near the fountain.*
Rimpetto all' America, *opposite America.*

Rule 76.—The preposition *da* is used when we wish to express an idea of separation, dependence, difference, origin, cause, use, fitness, distinction, residence, etc. :—

Andate da quella parte, *go that way.*
Allontanarsi da Roma, *to depart from Rome.*
Astenersi dal parlare, *to abstain from speaking.*
Da che egli è partito, *since he is gone.*
Dall' anno scorso, *from the last year.*
Difendersi dagli ipocriti, *to defend one's self against hypocrites.*
Distinguere un cane da un lupo, *to distinguish a dog from a wolf.*
Essere incalzato dal nemico, *to be pursued by the enemy.*
Fare una cosa da se, *to do a thing of one's self.*
Guardarsi da uno, *to beware of some one.*
Ripararsi dal vento, *to shelter one's self from the wind.*
Staccare una cosa da un' altra, *to separate one thing from another.*
Vengono da due parti opposte, *they come from two opposite quarters.*
Carta da scrivere, *writing-paper.*
Casa da vendere, *house to be sold.*
Cavalli da carrozza, *carriage-horses.*
Ragazza da maritare, *girl to be married.*
Cozzare col più forte è da balordo, *it is silly to contend with the strongest.*
È una storia da ridere, *it is a story to make one laugh.*
È un soggetto da commedia, *it is a subject fit for a play.*
È un ragazza da marito, *she is a girl of a marriageable age.*
Io non ho armi da difendermi, *I have no arms to defend myself.*
L' uomo dal mantello, *the man of the cloak.*
Non sono cose da dirsi, *these are not things to be told.*
Non è cosa da un pari vostro, *it is not a thing becoming a man like you.*
Sono tempi da piangere, *these are times to weep.*
Uomo da stento, *a man to bear fatigue, a drudge.*
Andate dal fornajo, *go to the baker's.*
Andrò da mia madre, *I will go to my mother's.*
Vive da signore, *he lives like a lord.*
Ha trattato da birbante, *he has acted like a rascal.*
Avete da fare? *have you something to do?*
Datemi da lavorare, *give me some work to do.*
Dite da burla? *do you speak in joke?*
Dite da vero? *do you speak in earnest?*
Egli fa da dottore, *he sets up for a doctor.*
Egli ha da due milioni di capitale, *he has about two millions of capital.*
Il re era da un canto, la regina da un altro, *the king was on one side, and the queen on the other.*
Non v' è da ridere, *there is no reason for laughing.*
Uomo da bene, *a good man.*
Visse da cento anni, *he lived about a hundred years.*
Vi giuro, da galantuomo, *I swear to you on the faith of an honest man.*
Venite qui da me, *come here near me.*

Rule 77.—The preposition a or ad, *to*, expresses intention, tendency, end, attribution, and the proximity of a place or person :—

Andare a pranzare, *to go to dine.*
Appoggiarsi ad uno, *to lean upon some one.*
Avvicinarsi ad uno, *to come near some one.*
Egli venne a trovarmi, *he came to meet me.*
Mandare a vedere, *to send and see.*
Mi si avventò addosso, *he rushed upon me.*
Passare all' altra parte della strada, *to cross on the other side of the street.*
Vicino al fuoco, *near the fire.*

Rule 78.—The preposition con, *with*, expresses the idea of society or union :—

Strignere amicizia con alcuno, *to form a friendship with some one.*
Egli camminava col bastone in mano, *he walked with the cane in his hand.*
È uscito col servitore, *he is gone with his servant.*
Venite insieme con me, *come along with me.*
Parlai con suo fratello, *I spoke with her brother.*

Rule 79.—The preposition in, *in* or *upon, on*, expresses the existence of an object in or on a body :—

Morire in età di cento anni, *to die at the age of one hundred years.*
Mettere una cosa in tasca, *to put a thing in one's pocket.*
Il pranzo è in tavola, *the dinner is on the table.*
Essere in mare, *to be at sea.*
Sto in casa, *I stay in the house.*

CONJUNCTIONS.

Rule 80.—The following conjunctions, and all those that are attended by a preposition, require the verb which follows them to be put in the infinitive :—

A fine di, *in order to.*
Avanti di, *before.*
Dopo, *after.*
In vece di, *instead of.*
Per, *to.*
Per paura di, *for fear.*
Prima di, *before.*
Senza, *without.*

The following sentences are examples :—

A fine di perfezionarla, *in order to perfect yourself.*
Dopo aver detto, *after having said.*
Per dir il vero, *to tell the truth.*
Prima di partire, *before going.*
Senza dal nostro proposito deviare, *without deviating from our subject.*

Rule 81.—The following conjunctions require the verb which follows them to be put in the indicative :—

Atteso che, *since.*
A causa che, *because.*
Di maniera che, *so that.*
Eccetto che, *unless.*
In tanto che, *so that.*
Mentre che, *whilst.*
Oltre che, *besides that.*
Secondo che, *according as.*
Se non che, *except.*
Subito che, *as soon as*, etc.

In the following sentences will be found some examples of this rule:—

Bisogna compatirlo atteso che il poverino è matto in mezzo al cervello, *we must excuse him, since the poor fellow is crack-brained.*

In tanto che non ritorno più, *so that he returned no more.*

Subito che il sole fu levato, *as soon as the sun was risen.*

Non ho cosa alcuna da dirvi se non che conviene i vostri maestri ubbidire, *I have nothing to say to you, except that you must obey your masters.*

Di maniera che ella puo far ciò che la piace, *so that you may do what you please.*

Rule 82.—The following conjunctions require the verb which follows them to be put in the subjunctive:—

Acciocchè, *that.*
Affinchè, *in order that.*
Ancorchè, *though.*
Anzi che, *before that.*
Avanti che, *before that.*
Avvegnachè, *though.*
Benchè, *although.*
Caso che, *in case that.*
Come che, *although.*
Come se, *as if.*
Con patto che, *on condition that.*
Contuttochè, *although.*
Dato che, *suppose that.*
Iuuauzi che, *before that.*
Purchè, *provided that.*
Quando anche, *although.*
Quantuuque, *though.*
Quasi, *as if.*
Pognamo che, *suppose that.*
Prima che, *before that.*
Seuza che, *without that.*

The following sentences are examples of this rule:—

Benchè sia difficile, bisogna però vincere se stesso, *however difficult it may be, we must nevertheless conquer ourselves.*

Ancorchè sia in età molto avanzata, nulladimeno gode perfetta salute, *he enjoys perfect health, though in very advanced age.*

Lo dice acciocchè, non diate a me la colpa, *he said it, that you may not lay the fault upon me.*

Affinchè ella gli scriva, *in order that you may write to him.*

Verrò, purchè non piova, *I will come, provided it does not rain.*

Rule 83.—The following conjunctions sometimes govern the indicative, and sometimes the subjunctive:—

Fino che, finchè, finattantochè, infino che, infinchè, infinattantochè, *till* or *until.*
Perchè, *why.*
Quando, *when.*
Se, *if.*
Sebbene, *though.*
Se bene, *although.*
Che, *that.*
Conciosiachè, conciosiacosachè, *for.*

In the following sentences will be found some examples of this rule:—

Lo mio cuore non può essere in pace, finattantochè egli non si riposi in voi, *my heart cannot rest, till it finds its repose in you.*

Che alcun non v' entrasse dentro, infinattantochè egli tornato fosse, *that nobody should enter until his return.*

Niuna doversi muovere del luogo suo, finattautochè io non ho la mia novella finita, *none of you are to stir from your places, till I put an end to my story.*

Sopra le rugiadose erbe, infinattantochè alquauto il sole fu alzato, colla sua compagnia diportando se n' andò, *she went away, diverting herself with her company upon the dewy grass, until the sun was a little higher.*

Chi te la fa, fagliele, e se tu non puoi, tienlati a mente finchè tu possa, *to him who plays you a trick, play another, and if you cannot, bear it in mind until you can.*

LESSONS IN ALGEBRA.—XLI.

EVOLUTION OF COMPOUND QUANTITIES.

RULE.—1. *Arrange the terms according to the powers of one of the letters, so that the highest power shall stand first, the next highest next, etc.*

2. *Take the root of the first term, for the first term of the required root.*

3. *Subtract the power from the given quantity, and divide the first term of the remainder by the first term of the root involved to the next inferior power and multiplied by the index of the given power; the quotient will be the next term of the root.*

4. *Subtract the power of the terms already found from the given quantity, and using the same divisor, proceed as before.*

PROOF.—*This rule verifies itself.* For the root, whenever a new term is added to it, is involved, for the purpose of subtracting its power from the given quantity; and when the power is *equal* to this quantity, it is evident the true root is found.

EXAMPLE.—Extract the cube root of

$$a^6 + 3a^5 - 3a^4 - 11a^3 + 6a^2 + 12a - 8\ (a^2 + a - -$$
$$a^6$$

Divisor A) $3a^4 + 3a^3 + a^2$ $\quad 3a^5 - 3a^4 - 11a^3$
$\quad 3a^5 + 3a^4 + \quad a^3$

Divisor B) $3a^4 + 6a^3 - 3a^2 - 6a + 4$ $\quad -6a^4 - 12a^3 + 6a^2 + 12a - 8$
$\quad -6a^4 - 12a^3 + 6a^2 + 12a - 8$

* * *

Divisor A is thus found, $3(a^2)^2$
$3 \times a \times a^2$
$(a)^2$
Sum $= 3a^4 + 3a^3 + a^2$

Divisor B is thus found, $3(a^2 + a)^2$
$3 \times (-2) \times (a^2 + a)$
$(-2)^2$
Sum $= 3a^4 + 6a^3 - 3a^2 - 6a + 4$

N.B. In finding the divisor in the 4th example of Exercise 73, the term $2a$ in the root is not involved, because the power next below the square is the first power.

The *square* root may be extracted by the following

RULE.—1. *Arrange the terms of the given quantity according to the powers of one of the letters, take the root of the first term, for the first term of the required root, and subtract the power from the given quantity.*

2. *Bring down two other terms for a dividend. Divide by double the root already found, and add the quotient both to the root and to the divisor. Multiply the divisor, thus increased, into the term last placed in the root, and subtract the product from the dividend.*

3. *Bring down two or three additional terms, and proceed as before.*

PROOF.—*Multiply the root into itself, and if the product is equal to the given quantity, the work is right.*

EXAMPLE.—What is the square root of

$a^2 + 2ab + b^2 + 2ac + 2bc + c^2\ (a + b + c$
a^2, the first subtrahend.

$2a + b)$ * $2ab + b^2$
Into $b =$ $2ab + b^2$, the second subtrahend.

$2a + 2b + c)$ * * $2ac + 2bc + c^2$
Into $c =$ $2ac + 2bc + c^2$, the third subtrahend.

Proof.—The square of the root $a + b + c$ is equal to the given quantity.

For $(a + b)^2 = a^2 + 2ab + b^2 = a^2 + (2a + b) \times b.$

And substituting $h = a + b$, the square $h^2 = a^2 + (2a + b) \times b$

And $(a + b + c)^2 = (h + c)^2 = h^2 + (2h + c) \times c$;

that is, restoring the values of h and h^2,

$$(a + b + c)^2 = a^2 + (2a + b) \times b + (2a + 2b + c) \times c.$$

In the same manner it may be proved that, if another term be added to the root, the power will be increased, by the product of that term into itself, and into twice the sum of the preceding terms.

The demonstration will be substantially the same, if some of the terms be *negative.*

It will frequently facilitate the extraction of roots to consider the index as composed of two or more *factors.*

Thus $a^{\frac{1}{4}} = a^{\frac{1}{2} \times \frac{1}{2}}$. And $a^{\frac{1}{6}} = a^{\frac{1}{3} \times \frac{1}{2}}$. That is,

The *fourth* root is equal to the *square* root of the *square* root;

The *sixth* root is equal to the *square* root of the *cube* root;

The *eighth* root is equal to the *square* root of the *fourth* root, etc.

To find the *sixth* root, therefore, we may first extract the *cube* root, and then the *square* root of that result.

EXERCISE 73.

1. Find the 4th root of $a^4 + 8a^3 + 24a^2 + 32a + 16$.
2. Find the 5th root of $a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab + b^5$.
3. Find the cube root of $a^3 - 6a^2b + 12ab^2 - 8b^3$.
4. Find the square root of $4a^2 - 12ab + 9b^2 + 16ah - 24bh + 16h^2$.
5. Find the square root of $1 - 4b + 4b^2 + 2y - 4by + y^2$.
6. Find the square root of $a^6 - 2a^5 + 3a^4 - 2a^3 + a^2$.
7. Find the square root of $a^4 + 4a^2b + 4b^2 - 4a^2 - 8b + 4$.
8. Find the square root of $x^4 - 4x^3 + 6x^2 - 4x + 1$.

9. Find the cube root of $x^6 - 6x^5 + 15x^4 - 20x^3 + 15x^2 - 6x + 1$.
10. Find the square root of $4x^4 - 4x^3 + 13x^2 - 6x + 9$.
11. Find the 4th root of $16a^4 - 96a^3x + 216a^2x^2 - 216ax^3 + 81x^4$.
12. Find the 5th root of $x^5 + 5x^4 + 10x^3 + 10x^2 + 5x + 1$.
13. Find the 6th root of $a^6 - 6a^5b + 15a^4b^2 - 20a^3b^3 + 15a^2b^4 - 6ab^5 + b^6$.

INDETERMINATE EQUATIONS.

When there are more unknown quantities than independent equations, the number of corresponding values which those quantities admit is indefinite. This number may be lessened by rejecting all the values which are not *integers*, and it may be further lessened by rejecting all the *negative values*.

An indeterminate equation of two unknown quantities of the *first degree* is of the form $mx + ny = d$; and here it may be remarked that this equation *cannot* be solved in whole numbers unless m and n are *prime* to each other, and that if one solution be given or found, all the others may be derived from it.

In the equation $mx - ny = \pm d$, the solution in whole numbers is *always* possible if m and n be prime to each other, and then an indefinite number of integral values may be assigned to x and y, which satisfy the equation.

In the equation $mx + ny = d$, the solution in whole numbers is *always* possible provided d be *greater* than $mn - m - n$.

EXAMPLES.

1. In how many ways can a guinea be paid by using shillings and crown pieces only?

Let x = the number of shillings, and y = the number of crowns, then $x + 5y = 21$ (taking all the values in shillings); $\therefore x = 21 - 5y$, where we see that to know the value of x we may assume y at pleasure; but since x must be a *positive integer* from the nature of the problem, it is natural to assume y equal to the consecutive whole numbers 1, 2, 3, etc.

If $y = 1, 2, 3, 4$, then $x = 16, 11, 6, 1$; and if y be taken $= 5$, this gives x a negative value; therefore the problem admits only of the above four solutions, and it is easy to test the correctness of the values thus found.

1 crown and 16 shillings; 2 crowns and 11 shillings; 3 crowns and 6 shillings; 4 crowns and 1 shilling, all equal 1 guinea, as required. *Ans.*

2. The difference between the values of $\frac{1}{12}$ of 5 lbs. of salt butter, and $\frac{1}{7}$ of 2 lbs. of fresh ditto, is $\frac{1}{4}$ of a penny. Find the price per lb. of each in integers?

Let x = the price per lb. of the salt butter,
And y = „ „ „ fresh butter;
Then, by the question, $\frac{5x}{12} - \frac{2y}{7} = \frac{1}{4}$.

Now, multiplying by 84 (the least common multiple of 12, 7 and 4), we have $35x - 24y = 21$; from which $y = \frac{35x - 21}{24}$; and here it may be remarked that it is best to find the value of that unknown which has the *least* co-efficient (in this case y).

Now $\frac{35x - 21}{24} = x + \frac{11x - 21}{24}$ (A). Now, since x is to be an integer, $\frac{11x - 21}{24}$ must be one also; $\therefore$ put $\frac{11x - 21}{24} = m$, whence $x = \frac{24m + 21}{11} = 2m + 1 + \frac{2m + 10}{11}$ (B). Now, for a similar reason, assume $\frac{2m + 10}{11} = n$, then $m = \frac{11n - 10}{2} = 5n - 5 + \frac{n}{2}$ (C). Now assume $\frac{n}{2} = r$, then $n = 2r$. Remembering that all the indeterminates, y, x, m, n, have an integral value, we retrace our steps by substitution, and have from (C), substituting $2r$ for n, $m = 10r - 5 + r = 11r - 5$; from (B), by substituting $11r - 5$ for m, $x = 22r - 10 + 1 + 2r = 24r - 9$; from (A), by substituting $24r - 9$ for x, $y = 24r - 9 + 11r - 5 = 35r - 14$. The two unknowns in terms of r are, therefore, $x = 24r - 9$, and $y = 35r - 14$, from which we see that any positive integer, from 1 to infinity, for the value of r, will give positive integers for the values of x and y. Thus,

If $r = 1, 2, 3, 4$, etc., increasing by 1;
$x = 15, 39, 63, 87$, etc., increasing by 24;
$y = 21, 56, 91, 126$, etc., increasing by 35.

Observe that the different values of x and y form *arithmetical progressions*, whose common differences are 24 and 35 respectively: that formed by the values of x has the co-efficient of y (*in the given equation*) for its common difference; and the one formed by the values of y has the co-efficient of x for its common difference. We also see from these two examples, that when the two unknowns have the *same* sign, the number of solutions is *limited*; but that the number is *unlimited* when they have *different* signs.

3. At a country railway station the money taken was £3. The tickets issued were for fares of 2s., 3s., and 5s. each. How many of each were issued? also find how many solutions the question admits of.

Let x, y, z represent the numbers of the different kinds; then by the question, $2x + 3y + 5z = 60$; whence $x = \frac{60 - 3y - 5z}{2} = 30 - y - 2z - \frac{y + z}{2}$; put $\frac{y + z}{2} = t$; then $y = 2t - z$, and $x = 30 - y - 2z - t = 30 - 3t - z$; if $z = 1$, then $x = 29 - 3t$, and $y = 2t - 1$; to make x and y whole numbers, t cannot be *more* than 9 nor *less* than 1 (thus giving 9 solutions).

If $t = 1, 2, 3, 4, 5, 6, 7, 8, 9$;
$x = 26, 23, 20, 17, 14, 11, 8, 5, 2$;
$y = 1, 3, 5, 7, 9, 11, 13, 15, 17$;
$z = 1, 1, 1, 1, 1, 1, 1, 1, 1$.

If $z = 2$, then $x = 28 - 3t$, and $y = 2t - 2$; t cannot be *greater* than 9 nor *less* than 2.

If $t = 2, 3, 4, 5, 6, 7, 8, 9$;
$x = 22, 19, 16, 13, 10, 7, 4$;
$y = 2, 4, 6, 8, 10, 12, 14, 16$;
$z = 2, 2, 2, 2, 2, 2, 2, 2$;

thus giving 8 more solutions.

If $z = 3$, $x = 27 - 3t$, and $y = 2t - 3$, from which we see t cannot be *more* than 8 nor *less* than 2; thus giving 7 more solutions.

If $z = 4$, $x = 26 - 3t$, and $y = 2t - 4$, where t cannot be *more* than 8 nor *less* than 3; thus giving 6 more solutions.

If $z = 5$, $x = 25 - 3t$, and $y = 2t - 5$, where t cannot be *more* than 8 nor *less* than 3; thus giving 6 more solutions.

If $z = 6$, $x = 24 - 3t$, and $y = 2t - 6$, where t cannot be *more* than 7 nor *less* than 4; thus giving 4 more solution

If $z = 7$, $x = 23 - 3t$, and $y = 2t - 7$, where t cannot be *more* than 7 nor *less* than 4; thus giving 4 more solutions.

If $z = 8$, $x = 22 - 3t$, and $y = 2t - 8$, where t cannot be *more* than 7 nor *less* than 5; thus giving 3 more solutions.

If $z = 9$, then $x = 21 - 3t$, and $y = 2t - 9$, where t cannot be *more* than 6 nor *less* than 5; thus giving 2 more solutions.

If $z = 10$, then $x = 20 - 3t$, and $y = 2t - 10$, where t can *only* be 6; thus giving 1 more solution.

If $z = 11$, then $x = 19 - 3t$, and $y = 2t - 11$, where t can *only* be 6; thus giving 1 more solution.

From the given equation, $2x + 3y + 5z = 60$, we see z cannot be *more* than 11; hence there are $9 + 8 + 7 + 6 + 6 + 4 + 4 + 3 + 2 + 1 + 1 = 51$ solutions to this question.

From the foregoing examples we may deduce the following

Rule.—If a simple equation express the relation of two unknown quantities, and their corresponding *integral* values be required, divide the whole equation by the co-efficient which is the *less* of the two, and suppose that part of the result which is in a fractional form equal to some *whole* number; thus a new simple equation is found, with which we must proceed as before, and so on till the co-efficient of one of the unknown quantities is 1, and the co-efficient of the other a whole number; then an integral value of the former may be found by substituting 0, or any *whole* number for the other; and from the preceding equations *integral* values of the original unknown quantities may be found.

EXERCISE 74.

1. Find the number of solutions, and the respective values of x, y, and z, in the equation $5x + 8y + 7z = 50$.

2. Find the number of solutions, and the values of x, y, and z, in the equations

$$\begin{cases} 5x + 7y - 3z = 10, \\ 5x - 2y + 4z = 18. \end{cases}$$

3. Find the number of solutions, and the values of x, y, z and m, in the equations

$$\begin{cases} x + y + z + m = 10, \\ 3x - 3y + 4z - m = 3. \\ 4x - 4z + m = 6y. \end{cases}$$

4. Find the number of solutions, and the values of x, y, z and n, in the equations

$$\begin{cases} x+y+z+2n=100. \\ 10x+5y+2z+n=100. \end{cases}$$

5. Bought 100 animals for £100: there were cows at £5, sheep at £1, and rabbits at 1s. How many solutions will this question admit of? and what was the price of each?

6. A person had a bag of nuts containing (he said) less than 500, and if he counted them by twos, threes, fours, fives or sixes, there was always an odd one; but when he counted them by sevens, there was none left. How many nuts did he have?

7. I retired to rest one evening at m minutes to n o'clock; and on rising 6 hours 55 minutes after, it wanted n minutes to m o'clock. Find the times of retiring to rest and getting up.

8. Find a sum consisting of P shillings and S pounds, the double of which is P pounds and S shillings?

9. What is the value of x, when £x and 18 shillings are twice the value of £18 and x shillings?

10. Divide 1591 into two parts, respectively divisible the one by 23 and the other by 34, and state the number of solutions.

11. Divide $\frac{58}{77}$ into two other fractions, whose denominators shall be 7 and 11.

12. Find two whole numbers whose sum and product together = 139, and how many solutions.

13. Divide 30 into 3 such parts that the 1st × 7, 2nd × 19, and 3rd × 38, the sum of products = 745. What are the parts?

14. Into what two parts must 4890 be divided that the 1st ÷ 37 may leave the remainder 3, and the 2nd ÷ 54 may leave the remainder 6?

15. I have a quantity of malt, weighing 39 lbs. per bushel, and if I had 5 lbs. *more* it would measure an exact number of bushels; or if I had 5 lbs. *less* it would weigh an *exact* number of cwts. What is the smallest quantity I can have to satisfy these conditions?

16. If I take out the nuts from a bag in successive quantities—thus, 1 the first draw, 2 the second, 4 the third, 8 the fourth, etc., I find that on taking out the last term of this progression no nuts will remain; I also find that if I had drawn them out in lots of 17 each, there would have been none left after a certain number of draws. Required the number of nuts.

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XL.

EXERCISE 71.

1. $n=4$, $a=4$, $s=256$; from which $r=4$, and the series = 4, 16, 64, 256.	2. $r=3$, and the series $=\frac{1}{9}, \frac{1}{3}, 1, 3, 9$.	5. $z=\frac{512}{19683}$, $s=2\frac{18659}{19683}$.
	3. $s=\frac{121}{162}$, $z=\frac{1}{162}$.	6. $z=8192$, $s=16382$.
	4. 1093.	7. $z=531441$, $s=797160$.
		8. £965114681693 13s. 4d.

EXERCISE 72.

1. 2, 4 and 8.	3. 5, 10, 20 and 40.	5. 5, 10 and 20.
2. 2, 10 and 50.	4. £120, £60 and £30.	6. 1, 3, 9 and 27.

LESSONS IN GERMAN.—LXXIII.

§ 121.—THE NOUN.

Rule.—A noun or pronoun which is the *subject* of a sentence must be in the nominative case; as, Der Mensch denkt, Gott lenkt, man devises, God disposes.

OBSERVATIONS.—The subject or nominative in German is seldom omitted, except in the case of the pronouns agreeing with verbs in the second person (singular and plural) of the imperative; as, Lies (du), read! Geht und sagt (Ihr) ihm, go and tell him. See, however, § 136 (2).

§ 122.—RULE.

A noun or pronoun which is the *predicate* of the sentence must be in the nominative case; as, er war ein großer König, he was a great king; dieser Knabe ist Kaufmann geworden, this boy has become a merchant.

§ 123.—RULE.

A noun used to limit the application of another noun signifying a different thing, is put in the genitive; as, der Lauf der Sonne, the course of the sun; die Erziehung der Kinder, the education of the children.

OBSERVATIONS.—(1.) If, however, the *limiting* noun (unless restricted itself by an adjective or some other qualifying word) signify *measure*, *number*, *weight*, or *quantity*, it is then put in the same case with that which it limits; as, sechs Pfund Thee (not Thees), six pounds (of) tea; but (with a restrictive term), sechs Pfund dieses Thees.

(2.) It should be observed that the two nouns under this rule must be of *different* significations; for two nouns standing for the *same* thing would be in the same case, forming an instance of *apposition*.

(3.) The noun in the genitive, that is, the *limiting* noun, is commonly said to be *governed* by the other one.

(4.) It seems hardly necessary to observe that under this rule come all words which perform the *office* of nouns; as, pronouns, adjectives used substantively, etc.; thus, die Gnade der Großen, the favour of the great.

(5.) We say often in English, he is a friend *to*, or an enemy *to*, or a nephew *to* any one; where, were these phrases put into German, we might expect the *dative* to be used. But in such cases the German always employs the genitive; thus, er ist ein Feind seines Vaterlandes, he is an enemy *of* his native country.

(6.) We say in English, the month *of* August, the city *of* London, and the like, where the common and the proper name of the same thing are connected by the preposition *of*. The Germans put the two nouns in *apposition*. (See § 133. *Obs.*)

(7.) So, too, in English, we say, the fifth *of* August; but in German the numeral is put in direct agreement with the name of the month; as, der fünfte August, the fifth (*of*) August, or August the fifth.

(8.) In place of the genitive, the preposition von, followed by the dative, is, in the following instances, generally used:—

(*a*) When succeeded by nouns signifying quality, rank, measure, weight, age, distance, and the like; as, ein Mann von hohem Stande, a man of high standing; ein Schiff von zwei hundert Tonnen, a ship of two hundred tons; ein Mann von achtzig Jahren, a man of eighty years; eine Reise von drei Meilen, a journey of three miles, etc.

(*b*) When followed by nouns denoting the material or substance of which anything is made; as, ein Becher von Silber, a cup of silver, *i.e.*, a silver cup; eine Uhr von Gold, a gold watch, etc.

(*c*) When followed by nouns whose cases are not indicated by the terminations of declension nor by the presence of the article; as, ein Vater von sechs Kindern, a father of six children; die Königin von England, the queen of England; die Grenzen von Frankreich, the boundaries of France.

(*d*) When followed by a word indicating the *whole*, of which the word preceding expresses but a *part*; as, einer von meinen Bekannten, one of my acquaintances; welcher von beiden? which of the two?

§ 124.—RULE.

A noun limiting the application of an adjective, where in English the relation would be expressed by such words as *of* or *from*, is put in the genitive; as, die meisten Verluste sind eines Ersatzes fähig, most losses are capable of reparation; die Erde ist voll der Güte des Herrn, the earth is full of the goodness of the Lord.

OBSERVATIONS.—(1.) The adjectives comprehended under this rule are, among others, the following:—

Bedürftig, in want, needing.	Gewöhnt, used to, in the habit.
Bewußt, conscious.	Kundig, having a knowledge, skilled.
Fähig, capable, susceptible.	Ledig, empty, void.
Froh, glad.	Müde, tired, weary.
Gewahr, aware.	Schuldig, guilty, indebted.
Gewärtig, waiting, in expectation.	Theilhaft, partaking.
Gewiß, sure, certain.	Werth, worth, worthy.

(2.) After gewahr, gewohnt, los, müde, satt, voll, and werth, the *accusative* is often used; as, er ward seinen Bruder gewahr, he was aware of (the presence of) his brother, *i.e.*, he observed his brother.

§ 125.—RULE.

A noun limiting the application of any of the verbs following, is put in the genitive:—

Achten, to mind, or regard.	Harren, to wait.
Bedürfen, to want.	Lachen, to laugh.
Begehren, to desire.	Pflegen, to foster.
Brauchen, to use.	Schonen, to spare.
Entbehren, to need.	Spotten, to mock.
Ermangeln, to want, or be without.	Verfehlen, to miss, or fail.
Erwähnen, to mention.	Vergessen, to forget.
Gedenken, to think, or ponder.	Wahren, to guard.
Genießen, to enjoy.	Wahrnehmen, to observe.
Gewahren, to observe.	Walten, to manage.
	Warten, to attend to, or mind.

OBSERVATIONS.—Bedürfen, begehren, brauchen, entbehren, erwähnen, genießen, pflegen, schonen, verfehlen, vergessen, wahrnehmen, wahren, and warten, take more frequently, in common conversation, the *accusative*. Achten, harren, and warten are more commonly construed with auf, and lachen, spotten, and walten with über, before an *accusative*.

§ 126.—RULE.

The following *reflective* verbs take, in addition to the pronoun peculiar to them, a word of limitation in the genitive:—

Sich annehmen, to engage in.	Sich erbarmen, to pity.
„ bedienen, to use.	„ erfrechen, to presume.
„ befleißen, } to apply to.	„ erinnern, to remember.
„ befleißigen, }	„ erkühnen, to venture.
„ bemächtigen, to take possession.	„ erwehren, to resist.
„ bemeistern, to seize.	„ erfreuen, to rejoice.
„ entäußern, to abstain.	„ getrösten, to hope for.
„ entblöden, to dare, to be bold.	„ rühmen, to boast.
„ entbrechen, to forbear.	„ schämen, to be ashamed.
„ enthalten, to refrain.	„ überheben, to be haughty.
„ entschlagen, to get rid of.	„ unterfangen, to undertake.
„ entsinnen, to recollect.	„ versehen, to be aware.
	„ wehren, to resist.
	„ weigern, to refuse; etc. etc.

OBSERVATIONS.—The genitive is in like manner put after the following *impersonals*:—

Es gelüstet mich, I desire.
Es jammert mich, I pity, or compassionate.
Es reut mich, I repent, or regret.
Es lohnt sich, it is worth while.

§ 127.—RULE.

The following verbs require after them a genitive denoting a *thing*, and an accusative signifying a *person*:—

Anklagen, to accuse.	Entsetzen, to displace.
Belehren, to inform.	Ueberheben, to exempt.
Berauben, to rob.	Ueberzeugen, to convince.
Beschuldigen, to accuse.	Versichern, to assure, etc.

OBSERVATIONS.—The verbs above, when in the *passive* voice, take for their *nominative* the word denoting the person, the genitive of the *thing* remaining the same; as, er ist eines Verbrechens angeklagt worden, he has been accused of a crime.

§ 128.—RULE.

Nouns denoting the *time*, *place*, *manner*, *intent*, or *cause* of an action, are often put absolutely in the genitive and treated as adverbs; as, des Morgens gehe ich aus, in the morning I go out; man sucht ihn aller Orten, they seek him everywhere; ich bin Willens hinzugehen, I am willing to go there.

OBSERVATIONS.—This adverbial use of the genitive is quite common in German. (See § 101.) In order, however, to express the particular *point*, or the *duration* of time, the accusative is generally employed, or a preposition with its proper case.

§ 129.—RULE.

A noun or pronoun used to represent the object in *reference* to which an action is done or directed, is put in the dative; as, ich danke dir, I thank (or am thankful *to*) you; er ist dem Tode entgangen, he has escaped from death.

OBSERVATIONS.—(1.) The dative is the case employed to denote the person or the thing, *in relation to* which the subject of the verb is represented as acting. Compared with the accusative, it is the case of the *remote* object: the accusative being the case of the *immediate* object. Thus, in the example, ich schrieb meinem Vater einen Brief, I wrote (to) my father a letter, the immediate object is *a letter;* while *father*, the person *to* whom I wrote, is the remote object. The number of verbs thus taking the accusative with the dative is quite large.

(2.) On the principle explained in the preceding observation may be resolved such cases as the following: es thut mir leid, it causes me sorrow, or, I am sorry; es wird mir im Herzen weh thun, it will cause pain to me in the heart (it will pain me to the heart), etc.

(3.) A right regard to the observation made above, namely, that the dative merely marks that person or thing in *reference to* which an action is performed, will serve also to explain all such examples as these; Ihnen bedeutet dieses Opfer nichts, to you (*i.e.*, so far as you are concerned) this sacrifice means nothing; die Thränen, die Eurem Streit geflossen, the tears which have flowed in relation to (*i.e.*, from) your dispute; mir tödtete ein Schuß das Pferd, a shot killed a horse for me (*i.e.*, killed my horse).

(4.) The rule comprehends all such verbs as the following: antworten, to answer; danken, to thank; dienen, to serve; drohen, to threaten; fehlen, to fall short; fluchen, to curse; folgen, to follow; fröhnen, to do homage; gebühren, to be due; gefallen, to please; gehören, to pertain to; gehorchen, to obey; genugen, to satisfy; gereichen, to be adequate; gleichen, to resemble; helfen, to help, etc.

(5.) This rule also comprehends all reflective verbs that govern the dative; as, ich maße mir keinen Titel an, welchen ich nicht habe, I claim to myself no title, which I have not; as also all impersonals requiring the dative; as, es beliebt mir, it pleases me, or, I am pleased; es mangelt mir, it is wanting to me, or, I am wanting, etc.

(6.) The dative is also often used after passive verbs; as, von Geistern wird der Weg dazu beschützt, the way thereto is guarded by angels; ihm wird gelohnt, (*literally*) it is rewarded to him, *i.e.*, he is rewarded.

§ 130.—RULE.

Many compound verbs, particularly those compounded with er, ver, ent, an, ab, auf, bei, nach, vor, zu, and wider, require after them the dative; as, Ich habe ihm Geld angeboten, I have offered him money.

§ 131.—RULE.

An adjective used to limit the application of a noun, where, in English, the relation would be expressed by such words as *to* or *for*, governs the dative; as, Sei deinem Herrn getreu, be faithful to your master.

OBSERVATIONS.—Under this rule are embraced (among others) the following adjectives: ähnlich, like; angemessen, appropriate; angenehm, agreeable; anstößig, offensive; bekannt, known; beschieden, destined; eigen, peculiar; fremd, foreign; gemäß, according to; gemein, common; gewachsen, competent; gnädig, gracious; heilsam, healthful; lieb, agreeable; nahe, near; überlegen, superior; willkommen, welcome; widrig, adverse; dienstbar, serviceable; gehorsam, obedient; nützlich, useful.

PAINTING IN WATER-COLOURS.—VII.

EFFECT OF COMBINATION ON COLOURS—CONCLUSION.

As we are desirous that these lessons upon painting in water-colours should, as far as possible, explain the principles of the art, we deem it necessary to include other subjects for our consideration, besides that of landscape. By these further investigations we shall add to our means of explaining the theory, and open out a more extensive field for practice. All who have had any considerable experience in painting can testify to the benefit that is derived from allowing their attention and practice to extend to other objects, rather than by confining them to one class only; and although the objects of our choice may differ in kind and character as widely as possible, yet the same colours and manner of execution may to a great extent be common to all. Besides, the knowledge and power we gain, directly or indirectly, from the study of one class may be found serviceable when we take up others—directly, when the same colours and method of using them may be repeated; indirectly, in teaching us that there are certain combinations and modes of treatment which can only be employed in special cases, all of which must give us a command, both of manner and material, that cannot fail to be of advantage to us upon all occasions.

When we consider that the proper application of colours lies in their arrangement and combinations, we shall not be at a loss to understand in what respect the diversity of study we speak of can help us to overcome the difficulties. Hence the source of originality, from depending principally upon our own observations. It is true we may in a great measure be guided by the experience of others, and it would be unwise to reject it; but as each painter has his own innate feeling, both of form and colour, which influences him in his method of representing either, we may easily account for the way in which every one makes for himself his own style and manner, peculiar to himself alone. On the other hand, they who entirely depend upon other men's experience, without looking away from it to Nature for the reasons which guided them in their practice, are but copyists, and more frequently copy the faults rather than the excellences of their masters. Let us suppose the case of two painters who have been in the habit of taking Nature as their guide, and ask each to paint the same subject according to his own ideas and the results of his own experience: we shall find their practice and theory so different as to make us almost doubt the possibility of their coming closely together at the conclusion; yet we find their finished pictures, when compared with the subject from which they were painted, to be truthful representations, but each in a different way.

It is then our desire to encourage our pupils to think for themselves, and to endeavour, as far as possible, to show them *how* to look at Nature, and *how* to distinguish the characteristic features which mark the individuality of objects, even amongst those of the same species. Whatever the experience of an artist may be, he cannot say positively that such and such colours are to be used invariably, even for the same class of objects, because there are so many accidental circumstances operating to influence him in his mode of proceeding. The light may be different at different times, it may be stronger or brighter on one occasion than another. This would very much affect reflections, and especially so if the surrounding objects sent back their colours under a powerful light; and besides, the very objects themselves, though precisely the same in class and character, may, from various causes, exhibit different degrees of colour—brighter, warmer, or colder, as the case might be. But the artist may be able to explain how colours are affected in their combinations, and how they may be used to neutralise or give more force to other colours under any particular arrangement, or when employed for some especial purpose; therefore, in order to give a practical illustration of our observations, we have selected a group of objects differing in colour, but belonging to the same classification, to form the subject of our next picture (Fig. 10). Our pupils may easily obtain any of these, and place them on the table as they are arranged in the engraving, with the light from the left. Now, as there are great varieties of these, especially the stable-lantern and the jar, in size and details of colour, it is obvious that there can be no positive directions given as to the exact colour to be used, either in quantity or order; therefore, we can only explain the principles upon which they must proceed in painting them, that our pupils may be able to make their own deductions.

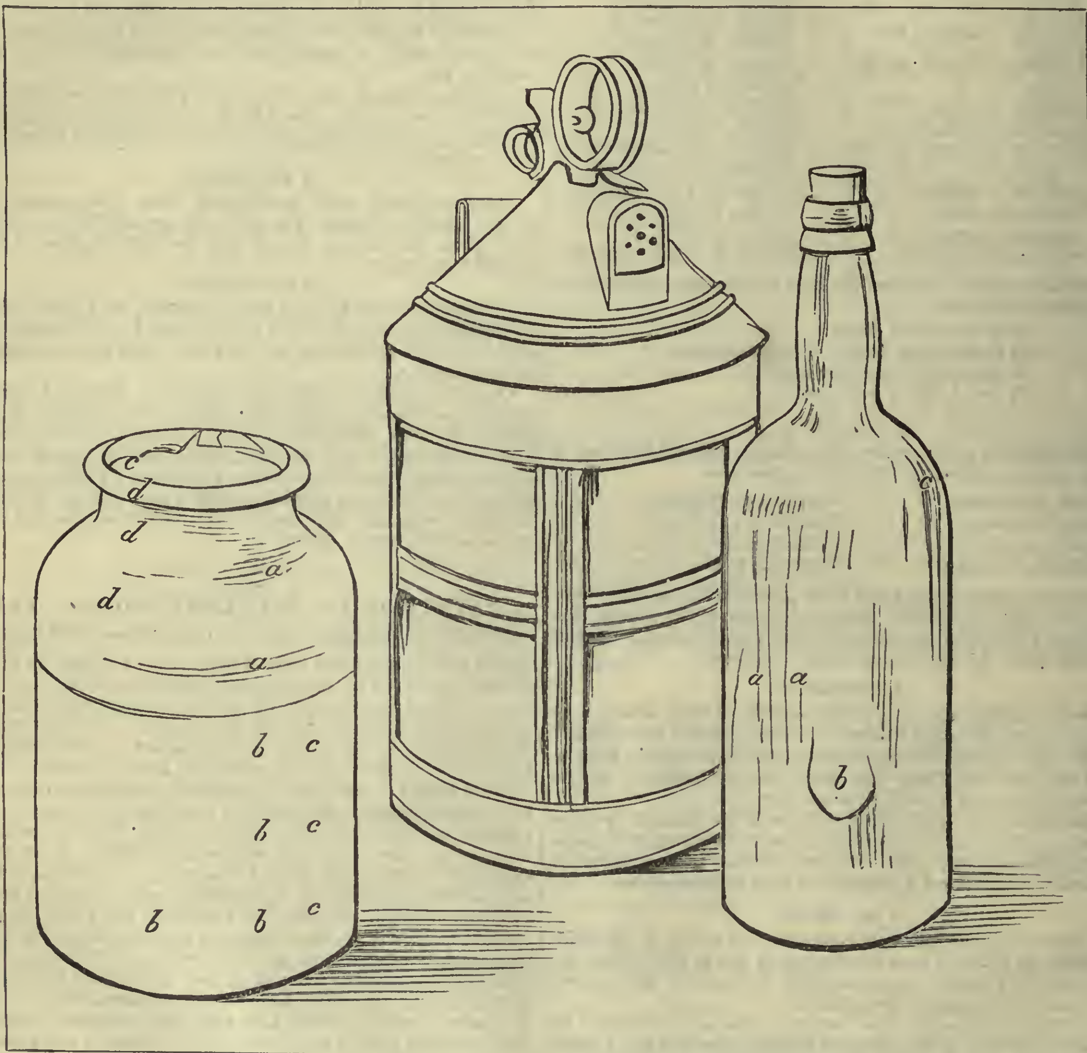


Fig. 10.—EFFECT OF COMBINATION ON COLOUR—OUTLINE DRAWING.

We will commence with the jar. The majority of articles of this kind are of a dark-brown, warm colour, from the top to about one-third of the distance downwards; there are some of a pale, sickly yellow, approaching in tone to the rest of the colour below, but we prefer to take the darker. The prevailing colour in the upper portion is burnt sienna. The jar may not be very evenly stained, but should there be darker portions than the middle tone of sienna just mentioned (*a*, *a*, Fig. 10), paint them in, whilst the first wash of sienna is wet, with some madder brown, and a little sepia mixed with it for the darkest portions. The yellowish drab tone below may be imitated with yellow ochre, raw umber, and very little grey, the latter composed of sepia, cobalt blue, and a little lake. In the lower part of some jars there is a very slight tone approaching lake. This may be added to the colour at the time, or perhaps it would be better to leave it till the umber, ochre, and grey tone is dry, then glaze it with the lake; but as this colour will be so very faint as to be almost imperceptible, a very weak tint must be used. Here

With respect to more decisive colours, to be found scattered in places over an object—but not altogether, as in the case of any general delicate tone like the one mentioned above—we advise that particular notice should be taken where they are warmer or cooler. These changes of colour are universal in Nature, and demand all the care that we can patiently bestow upon them. It is necessary to observe the strength of the colour either way which causes the difference, and when the under ground is dry, wash the required tint over it. In the case of the jar before us there is a warm tint over *b*, *b* of raw umber and

Fig. 11.—EFFECT OF COMBINATION ON COLOUR—FINISHED DRAWING.

is an instance of delicate tones so frequently found in Nature, and which give so much value to the painting, and are so very difficult for beginners to detect; it requires much experience to recognise them, and in first attempts the great danger is in overdoing them. We caution our pupils, when glazing colours over others that are dry, not to rub the brush backwards and forwards, because the first time the brush goes over the undertone the colour is softened, a repetition of this will rub it up, and then the purity is lost; the brush must be carefully passed over every part, and once only. We recommend the practice of trying the most prominent and positive colours, when prepared, on a piece of paper, and then hold it near to those parts of the object corresponding to the colour; this practice will greatly assist the judgment in determining the exact tone required.

burnt sienna, the edges being broken off over the under colour until they are lost on the side of the light, and on the shadow side mingle with a cool grey near the edge of the jar. The next thing will be to put in the broad and cast shadows with the usual shadow tint—sepia, cobalt, and lake. The darkest portion on the object will be throughout the length, between *b*, *b*, and *c*, *c*, making it sharp and decisive at *c*, *c*. The edge must be washed off on the light side, and continued on the shadow side with a somewhat lighter and cooler tone to the side of the jar. The cast shadow must be darker than the broad shadow. The shining bright spots, *d*, *d*, being the highest lights, may be wetted and rubbed off with india-rubber, as we explained in a former lesson upon sepia painting. The inside of the jar may require a purer yellow than the outside: if so, less umber must be used, and the brown colouring over the rim may be sharp and distinct in its edges. If our pupils will look at their model more attentively, after this first process is completed, they will no doubt perceive other colours more or less influencing the general effect—slight glazings of lake over some parts of the brown, especially on the light side. Probably here and there, in connection with these, some similar glazings of raw sienna, where the brown is not so strong and partakes of that colour; even delicate washes of indigo may be seen; but it must be remembered these are only suggestions, and must be followed with judgment.

The next part of the subject to be considered is the lantern. The general colour here is grey. The horn through which the light passes will most probably be warmer in tone. This may be effected with burnt and raw sienna broken to different degrees of strength, and for the clearer parts a little yellow ochre may be useful. If the lantern is an old one, patches of rust may be scattered over it in places—Indian red will answer the purpose; but, as we have said, grey is the prevailing colour, diversified by warmer or cooler colours, subject to the manner in which they are disposed in the object. The darkest and very sharp shadows under the rim and in the corners can be imitated with sepia, indigo, and a little lake. There is a greenness about sepia and indigo alone which lake will neutralise and render the tint more intense.

It will be well now to paint the background; this will reveal the strength of the colours in the objects, and very likely we shall discover some parts deficient. Let this at first be done with grey tint (backgrounds must be of a retiring character; grey will accomplish this), till it descends to below the top of the jar, then continue it to the bottom with an addition of raw umber and yellow ochre. If after this is dry a wash of terre verte be passed over the grey only, the slight green thus contributed will increase by contrast the value of the red, and confine the greys of the lantern more particularly to itself.

Lastly, the bottle. This is a dark object, and affords a powerful contrast to the others, assisting to give the greys and lighter tones in the lantern their true value and strength. The principal and general colour will be sepia and indigo; but this will be broken up by a variety of other colours depending upon the objects which surround it. The narrow strips of middle tone at *a*, *a* were caused by the reflection of the jar and another object near it, not in the picture. The one *b* was from a saucer placed near to the bottle, and *c* was from a plaster cast that stood about two feet away from it. This being an object susceptible of reflection, everything near it has an influence upon the colour, and it must be remembered that the colours for these reflections are always those of the objects reflected. The cork may be painted with raw umber and a little ochre; the shadow sepia. The darkest parts of the bottle, not affected by reflection, must be put in with sharp, decisive touches of very dark indigo and sepia. There will also be many cool tones to be painted with indigo. Very frequently it is necessary to assist the very darkest parts with a little gum. We do not advocate an indiscriminate use of gum; but in cases like this, to assist the intensity of the darkest parts, an exception may be made; only it must be used sparingly, or the intention would be frustrated.

Now we desire our pupils to understand that the above hints are given for the purpose of directing them *how to look at an object and to study its colour.* No absolute rule could be given for painting either this or any other subject; even if it were possible to write one, it could not be of any use. Therefore, all who wish to overcome the difficulties of painting from Nature, must persevere under continual practice until they become quite familiar with their colours, and know, in short, the full extent of their capabilities. When this has been acquired, together with a readiness of execution, there need not be any embarrassment in finding a subject to paint from. The motive that guided us in this lesson has been to direct the attention of our pupils to other subjects besides that of landscape, from which may be derived many valuable lessons upon colouring. We know of none better capable of helping them in their studies than those which are usually termed "still life;" their variety affords abundant choice, in which both form and colour may be studied with equal advantage. Fruits, flowers, vegetables, articles of ornament and dress, culinary utensils, and numberless other objects, insignificant perhaps in themselves, possess great value in the eyes of an artist, who is open to receive instruction from whatever source it may be obtained. There are times and seasons when it would be impossible to seek our subjects out of doors, and on these occasions we must depend upon something we can place upon the table: and although our model may not be of the class to enable us to produce a picture of very high art, it may, nevertheless, afford us some valuable instruction, and on that account it must not be despised.

LESSONS IN GREEK.—LI.

THE VOICES OF THE VERB.

We have seen that the verb in Greek appears in three voices—active, middle, and passive. The connection of these with the subject may be shown as follows:—In the active, the subject conveys the action, as ὁ παις τυπτει, *the boy strikes;* in the passive, the subject receives the action from an object, as ὁ παις τυπτεται ὑπο του πατρος, *the boy is struck* BY HIS FATHER; while in the middle the subject acts on itself, as ὁ παις τυπτεται, *the boy* STRIKES HIMSELF.

The second modification of the form of verbs is owing to the fact that every affirmation has respect to time—the time when the declared fact took place. But time is grammatically expressed by tense. Accordingly, we must consider the Greek verb in its *tenses.*

Further, declarations or affirmations may be made in different ways. We may declare a fact simply and independently, and we may declare one fact in relation to another. Hence the manner in which affirmations are made demands attention, and so we are led to study the verb in its *moods.*

The active voice has two modifications, and may appear as either transitive or intransitive: for example—active transitive, ὁ παις τυπτει (τον αδελφον), *the boy* STRIKES (HIS BROTHER); active intransitive, ὁ παις τρεχει, *the boy* RUNS.

In the first instance the verb is transitive as well as active, because the action passes from the subject to an object. In the second instance the verb is intransitive, since it has no object, but the action limits itself to the subject. The form of the verbs shows that they are both in the active voice.

Generally every verb has either a transitive or an intransitive signification. Many verbs combine the two meanings, being sometimes transitive and sometimes intransitive. When the two imports unite in one verb, either the two run through all the forms, or they are united, so that one signification belongs to this form, and the other signification belongs to that form.

Of the verbs, however, in which the two—namely, the transitive and the intransitive import—run through all the tenses, take as examples εχειν, *to hold;* τεινειν, *to stretch;* κλινειν, *to lean;* στρεφειν, *to turn;* and πραττειν, *to do.*

Many transitive verbs become intransitive by combination with prepositions, as προσκρουειν, *to dash against;* απαλλαττειν, *to depart;* μεταβαλλειν, *to change;* επιδιδοναι, *to increase.*

Many verbs which have only a transitive meaning become intransitive by the omission of an easily understood object; as τελευταν (scil. τον βιον), *to end (life), to die;* προσεχειν (understanding τον νουν), literally, *to apply (one's mind) to.*

The ensuing are the forms to which the intransitive meaning chiefly belongs—namely, the second perfect and its derivative the second pluperfect, which are intransitive not merely in the verbs which in the present have both significations, but also in other verbs which in the other tenses are employed only transitively. Of the first kind take as examples, πεπραγα, *I have found myself, I am;* ανεῳγα, *I am open.* As examples of the second sort take εγρηγορα, *I am awakened, I watch;* μεμηνα, *I rage;* πεποιθα, *I trust.*

The intransitive import attaches also to the second aorist, the perfect and the pluperfect of ἱστημι, *I place;* δυω, *I enclose;* φυω, *I beget;* which in the tenses mentioned signify *I stand, I enter, I arise.*

If, with intransitive verbs, the object is named by which the condition expressed in the verb is occasioned, then, as in the passive, that object is put in the genitive with a preposition; as πολλα κακα επαθομεν ὑπο τῶν ληστων, *we have* SUFFERED *many evil things* FROM ROBBERS.

If a thing or a circumstance is given with the passive as the occasion of the act spoken of in the verb, then the object is generally in the dative without a preposition, as νοσῳ εφθαρμενοι εισιν οἱ Αθηναιοι, *the Athenians were destroyed by the plague.* Also the person by whom a condition is brought about stands with a passive verb, sometimes in the dative without a preposition, most frequently with the perfect and the pluperfect, and regularly with the verbal adjective; as ασκητεον εστι σοι ἡ αρετη, *virtue must be practised by you.*

Every passive predicate may be converted into an active one, or derived from an active one. In this change the object in the active representation becomes the subject in the passive :—

Passive Predicate,	ὁ παις τυπτεται ὑπο τον ανδρος,
(converted into)	*the boy is struck by the man,*
Active Predicate,	ὁ ανηρ τυπτει τον παιδα.

If, however, a verb in the active voice takes two objects, only one of them can appear as subject in the passive.

The Greeks subjoined to intransitive verbs in the accusative the abstract object implied in the verb, saying, for instance, *to live a life,* βιον βιωναι. From this active a passive was formed, as βιος βεβιωται, *a life has been lived.* Agreeably to this usage they employed the verbal adjective, as βιος βιωτος, *liveable life.*

The middle form of the verb presents the subject as active, but at the same time as acted on by its own act.

Some verbs altogether want the active form, and, appearing only in the middle, have the reflex or intransitive signification. These are called *deponents,* because they have laid down the active form. These deponents may be divided into two classes, *middle deponents* and *passive deponents.* The middle deponents are those which form their aorist with a middle form, as αισθανομαι, *I perceive,* aor. ησθομην. The passive deponents are those which form their aorist with a passive form, as δυναμαι, *I am able,* aor. εδυνηθην.

For the expression of external circumstances, the Greeks use the middle voice in its reflex sense but sparingly. Examples of such usage are—λουεσθαι, *to wash one's self, to bathe;* γυμναζεσθαι, *to exercise one's self, to contend;* στασθαι, *to place one's self, to stand.*

Very common is the use of the reflective middle, when a condition of mind is represented, and the subject appears as in his own spirit producing a result, or as acting on his own internal state. Thus παρεχειν means *to afford, to offer,* and παρεχεσθαι *to offer* or *give one's self, to present from one's self, of one's own accord, from one's own resources.*

The middle voice is often used to express that which is done in some way for or to the subject, for the benefit or interest or at the command of the subject. This reference to the subject is sometimes strengthened by the reflective pronoun, as ἑαυτῳ εθετο νομον, *he made a law for himself.* The middle voice is used mediately in these examples :—μισθωσασθαι οικιαν, *to take a house;* αγεσθαι γυναικα, *to marry a wife;* μεταπεμπεσθαι τινα, *to send for a person;* αμυνεσθαι, *to guard one's self against, punish.*

The use of the middle voice, in contrast with the active, may be illustrated in the verb τιθεναι, as τιθεναι νομους, *to establish or give laws* (the act of the legislator), and τιθεσθαι νομους, *to pass or enact laws* (the act of the legislature or people).

THE TENSES OF THE VERB.

Every act has a relation to time. Time is conceived of in three ways—the present, the past, the future. Tense, as corresponding to time, must have the same divisions, though in some languages the tenses do not fully correspond to the three modifications of time; for instance, in English we have not a future tense, and are obliged to express future time by the aid of auxiliary verbs.

The exact import of the tenses appears best in the indicative mood.

If we conceive of time in the present, we have the condition (or action) of the verb as taking an actual shape, the present; as completed, the perfect; as coming on, the periphrastic future, formed by μελλω and the infinitive.

If we conceive of time in the past, we have the condition of the verb as taking an actual shape, the imperfect; as completed, the pluperfect; as coming on, the periphrastic future, formed by εμελλον and the infinitive.

If we conceive of time in the future, we have the condition of the verb as taking an actual shape, the ordinary future; as completed, the future perfect or third future; as coming on, the periphrastic future, formed by μελλησω and the infinitive.

The present indicates that the action or condition of the verb is forming, or realising itself; it consequently denotes continuance, and gives the idea in a general and unlimited manner; thus, παντα τα αγαθα διδωσιν ὁ Θεος, *God gives all good things.*

In narrative the writer often transfers past events to present time, and relates them as if now actually proceeding. This is called the *historic present* (praesens historicum). The historic present gives a liveliness to the style, and is common with the Greek authors.

When a past event may in itself or in its consequences be considered as coming down to the present, it is often spoken of by the Greeks in the present. Thus we find in the present ακουω, πυνθανομαι, μανθανω, γιγνωσκω, though this use is not limited to these verbs: for example, Θεμιστοκλεα ουκ ακουεις ανδρα αγαθον οντα; *do you not hear* (for *have you not heard*) *that Themistocles was a good man?*

Ἡκω, *I have come,* and οιχομαι, *I have left,* are regularly used in a kind of perfect signification, while many other verbs, besides their ordinary meaning, have an import which can be best rendered into English by a perfect; as φευγω, *I flee, I have been accused, I have been banished;* νικω, *I conquer, I am a conqueror,* that is, *I have conquered.*

Future events also may be spoken of as present, while an additional degree of certainty is given to them. Especially are ερχομαι and πορευομαι thus used. Εἰμι is regularly employed with a future signification.

The perfect presents the action or condition of the verb as completed in regard to the present; the pluperfect presents the action or condition of the verb as completed in regard to the past. The use of both tenses, however, undergoes in Greek a considerable limitation by means of the aorist.

As the conclusion of an act has commonly a result, the perfect, which denotes the conclusion, may denote also the result. And as the result, if a completed act comes down to or near the present, so the perfect may signify that which is, or that which lately was: for example, των ποιητων τινες ὑποθηκας ὡς χρη ζην καταλελοιπασιν, *some of the poets have left directions how we ought to live.* They have left them, and here they are; thus the perfect has the force of a present. Hence this form has been called "a present-perfect," being past in act but present in consequence.

In Greek this use of the perfect is common. Accordingly the perfect signifies the result of the action of the present, and is sometimes best represented in English by another verb; thus κεκτημαι, *I possess,* as expressive of the result of κταομαι, *I acquire;* οιδα, *I know,* the result of ειδω, *I see.* So μεμνημαι, *I remember;* δεδοικα (or δεδια), *I fear.* As the perfect in these verbs has the force of a present, so the pluperfect has the force of a simple past or an imperfect; thus, εκεκλημην, *I was called,* or *I bore the name;* ηδειν, *I knew.*

The imperfect represents the action or condition of the verb as forming itself in the past, and so describes a past event in its progress and continuance in time. The imperfect may thus denote continuance, an habitual state, as well as repetition, in the past.

The aorist presents the action or condition of the verb as belonging to the past, without extension or limitation. On this account the aorist is specifically the narrative tense—the tense for reporting events as so many vanishing points in past time. The corresponding English tense is the simple preterite or the past, as *he read, they gave.* If during the narration events are spoken of in their continuance, the imperfect is employed in Greek; and if events are introduced with their consequences in the present, then the perfect is used; as—

Aorist.—Οἱ Ἑλληνες ενικησαν τους Περσας,
the Greeks CONQUERED *the Persians.*
Perfect.—Ὁ πολεμος ἁπαντων ἡμας απεστερηκεν,
the war HAS DEPRIVED *us of everything.*

In propositions which in English set forth general truths or facts which arise from common experience, the Greeks also employ the aorist to indicate a single fact or observation; as πολλα ανθρωποις παρα γνωμην επεσε, *many things happen to men contrary to their expectation.*

The future declares that the act or condition will take place in time to come. The periphrastic future, formed with parts of μελλω and the infinitive present, future, or aorist, is to be distinguished from the simple future. The latter is a future indefinite, merely declaring that an act will take place or a condition arise at some future moment; while the former is a future with a limitation, denoting that the circumstance will occur in relation to some other time, either immediately in the present, or after another future event. The simple future, or the future formed by adding a termination to the stem, as representing a thing that will be, may denote an event that is to be, or must be; so it comes to signify a request or convey a command, especially in questions with *ου*.

The future may also express that which is conformable to the character of the subject, that which may be expected from the subject, as *'Ο δικαιος ανηρ ευ βιωσεται, κακως δε ὁ αδικος*, *the just man will live well, but the unjust ill.*

After verbs signifying to promise, to wish, to request, to hinder, to swear, to expect, to hope, etc., the Greeks use either the infinitive future, or the infinitive present, or the infinitive aorist.

The perfect future or third future denotes a condition or an action which is considered as completed in the future; as *ματην εμοι κεκλαυσεται*, *in vain shall I have wept.*

The third future is used also to indicate a continuous future condition, and serves therefore as the ordinary future to verbs which in the perfect have a present signification; as *αει της σης φιλιας μεμνησομαι*, *I will always remember thy friendship.*

KEY TO EXERCISES IN LESSONS IN GREEK.—L.

Exercise 135.—Greek-English.

1. A few sensible men are more to be feared than many senseless ones. 2. The wrath of those who lose lasts but a short time. 3. Men say that there are more evil things in life than good. 4. The country has many mountainous parts. 5. Agriculture accustoms one to endure both the cold of winter and the heat of summer. 6. Prosperity helps to hide wickedness, but adversity soon makes it manifest. 7. When the enemy came up, he ordered the Greeks to make ready. 8. Three came. 9. The wise man is happy. 10. The men of old were courageous. 11. Miltiades and his men fought bravely (lit., *those around Miltiades*). 12. It is honourable to teach. 13. The word "if" is a conjunction. 14. I will kill you; but what say you? It is not I that will kill you, but the law of the state. 15. We all praise what you say. 16. Socrates was always in public, for in the morning he used to go into the promenades and gymnasia, and during the rest of the day wherever he was likely to meet the largest number of people. 17. The future is hidden. 18. The power of the gods is very great. 19. Men are mortal. 20. I am a Greek. 21. It is impossible to be a good citizen without justice.

Exercise 136.—English-Greek.

1. 'Εξ ηλθον. 2. Δυω ηλθετην. 3. Εκεινος και συ αγαθω εστον. 4. 'Ο πατηρ εμος και εγω αγαθω εστον. 5. Ξενοφων ηρεθη στρατηγος. 6. Εκεινω δυω ηρεθητην στρατηγω, και παρεσκευασασθην ιεναι επι τον πολεμιον. 7. Λεγω σε κακον ειναι. 8. Συ δε; 9. Λεγω. 10. Συ ει σοφος, εκεινοι δε ου. 11. 'Ημεις εσμεν 'Ελληνες. 12. Αδηλα εστι τα μελλοντα. 13. Ανθρωπος θνητος εστι. 14. 'Η αδελφη εμη θνητη εστι. 15. Οἱ εμοι αδελφοι και αδελφαι θνητοι εισιν. 16. Εγω και συ θνητω εστον. 17. Εκεινο εστι μωρια. 18. Νουν ὑγιη εχειν σοφια εστιν. 19. 'Η αγορα και πασα ἡ πολις πεπληρωμεναι εισιν. 20. 'Ημεις και εκεινοι γραφομεν. 21. Εκεινος και εγω γραφομεν. 22. 'Η δημοκρατια ουκ εστιν αγαθον. 23. Οἱ ανδρες, αἱ γυναικες, και οἱ παιδες παρεσκευασμενοι εισιν. 24. Εστι τα χρηματα ευδαιμονιας σημειον; 25. Τα χρηματα ουκ εστι σημειον ευδαιμονιας.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XIX.—COMMERCE OF THE ITALIAN REPUBLICS (*continued*).

GENOA.

GENOA, like most of the Italian cities which rose to commercial eminence in the Middle Ages, had existed as a Roman municipium, and is referred to at the time of the Second Punic War. The city, allied with Pisa, was the first to engage in attacking the Saracen corsairs which infested the Mediterranean. During the Crusades, Genoa vied with Venice in the part she played. The profits obtained at this period stimulated commerce and navigation. The Republic became rich, and its sailors were so gallant as to be dreaded even by the Venetians. It was at this date that the Genoese made the conquest of Corsica and part of Sardinia, driving out the Saracens, whom they also deprived of Minorca and some Iberian provinces. The climax of Genoese prosperity was reached in 1261, when, for the assistance rendered to the Byzantine Government, they were permitted to supplant the Venetians at Constantinople, and to monopolise the commerce of the Euxine; and some years after their vessels were freighted with rich cargoes of Oriental goods, as well as with the furs and gold of Russia.

Genoa increased its riches by its manufactures of velvet, broadcloth, hosiery, lace, perfumes, and artistic work in gold, silver, and marble. It was the entrepôt for Switzerland, and the outlet for the produce of the fertile districts of Lombardy and Piedmont. Goods were sent inland to Germany, through Nuremberg, and also to Milan, the common depôt of Venetians and Genoese. In the height of its power it became covered with palaces, churches, and benevolent institutions, built of pure marble or of porphyry.

Genoese history is bound up with that of Pisa and of Venice. Jealous of the prosperity of other states, Genoa was always at feud. Between 1070 and 1282 four wars with Pisa occurred. They were a repetition of the Punic contests, and resulted in the extinction of the power of the Pisanese. The conflict with Venice endured for a period of 131 years. In 1351 the indecisive battle of Pera, a suburb of Constantinople, took place, when seventy-six Genoese galleys engaged seventy-four belonging to the Venetians, Catalans, and Greeks. Encouraged by the sympathy of the Pope, whose legate in the East was always the Bishop of Genoa, as well as by their own vigour, the Genoese fought again, when out of seventy galleys only nineteen remained to dispute for the further possession of the title of Mistress of the Seas. Finally, in 1381, the Genoese were compelled to succumb to the maritime ascendancy of their Venetian rivals.

During the financial difficulties caused by these long and protracted struggles, the government was frequently obliged to borrow money from the wealthy citizens, to whom the revenues arising from customs' duties were pledged in payment of the interest, and, if possible, in liquidation of the debt. These state creditors formed themselves into a company, with independent administration, known as the Bank of St. George, whose constitution, rights, and privileges, all officers of the Republic, previous to the assumption of their dignities, swore to maintain and respect. The capital or debt due by the State was divided into shares of 100 lire—which sum was called *luogo della republica*—and the management was entrusted to a committee of one hundred shareholders and a board of eight directors, chosen annually at a general meeting. When the power of Genoa in the East began to wane before that of Venice, the Bank of St. George undertook the defence of several of the colonial possessions for the general government. In 1546 the entire island of Corsica and the distant and important settlement of Kaffa on the Euxine were in the hands of this company. The latter fell under the rule of the Turks in 1474. With Corsica they were more successful; and, notwithstanding the irretrievable losses in the East, the Bank of St. George would probably have succeeded, through its commercial activity, in retrieving the falling fortunes of the city, had not internal dissensions ruined the independence of the republic.

The sources of the wealth of Genoa, as of Venice, were numerous. Its most important trade was westward with Normandy and Flanders, and eastward with the Euxine. Genoa, in its zenith, possessed Marseilles, Kaffa, Azof, Corsica, and Elba. Factions often rent the republic. In 1339 a doge, or supreme magistrate, was elected. Rivalry for this office led, during two centuries, to frequent strife, and subjected the state more than once to the power of its neighbours. Andrea Doria freed his country from the yoke of France, and changed the form of government to that of biennial doges, with an advising council, a system retained during the rest of its mediæval history.

In their contest with Venice, in the middle of the fourteenth century, the Genoese sought assistance from John Visconti, Duke of Milan. This was rendered, but at the cost of their civic freedom. The state never regained its independence. The Portuguese discovery of a new route to India was also seriously prejudicial to it, although it injured Genoa less than Venice.

PISA.

The citizens of Pisa were the early pioneers of the Italian Lombard commerce, and were distinguished as traders from the age of the Othos. The city was the third in importance amongst the commercial states of Italy, but the first to rise to eminence; and from the eleventh to the thirteenth century it was a small but prosperous republic. The foreign possessions of Pisa were Sardinia, Corsica, and the Balearic Islands, all of which were taken from the Moors. These conquests, and the aid the Pisanese had rendered to the crusaders, made their power respected, and their alliance sought both by the Genoese and the Venetians. We read of them as being at first leagued with the former against the latter, and as being bought off by the offer of mercantile privileges denied by Venice to other states. Thus they were allowed to trade with the Venetian possessions, paying only a quarter of the customary dues, and at Constantinople they shared on equal terms the privileges which the Venetians enjoyed. When Genoa succeeded Venice in influence at Constantinople, in 1261, the Pisanese had their privileges continued, in order to secure their co-operation, and to sever them from Venice.

During this flourishing period there arose in Pisa those marvellous edifices which made the city the school of European architects—the Dome, the Baptistry, the Leaning Tower, and the Arcades of the Campo Santo or Cemetery. The Brotherhood of Humility, a company partly ecclesiastical and partly secular, established also at this time Eastern trading settlements which materially extended the Pisan commerce. The bitter feeling against the Saracens eventually toning down, the ports of Barbary, Spain, and Sicily were filled with Pisanese merchantmen.

Trimming between Genoa and Venice, Pisa made real friends of neither. For two hundred years a growing envy had smouldered in the Genoese mind, and at length it burst forth into a flame. Both states raised armaments so prodigious that they read like fabulous exaggerations. The success which had crowned their contests with the Moors did not attend the Pisanese when opposed to Genoa. On every occasion they were met by a superior fleet, and in the final battle of Meliora 5,000 Pisanese fell, and 11,000 were taken prisoners, most of whom perished in chains. "If you wish to find Pisa," it was commonly said, "you must look for her in the dungeons of Genoa." The port of Pisa was destroyed by the Genoese, and the mouth of the harbour was filled up. From this reverse the republic never recovered. It was vain any longer to contend for empire. Her colonies fell rapidly, and her commerce dwindled away. One of the Visconti family usurped the dominion over the city, and subsequently sold it to Florence for 400,000 florins; and with this state, after a century of intermittent struggles, it became permanently united.

FLORENCE.

Florence, the capital of Tuscany, a part of the ancient Etruria, with but a scanty history till the end of the twelfth century, when Rudolf of Austria, the reigning prince, sold the citizens their freedom for £70,000, ultimately became one of the leading cities of Italy in luxury and wealth. Manufactures rather than commerce were the source of its riches, and the foundation of the fortunes of its most eminent citizens, of whom the Medici attained regal power, though without the name.

The industry of the free republic was directed and controlled by guilds or arts, seven of which were styled the greater guilds, and five (afterwards increased to fourteen) the lesser guilds. The seven greater arts were lawyers, bankers, physicians, merchants, salesmen, and two guilds of manufacturers. The lower arts were smiths, shoemakers, carpenters, masons, butchers, and others. The Pisanese at first acted as maritime carriers for the Florentines, but, urged by jealousy, eventually cut themselves off from this profitable trade. The Florentines then turned their own attention to ship-building, buying Livorno (*Leghorn*) of the Genoese as a convenient site for the purpose, and in the end they acquired an important commerce both by land and sea. Among their chief manufactures were woollens, silks, and jewellery, of which the first was pre-eminent. They possessed agencies everywhere, and acted as the exchangers or bankers of Europe. Their mercantile fleet consisted of twenty-six vessels—eleven large and fifteen small galleys—the sailing and return of which, as well as the nature of the cargo, were subjected to statutory regulations, after the example of Venice. The importance which their foreign trade attained was exemplified on the occasion of Boniface VIII. receiving the courtesies of foreign states on his elevation to the Papal chair, when twelve envoys out of the number proved to be citizens of Florence.

The name of the Medici is associated with science and art, letters and poetry, architecture, sculpture and painting, and with colossal wealth. As princes, they forgot their former thrift, and lost vast fortunes in commerce through the mismanagement of their agents. The expenditure of the family in thirty-seven years (1434—1471) in buildings and charities amounted, according to Sismondi, to 32,000,000 francs of our present money.

A simple and a correct taste distinguished the Florentines, and even when their virtue had degenerated, and their voluptuousness had become a proverb, they still possessed their fine appreciation of the beautiful.

Florentine dyers, especially of scarlet, were unequalled. French cloths were finished off at Florence. Scarlet stuffs alone employed 200 manufacturers, producing annually 80,000 pieces or rolls of cloth. Silk fabrics and tapestries, straw hats and artificial flowers, soaps, essences, and perfumes, lacquered ware, and artistic work in mosaic, metal, and alabaster, glass, musical, mathematical, and philosophical instruments, and carriages, were all products of Florentine genius and industry. In the chronicle of Benedetto Dei we meet with the following quaint contrast between Venice and Florence:—

"Know that we in Florence have two guilds, which are more estimable and noble than any in your city of Venice;—we mean the woollen and cloth manufacturers. They are known at the court of Rome as well as at that of Naples, in Sicily, and at Constantinople, Pera, Scio, Bursa, Gallipoli, Saloniki, Adrianople; and wherever the Florentines send their cloths, there they have banks, chambers of commerce, agencies and consulates. In silk wares, gold and silver stuffs, we make and shall always make more than Genoa, Venice, and Lucca together. Ask your merchants who frequent Marseilles, Avignon, Lyons, Geneva, Bruges, Antwerp, and London. They find everywhere respectable banks, splendid exchanges, estimable trade-societies, churches, and consulates belonging to the Florentines. Inquire at the banks of the Medici, Pozzi Capoui, Buondelmonti, Corsini, Falconieri, Pontinari, and as many other houses as would fill a hundred pages with their names. These houses do no trade in merceries, quinquillas, sewing-threads, fringes, rose wreaths, or glass-ware, but in ducats, brocade, and cloth. When you Venetians want to buy spiceries, cottons, and wax from Alexandria you must pay for them in hard cash. The Florentines give, on the contrary, their cloths and other stuffs in exchange for their commodities, which they, moreover, get still more conveniently from Bursa."

AMALFI.

The republic of Amalfi, a small state in Naples, had the singular fortune of uniting the ancient Roman refinement with the new civilisation of the Middle Ages. It rose, reached the height of its power, and declined, between the sixth and the twelfth centuries. Its career as a free trading state was brilliant, till checked by the arms of Roger Guiscard, King of Sicily; from this period its splendour was lost, though even to the present day it retains some trade. Its citizens were renowned as sailors, and took an active share in the crusades. The port extended its trade to Egypt, Syria, and Constantinople, and was a great mart of Eastern merchandise frequented by Africans, Hindoos, Arabs, and Sicilians. French cloths formed a large item in its trade. Amalfi, scarcely referred to as a commercial port after its capture, has its name often repeated in connection with interesting historical incidents. Its citizens founded in Palestine the Hospital of St. John of Jerusalem, from which the military order took its name. Flavio Gioja, a citizen, introduced or improved the mariner's compass. Justinian's Pandects, after having been lost for ages, are said to have been brought to light at the siege of Amalfi in 1137. Hallam, however, states that the discovery of the Pandects and the compass is falsely imputed to this state.

ANCONA.

Ancona, in the Papal States, was founded by the Syracusans about four centuries before Christ, and has ever been, next to Venice, the most considerable port on the Adriatic coast of Italy. Its early Eastern trade, chiefly with Cyprus, was supervised by a consul residing at St. Jean d'Acre. From the countries of the Levant it obtained raw cotton, spices, sugar, and alum, giving in return Florentine and French cloths, soap, and wine. At a later date, the area over which its commerce extended comprised Northern Europe, and the number of its imports and exports was greatly increased. Home produce, grain, hemp, pulse, linseed, fruits, wine, and oil; cattle, sheep, hogs, and cheese; manufactured goods of silk and leather; cordage, sail-cloth, wax, candles, sulphur, and verdigris, were articles of export. The imports comprehended manufactures, timber, dye-stuffs, drugs, salt fish, wool and wax, hardware and metals, some of which reached Ancona only in course of transit.

OTHER ITALIAN STATES.

The republics of Italy were so numerous in the Middle Ages, and their struggles and vicissitudes of fortune so frequent, that even to enumerate a few facts concerning each would be too long a task.

Bologna, Ferrara, Modena, Lucca, Milan, Mantua, Brixen, Como, and Verona must be passed with the briefest reference. These and other Italian cities prescribed customs' duties for themselves, and carried on trade. Many new manufactures were likewise established, the knowledge of these having been gained at Constantinople. In the year 1131 Roger Guiscard was crowned king of the Two Sicilies, at Palermo. He brought artisans from Athens, and founded a silk manufactory in this city in 1146. The sugar-cane was brought from China and planted in Sicily in the same century. The introduction of many plants and animals of economic importance, from their native habitats, about this period, widened the range of industry and trade. Under the name of Lombards, Italian capitalists were found in every European city, competing with the Jews as bankers and money-changers. A bankers' district of the city of London still retains the name of Lombard Street. All important as banking has been to society, its practice at first was held in as low esteem as pawnbroking. Bankers were in ill repute for the usury they exacted, arising from mutual ignorance of the principles that should govern the borrowing and lending of money. To charge interest on a loan was in feudal times thought wrong. Judging from the failures of the chief bankers of Florence, in consequence of the non-payment of enormous sums lent to our Edward III., it would appear that there were, earlier than Pistol, debtors who thought that "base is the soul that pays." In a similar spirit, St. Louis of France published an ordinance relative to the Jews, the predecessors of the Lombards in his dominions, whereby "for the salvation of his own soul, and those of his ancestors, he releases to all Christians a third part of what was owing by them to Jews." Louis at the same time claimed a per-centage upon the savings thus effected.

CHAPTER XX.—COMMERCE OF BARCELONA.

Barcelona, the chief town of the province of Catalonia, lays claim to a genealogy extending further back than the foundation of Rome. It was in turn a Carthaginian and a Roman colony. In the Middle Ages it was alternately the possession of Christians and Moors. In 1164 the whole province became absorbed in the kingdom of Aragon. As a commercial state, the history of Barcelona dates from the middle of the thirteenth century. At this period the Catalans began to emulate the enterprise of the maritime cities of Italy, both in war and commerce. Their vessels sailed to every part of the Mediterranean and other European seas. Barcelona was a formidable rival of Genoa, with which city it was engaged in frequent hostilities. Its rank was highest in the fifteenth century, when Venice alone exceeded its maritime power. It was the depôt of Eastern wealth for distribution in Christian Spain. After the conquest of the New World, Barcelona became the great manufacturing centre of cutlery and fire-arms for the Spanish adventurers, yet its commerce never attained such a magnitude as it had formerly reached. The privileges granted to the Catalans by the kings of Arragon were such as to secure to them almost the independence of a sovereign state. Personal liberty was so guarded, that no one could be arrested on board a ship for an offence, provided he offered security for his surrender to justice after the voyage. The Catalans became so experienced in shipbuilding, that other nations resorted to their dockyards for the purchase of merchant-vessels. They excelled the Genoese mariners in intrepidity, while as manufacturers they were especially expert and industrious. The nobles were as eager for the profits of commerce as the common people, and thus all ranks were united for the common benefit.

Barcelona possessed, besides its ship-yards and wharves (now unimportant from the deterioration of the harbour), a custom-house, a fine arsenal, foreign warehouses, manufactories, banks, and exchanges, where Jews and Lombards, French, Italian, and German traders, attracted by the enlightened spirit of its laws, carried on their business. Among others, we read in 1400 of fifteen Dutch and thirteen Savoyard houses of business.

Commerce rather than manufactures was the pursuit of this enterprising people. It would have been useless to compete in manufacturing industry with the skilful Moors of Seville, Toledo, Xativa, Malaga, Granada, and Almeria. Numerous guilds of artificers existed notwithstanding, and these proved invaluable to Barcelona after the expulsion of the Moors, making it then the most important manufacturing town in Spain. The manufactures consisted chiefly of woollen, cotton, and silk goods, lace, linens, paper, leather, and cordage.

Much of Catalonia was rocky and barren, but part was very fertile, producing cereals, flax, hemp, liquorice, madder, saffron, almonds, filberts, chestnuts, figs, citrons, grapes, olive-oil, and silk; of mineral produce, copper, lead, zinc, manganese, cobalt, with coal, nitre, rock-salt, barilla, and marble occurred. A good deal of wine was made, and there existed forests of the cork-oak as well as of timber fit for ship-building. Upon these foundations the Catalans built up a great commerce, extended by even a greater transport trade. They held intercourse with the Spanish ports of Valencia and Lerida. They possessed a Catalan quarter in the French markets of Beaucaire and Troyes, carrying thither especially Moorish or Morocco leather. They took cloth, saffron, and Eastern goods to Sicily, bringing away grain and silk. Their commerce with Barbary, Egypt, and Syria provided them with herbs, spices, drugs, raw and spun cotton, ivory, indigo of two varieties, carmine, gums, balsams, rhubarb, aloe-wood, coral, pearls, and porcelain brought by the Arabs from China. These commodities they again dispersed abroad.

Flanders, the principal centre of their trade with North Europe, received from them logwood, saffron, cotton-thread, dates, sugar, anise, lac, and furs. Their ships were shut out from Constantinople and the Black Sea by the opposition of the Italians, but with Cyprus, Rhodes, and Candia they had an extensive trade.

We owe to Barcelona the establishment of the first bank of deposit for the convenience of private merchants (1401), and also the earliest well-authenticated regulations for marine insurance, germs of which came under our notice in the history of Ancient Commerce.

RECREATIVE SCIENCE.—XXII.

THE WHEEL ANIMALCULE—BEALE'S DANCING SKELETON.

In the wheel animalcule both wheels move usually in the same direction; and when the head of the animal is towards the observer, the direction is generally the same as that of the hands of a clock. Baker states, however, that he has seen them move in opposite directions, and also has seen the motion first discontinued and then reversed in the same wheel. The velocity is not always the same, but varies with the efforts of the animal to catch its food. Whatever the mechanism of the parts, the result is that currents are established in the water towards the head of the animal, which currents pass off outward from the edges of the apparent wheels; and little particles floating in the water may be seen to pass towards the head, and be suddenly thrown off at the edges of the wheels with considerable force. So striking are the appearances of these animalcules, that men of much practice in microscopical observation are at this day convinced they do possess wheels, which actually revolve continually in one direction. The struggle in Mr. Baker's mind between the evidence of his senses and his judgment illustrates this point in so lively a manner, that we may be excused quoting his account of it:—"As I call these parts *wheels*, I also term the motion of them a rotation, because it has exactly the appearance of being such. But some gentlemen have imagined there may be a deception in the case, and that they do not really turn round, though indeed they seem to do so. The doubt of these gentlemen arises from the difficulty they find in conceiving how or in what manner a wheel or any other form, as part of a living animal, can possibly turn upon an axis supposed to be another part of the same living animal, since the wheel must be a part absolutely distinct and separate from the axis whereon it turns; and then, say they, how can this living wheel be nourished, as there cannot be any vessels of communication between that and the part it goes round upon, and which it must be separate and distinct from? To this I can only answer that, place the object in whatever light or manner you please, when the wheels are fully protruded they never fail to show all the visible marks imaginable of a regular turning round, which I think no less difficult to account for if they do not really do so. Nay, in some positions you may with your eye follow the same cogs or teeth whilst they seem to make a complete revolution; for the other parts of the insect being very transparent, they are easily distinguished through it. As for the machinery, I shall only say that no true judgment can be formed of the structure and parts of minute insects by imaginary comparisons between them and larger animals to which they bear not the least similitude. However, as a man can move his arms or his legs circularly as often as he pleases by the articulation of a ball and socket, may not there possibly be some sort of articulation in this creature whereby its wheels or funnels are enabled to turn themselves quite round? It is certain all appearances are so much on this side the question, that I never met with any who did not, on seeing it, call it a *rotation;* though, from a difficulty concerning how it can be effected, some have imagined they might be deceived. M. Leeuwenhoek also declared them to be *wheels* that *turn round.* (Vide *Philosophical Transactions*, No. 295.) But I shall contend with nobody about this matter: it is very easy for me, I know, to be mistaken, and so far possible for others to be so too, that I am persuaded some have mistaken the animal itself, which perhaps they never saw; whilst, instead thereof, they have been examining one or other of the several water animalcules that are furnished with an apparatus commonly called wheels, though they turn not round, but excite a current by the mere vibration of fibrillæ about their edges."

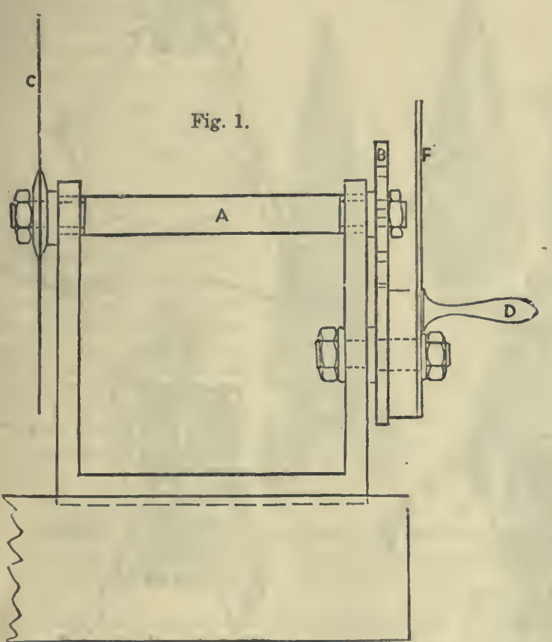


Fig. 1.

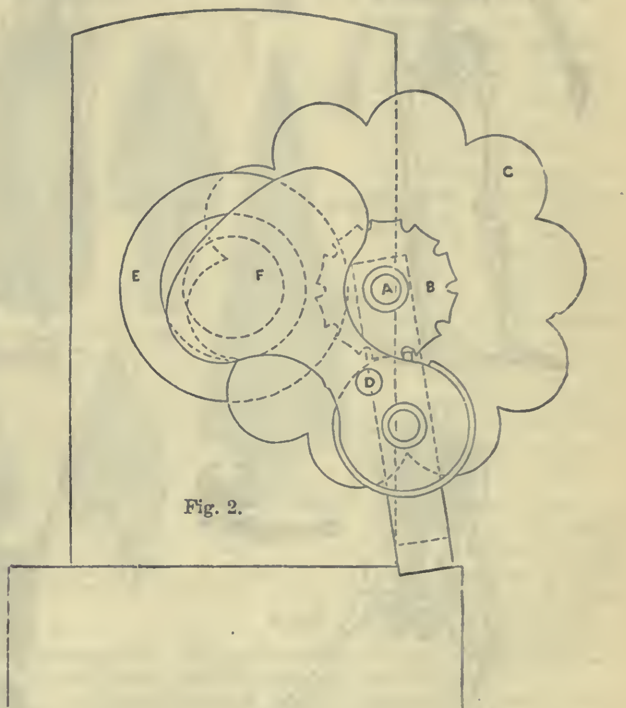


Fig. 2.

Notwithstanding the evidence adduced by Mr. Baker, which, as we have said, is admitted by some at the present day, it must be evident, from a consideration of the nature of muscular force and the condition of continuity under which all animals exist, that the rotation cannot really occur. The appearances are altogether so like some of those exhibited in the experiments with cogged wheels, that we feel no doubt the wheels must be considered not as having any real existence, but merely as *spectra*, produced by parts too minute, or else having too great a velocity, when in use by the animal, to be themselves recognised. It is not meant that they are produced by toothed or radiated wheels, for that supposition would take for granted what has already been considered as impossible—continued revolution of one part of an animal whilst another part is fixed; but arrangements may be conceived which are perfectly consistent with the usual animal organisation, and yet competent to produce all the effects and appearances observed. Thus, if that part of the head of the animal were surrounded by fibrillæ, endowed each with muscular power, and projecting on all sides, so as to form a kind of wheel; and if these fibrils were successively moved in a tangential direction rapidly the one way, and more slowly back again, it is evident that currents would be formed in the fluid, of the kind apparently required to bring food to the mouth of the animal; and it is also evident that if the fibrils, either alone or grouped many together, had any power of affecting the sight, so as to be visible, they would be less visible at the part through which they were rapidly moving than that through which they were slowly returning; and at that place, therefore, an interval would appear, which would seem to travel round the wheel, in consequence of the successive action of the fibrils. But if, instead of the whole group of fibrils acting in succession as one series, they were to be divided by the will or powers of the animal into fifteen or sixteen groups, the action being in every respect the same, then there would be the appearance of fifteen or sixteen dark spaces, and as many light ones, disposed as a wheel; and these would continue to travel round in one direction, so long as the animal continued the alternate action of the fibrils. This may be illustrated by supposing it to represent a fixed circular brush with long hairs, and the little dots to be the sections of so many wires forming the arms of a frame which, when turned round, shall carry the hairs of the brush forward a little, and then, letting them go, allow them to return quickly to their first position. If this frame be turned continually round, it would cause the brush, when looked at from a distance, to appear as a revolving toothed wheel, although in reality it had no circular motion. Now, what is performed here by the wire arms at the outer extremity of the hairs, and the natural elasticity of the latter, may in the wheel animalcule be effected at the roots of the fibrillæ by muscular power; and in this or some similar way the animal may have the power of urging the current necessary to supply food, and at the same time producing the spectrum of a continually revolving wheel, or even the more complicated forms discovered by Leeuwenhoek, without requiring any powers beyond those which are within the understood laws of Nature, and known to exist in the animal structure.

It may be observed in the previous papers how much ingenuity has been displayed by the various inventors—viz., Paris, Plateau, Rose, and Beale—in the construction of instruments, all of which illustrate the phenomena, simple or complicated, of the duration of impressions of light upon the optic nerve. In two very marked instances we have found Dame Nature has been before the earliest human inventor—in the splendid meteors of the skies, and the tiny creature called the wheel animalcule. Still, however, the subject seems inexhaustible, and another addition has been made to the contrivances for producing apparent motion in the very ingenious and most perfect apparatus invented by Mr. John Beale, and adapted for use in the oxy-hydrogen lantern. The illusion called "The Dancing Skeleton," which has created quite a furore whenever shown by the writer, in his optical lectures, consists, as shown in Figs. 1 and 2 (representing the two most important positions of the instrument), of a shaft A, carrying at one end the intermittent motion-piece B, and at the other end of the shaft a disc of aluminium C, selected for its lightness. This circular piece of metal has the figure of the grisly King of Terrors cut through it in any number of positions; in fact, they constitute admirably designed stencil plates of the various movements that might be made by a skeleton if worked by mechanical means, as by threads in the ordinary exhibition of Marionette figures, six of which are shown in Figs. 3, 4, 5, 6, 7, and 8. The number of positions, say ten, correspond to the divisions of the piece B. With the handle D (Fig. 1) the pictures of the skeleton are successively brought into position before the condensing lenses of an oxy-hydrogen lantern E (Fig. 2); and in order to prevent any motion being perceptible, which is usually so injurious to optical deception of this class, the "*Intercepter*," F (Figs. 1 and 2), cuts off the light during the motion. The light which passes through the aluminium disc plates, and which represents the figures of the skeleton, is properly focussed and thus sharply defined on a white screen by proper lenses; and the general effect produced by causing the skeleton to rise in another view already on the white screen, representing a churchyard or a vaulted chamber, is perfectly magical in effect, and far surpasses any mere painted slides which might be used to represent a scene such as the grand incantation scene of Der Freischutz. There is also a grotesqueness in the movements, which deprives the exhibition of any alarming effect on the juvenile mind, whilst the ingenuity of the apparatus in producing such complicated movements in a figure projected on to a white screen, interests the more sober part of a mixed audience.

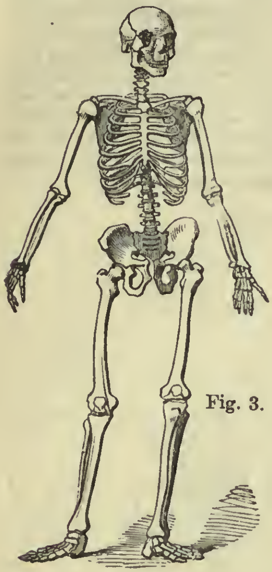


Fig. 3.


Fig. 4.

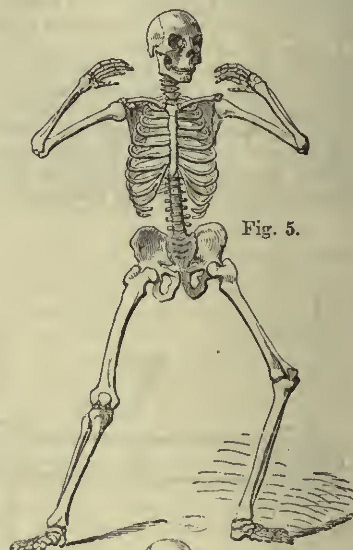


Fig. 5.

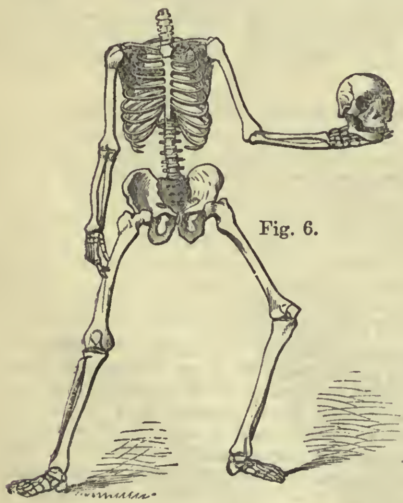


Fig. 6.


Fig. 7.

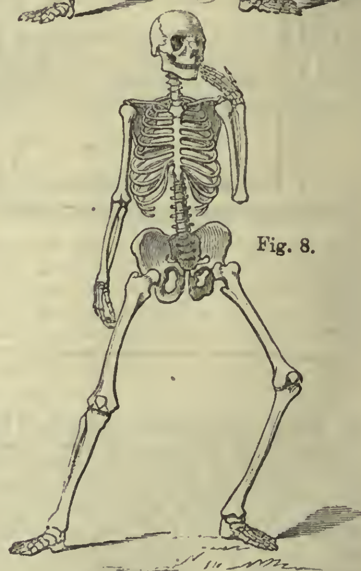


Fig. 8.

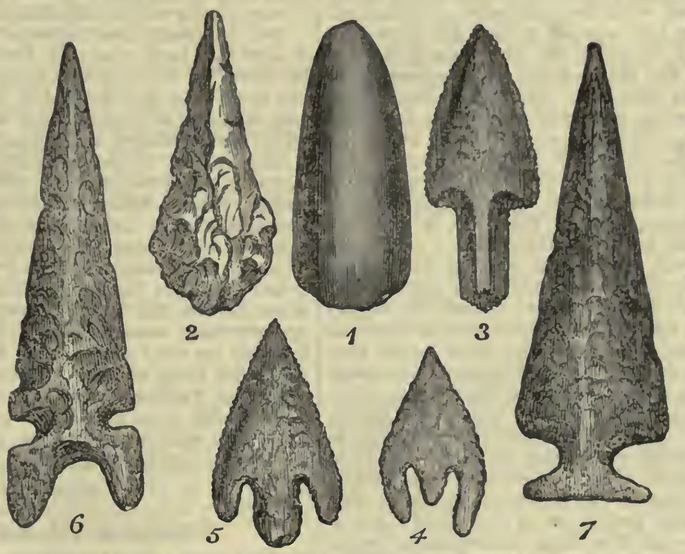
LESSONS IN GEOLOGY.—XXVII.

POST-TERTIARY OR RECENT PERIOD—CONCLUSION.

Every accumulation which has been gathered together by any agency since the times of the Glacial period, belongs to the Recent or Post-tertiary age. No agent has laid down its power and ceased to work; everything now goes on as in the times we have been passing through, times whose years we may count by ages. Solomon was wise, and perhaps said more truth than he at all suspected when he wrote, "There is nothing new under the sun." So that we may define the Post-tertiary system—if a system it can be called—as that geological work done since the times of the ice and glaciers of the Pleistocene period.

The *Rivers* have made deltas, they have scooped out valleys, and worn down rocks into beds of gravel. For their powers of delta-making we must refer the reader to our early lessons, in which the work done by the Ganges and Mississippi is specially noted. Frequently the river, in excavating a valley, leaves behind it evidences of its labour in *river-terraces*. These are lines of gravel running along the valley-sides at different heights; but there are always corresponding terraces on each of the facing hills. These terraces mark an old water-level, at which for some time the water stood. It may have been that the valley was blocked up and the water stood at that height, forming a lake, when suddenly the embankment gave way and the water fell to a lower level. The gravel represents the ancient beach. Or if the upheaving movement ceased, the river would run at that level for an unusually long period, and when the land again began to rise the current would be increased, and the erosion of the valley re-commence with renewed activity.

These river-terraces, as we shall see, are made peculiarly interesting by the remains of animals and man which they preserve for us.



Arrowheads:—1. Miscarn, Desertmartin, Co. Derry. 2. Valley of the Somme. 3. Meelahans, near Tullymore. 4, 5. Ireland. 6. Peru. 7. North America.

Closely allied to the river work are the *Lake* or *Lacustrine Deposits*. These are either now in process of being accumulated, or are deposits of mud and silt, intermixed with vegetable drift, which occupy the area once covered by the lake water; the lake either having been drained by the upheaval of the land, or the hollow which contained its water having been filled up by the débris carried down by the river which supplied it. These deposits contain many skeletons of land animals, together with fresh-water shells, and not unfrequently evidences of the existence of man.

Similarly, the present work of the sea is to be sought in deposits now in course of being made. Of these, recent dredging has given us some knowledge, though necessarily we are in all but ignorance of the subject. In many places the coast-line has been greatly altered by the encroachments of the sea, or by the additions made to it by the deposits left by the water. Tyre and Sidon, the oft-mentioned sea-ports of Scripture, are now several miles inland. We owe to the sea, as a recent gift, the fens of Lincolnshire and Cambridge, the 300 miles of Humber "warp." Other countries are far more indebted; Holland and Denmark are well nigh wholly the product of the German Ocean, deposited in the last of geological periods.

The *Volcanoes*, now in action, also add their quota to "recent" productions in the beds of lava, scoriæ, and ashes which they have ejected during the "Post-tertiary" period.

Antiquity of Man.—But by far the most interesting subject this period introduces to us, is the appearance of man on the earth. It is evident that we shall be warned of his existence either by the discovery of human skeletons, or by finding indications of his presence in some of his works.

We shall speak of the latter first. The works of the earliest members of our race, of whom we have at present found any record, are always the knives, arrow and spear heads, hatchets, hammers, which are the essential implements of savage life. The material and workmanship of these tools mark the successive stages of civilisation through which our forefathers passed. The earliest instruments are of stone; then, as men gained experience and discovered the rudiments of metallurgy, bronze, an alloy of tin and copper, took the place of stone; and as civilisation still further advanced, and the more difficult exploit of reducing iron from its ore was achieved, the bronze gave way to the more useful iron.

The ages in which these successive stages were in progress are termed the Stone age, the Bronze age, and the Iron age.

In the stone age there is also a marked progression. The earliest implements were made of flint, chipped into the required shape by hand. The regularity of the arrow and spear heads is often remarkable; but flint is more readily worked than at first might be supposed, and there are now many men in England who are adepts in chipping flint, and producing stone implements which are palmed off upon the credulous public as the handiwork of our savage ancestors. Although it may appear strange, it is said that the flint chips more readily when worked with another flint than if an iron tool be used; so that we need not be surprised at the clever specimens of stone handicraft preserved for us in the gravels and cave deposits of the Post-tertiary period.

In due time, however, the plan of grinding the flints was resorted to, and the consequence is that the implements at the latter period of the stone age exhibit more skilled workmanship. This improvement in the stone implements has divided the age into *Neolithic* and *Palæolithic* ages.

The *Palæolithic* age is the older portion of the stone period, and is marked by the hand-chipped flints. The ancient people who fabricated these implements lived in Northern France and in the south of our island. In the river gravels of Abbeville and Amiens, in 1847, M. Boucher de Perthes found many specimens of their handicraft. These beds of gravel vary in their height above the present bottom of the valley from 20 to 200 feet. This depth indicates the amount of scooping work the river has done since these ancient occupiers of the country pitched their wigwams on its banks. These tools are usually bleached by long exposure to the air, or they are stained with the same yellow tinge which pervades the gravel-bank, and sometimes crystalline incrustations of carbonate of lime appear upon their surface. Their edges are blunted either by wear or by the rolling action of the water, and they are usually found at depths of fifteen to twenty-five feet from the surface.

The fact that the Somme has excavated as much as 200 feet of valley since the people of the early stone age hunted upon its banks, may impress us with some notion of the lapse of time since that very remote period, yet the positions in which similar rude flint instruments are found in England carry our minds yet more forcibly back into the long past. On the tops of the hills in South Hampshire, and in the north of the Isle of Wight, masses of gravel are found. These detached beds are evidently but remnants of a great deposit of drift resting on the

Eocene Tertiary strata. In this gravel are blocks of sandstone, some twenty feet in circumference, and to account for their presence at some distance from their mother rock, we must have recourse to the agency of ice. It is in this gravel those numerous specimens of stone tools, precisely similar to those of the Somme valley, have been found. Hence, when these Palæolithic men inhabited our island it was amid the ice and snow of an Arctic region, or at least in the proximity of glaciers and ice-fields; and since the time of their existence the Southampton river, the Avon, and the Stour have begun their course, and gradually worn for themselves their present valleys; and probably the Isle of Wight was then part of the mainland. But not only have their hunting grounds passed away, but many of the animals they chased are now extinct; the bones of the mammoth, the woolly-haired rhinoceros, the reindeer, the Norwegian lemming, are all associated with the flint weapons. These animals have all an Arctic relation—the two first have never been known alive in historical times. In the valley of the Somme the hippopotamus and the musk-ox are also found, indicating a somewhat more genial climate.

For a long time geologists refused to entertain the notion that man was co-existing with the mammoth; but now all doubt upon the subject has been set at rest, for more than 3,000 flint instruments belonging to the Palæolithic age have been discovered. The south of our island appears to be the highest latitude then inhabited. Probably all Scandinavia was under ice. As, however, the causes which made the whole of Europe as far as the 40th degree of latitude an Arctic region during the Pleistocene period gradually declined, the more genial climate crept northwards, bringing man with it. Throughout the whole of Scandinavia, although quantities of flint instruments are found, none of them are of the rude Palæolithic type, but all belong to the *Neolithic* age, being ground and better shaped. Along the coast of the Danish Islands are mounds from three to ten feet high, and some of them as many as 1,000 feet long. These mounds are rightly termed *kitchen-middens*, being in reality refuse heaps where the savages threw the shells of the mollusks upon which they existed. Being in close proximity to their huts, it is natural that they should contain many remnants of their savage life—burnt bones of the animals they cooked, their stone knives, spears, etc. Sometimes bone and horn implements are found in great numbers. The animals with which they were associated are all still living in Europe, with the exception of the beaver. However, the dog alone seems to have been domesticated. This fact, and fragments of rude pottery, go to prove that a step in the progress of civilisation had been taken. These ancient people have reminiscences of their existence also preserved to us in *peat-mosses*, and in Denmark the successive ages are strikingly marked. In the lower beds of peat the stone weapons occur side by side with roots of the Scotch pine, a tree which has never been known in Denmark in historical times; higher up in the same bog, bronze instruments are found; but now the pine has become extinct, and the oak takes its place. Still nearer the surface the bronze gives way to the iron age; but during that bronze age the oak growth waxed and waned, and next the beech tree, which now flourishes in Denmark, occupied the country. Let the long years which it must take for the growth of generations of forest trees to wear itself out, tell the years which measure those ages of stone, and bronze, and iron.

An interesting and singular repository of these ancient relics has lately been discovered in Switzerland. It seems that it was the custom of the ancient inhabitants of the Swiss valleys to construct their villages on piles driven into the bottom of the lakes, when the water was not more than fifteen feet deep. No fewer than 150 of these lake-villages have been discovered. Being surrounded by water, the inhabitants were secure from wild beasts, and in some measure safe from sudden attacks of their enemies. By dredging in the ooze great numbers of articles have been found. Some villages are exclusively of the stone age, others of the bronze, others have been inhabited successively by people of both ages. Amongst other things dredged up from the stone age settlements, are charred corn and bread. This proves that the people of even this early period cultivated cereal crops. During the bronze age no coins have been discovered, but the pottery occasionally bears the mark of the potter's wheel. Many animals were domesticated, and gold, amber, and glass were used for ornaments. From the size of the sword-handles and the bracelets it is concluded that the people of the stone age were smaller than the present inhabitants of Northern Europe.

Of *Human Skeletons* we need say little. During the stone age the mode of burial seems to have been in rude coffins of undressed stone. The skull is remarkably round and small. This type is most nearly approached in the Laplander. He may be the survivor of the people of the stone age, having followed the edge of the ice as it gradually retreated northwards. He now occupies the Arctic regions, which in the times of his forefathers stretched southward to the Isle of Wight. During the bronze age the fashion of burial changed, and they burned their dead, so that we have no human remains of this period. When the iron age dawned the sepulchral burial was again resorted to, and now we find that the skull has become larger and longer.

The floors of caves have proved the richest repositories of human remains; but owing to the fact that the cave may have been occupied or used as a burying-place in comparatively recent times, it does not necessarily follow that human remains lying side by side with the bones of extinct animals belonged to a human being who lived contemporaneously with those animals.

Out of the numerous fragments of skeletons which from time to time have been unearthed, Professor Duncan concludes that the lower jaw found in the Cave of La Naulette, the skull from the Engis cave, and the jaw of the Grotto des Fées are "the only examples of human bones which can bear criticism, and which can be referred to the mammoth age."

This subject of the antiquity of man is of the greatest interest; but as yet no safe conclusions can be drawn as to the length of time which has elapsed since the period of the Palæolithic man. In our opening lesson (Vol. IV., p. 159) we asserted that though the Bible does not, and was never intended to, contain *all* truth; yet whatever it does contain *is* truth, and the day must yet come when the perfect coincidence between the Book of Nature and the Book of Grace, in matters which concern both, will be made apparent. And if that day has not a place in time it will have in eternity, when God shall bring to light "hidden things," and we, untrammelled by "villain bodies"—bodies of serfdom—shall roam through the fields of Nature, and, devoid of many of the hindrances which now beset our path of observation, the more readily arrive at truth and gather for Him garlands of praise.

LESSONS IN ENGLISH.—LV.

SYNTAX OF THE PREDICATE: THE VERB—THE OBJECT.

I MUST now conduct you to the predicate of a simple proposition. In order to effect my purpose, I must modify our model sentence a little, as thus:—

SUBJECT.	PREDICATE.
The sick man	drinks a beverage made of wine and water.

The sentence thus altered brings under our notice two additional parts of speech, namely, the preposition (*of*) and the conjunction (*and*). It also directs our attention specifically to government, namely, in the relation borne by the verb *drinks* to the noun *beverage*, and in the relation borne by the preposition *of* to the noun *wine* and the noun *water*.

If now we look at our predicate, we find that it may be divided into two parts, namely, the verb and the object; as—

SUBJECT.	PREDICATE.	
	Verb.	*Object.*
The man	drinks	a beverage made of wine and water.

Viewed in relation to its several components, the predicate contains the verb *drinks*; the article *a*; the nouns *beverage*, *wine*, *water*; the past participle *made*; the preposition *of*; finally, the conjunction *and*. The articles have been already handled. The nouns, the verb, and the preposition range themselves under the general head of government; the past participle offers an instance of agreement; the conjunction acts merely in the way of combination.

GOVERNMENT—THE OBJECT AFTER A VERB.

Every transitive verb has an object, expressed or understood, and the same verb may sometimes be used transitively or intransitively. If no specific object is given, the verb may be considered intransitive; as—

Intransitive.—Man drinks; the horse trots;
Transitive.—Man drinks *water*; the horse trots *ten miles* an hour.

The verb *drinks* may be resolved into these terms, *is drinking*; as in this example:—

The sick man *is drinking* a beverage;

whence we learn that present participles have the same government as the verbs to which they belong.

Intransitive verbs, though in general incapable of an object, may take an object in a noun of kindred meaning; as—

"Let me *die the death* of the righteous." (Numb. xxiii. 10.)

Intransitives have the force of transitives also in certain idiomatic phrases; as—

"They laughed him to scorn." (Matt. ix. 24.)

THE OBJECT.

The object of a proposition may, as we have seen, appear in a variety of forms. The object also assumes several shapes. The chief variations may be presented as follows:—

The object of a proposition may be either

1. *A Noun.*—The man drinks *a beverage.*
2. *A Pronoun.*—The man calls *me.*
3. *A Noun and an Infinitive.*—The man bids *his son remain.*
4. *Two Nouns.*—He teaches *his son Latin.*
5. *A Proposition.*—The man declares *he is ill.*

If dependent on the verb—that is, if it receives the action of the verb—the noun is the object of the verb; as—

"Preventing *fame*, misfortune lends him *wings*;
And Pompey's self his own sad *story* brings."—*Rowe's* "*Lucan.*"

Equally simple is the case of a pronoun viewed as the object of a verb; as—

"Did I request *thee*, Maker, from my clay
To mould *me* man?"—*Milton.*

The construction of a noun and infinitive as the object of a verb may be slightly varied. For the noun a pronoun may be substituted; as—

The man bids *me* remain.

Before most verbs thus related the preposition *to* is placed; as in this example:—

The man commands his son *to* remain.

In this sentence it is clear that the words "his son to remain" form a compound object, and are in the same relation to the verb as the single noun *army* in the ensuing sentence:—

The man commands an *army*.

In the previous sentence, *son* is at once the object (or part of the object) to the verb *commands*, and the subject of the infinitive *to remain*; *son*, therefore, may be considered as the objective case before the infinitive *to remain*.

The object, "his son to remain," may be enlarged, thus:—

The man commands his son and *daughter* to remain.
The man commands his *only* son to remain.
The man commands his son *forthwith to go home and remain there.*

All these constructions, and others of a similar kind, hold to the verb the same relation that I have indicated, that is to say, they are severally the objects to the verb *commands*. These objects are compound, and being compound, they may be resolved into their component parts, and the relations set forth which those parts bear to each other, as well as that which they bear to their common head, the verb *commands*.

Instead of the second object, a noun might be given, as—

The man teaches his son Greek.

Here the noun *Greek* (that is, the Greek language) holds to *teaches* the relation which *to remain* holds to *commands*. It is not every verb, however, which has after it two nouns as objects. But as in Latin, so in English, verbs which signify *to learn* and *to teach* may have dependent on them two separate objects.

In some instances where two objects appear after a verb, the construction is in reality elliptical; for example—

He gave his son a book;

that is, in full—

He gave a book *to* his son.

You will now have the less difficulty in understanding how a sentence may be the object of a verb; as—

The man says (that) *he is ill.*

The words *he is ill* you will at once recognise as a sentence or statement, and a little reflection will show you that the sentence bears to the verb *says* the relation of an object to its verb. The conjunction *that* is merely an explanatory word, or, indeed, an expletive.

A sentence as the object of the verb may also be enlarged:—

The man says he is sick *and likely to die*
The man says he is sick, *and has been given over by the faculty for a long time.*

The compound object in our model sentence will now be readily understood, namely—

The man drinks *a beverage made of wine and water.*

In this compound object, which consists of the words in italics, analysis shows us a noun, *beverage*, depending on the verb *drinks*; a participle, *made*, agreeing with *beverage*, and therefore conjointly with *beverage* dependent on *drinks*; a preposition, *of*, connecting *made* with *wine* and *water*; a noun, *water*, dependent on the preposition *of*; a conjunction, *and*, connecting *water* with *wine*; and, finally, another noun, *wine*, connected with *water* and the preposition *of*, and consequently standing to the preposition *of* and to the sentence generally in the relation held by the noun *water*.

I must subjoin a few words respecting the object.

Observe, then, that *wine* and *water* do not hold to *drinks* exactly the same relation which the words "his son Greek" hold in the above example. If so, a verb might be said to have several objects: for example:—

The man bequeathed *money*, *wine*, *books*, and *land*.

It is true that the nouns form the object to the verb *bequeathed*, but they are a compound object made by *repetition*; whereas in the proposition

The man taught his son Greek,

the compound object is formed by *addition*. And in the construction which assigns to certain verbs a double object, one of those objects is a person, the other is a thing. Double objects, like single ones, may be augmented by repetition; as—

The man taught his wife, his sons, and his daughters Greek.
The man taught his son Greek, Latin, German, and French.

The position of the object is after the verb. And the observance of this law is in English so imperative that by disregarding it you create ambiguity, if you do not change the object into the subject and the subject into the object; as—

SUBJECT.		OBJECT.	SUBJECT.		OBJECT.
The father	struck	the son	The son	struck	the father.

As an instance of ambiguity from the inversion of the object, take this instance:—

"This *power* has *praise* that virtue scarce can warm,
Till fame supplies the universal charm."—*Johnson.*

Which is the subject, and which the object? Do you mean that *power* has *praise*, or that *praise* has *power*?

PREPOSITIONS.

The preposition is intimately connected with two other parts of speech, the verb and the noun. The relation of the verb to its object, or of the doer and the doing to the thing done, is often expressed but imperfectly by the verb. Thus, when I say *I go*, I make a merely general statement; if I wish to give specific information, I say—

I go *from* the city *into* the country.

It is not every object, however, which requires a preposition. When I say—

I pull the boat,

boat stands in immediate dependence on *pull*, and neither has nor needs any preposition; but if I add a second object with that object, I (for the most part) employ a preposition; as—

I pull the boat *from* the shore.

The verb and preposition may indeed be regarded as one word—thus, *to come-from*, *to go-to*—when by means of the several suffixes a modification of meaning is in each instance caused. These intransitive verbs thus supplemented become transitive, that is, have an immediate object, for we can say—

I come-from Bath; I go-to Bath, etc.

The preposition is thus seen to stand between the verb and its object in order to assist the former in the expression of the latter. As, however, the object stands in immediate dependence on the preposition, and only in remote dependence on the verb, so we may frame the rule thus :—

A noun as an object may be dependent on a preposition;

or thus :—

A preposition may govern a noun as its object; as—

"Ah ! who can tell the triumphs *of* the mind,
By truth illumined, and *by* taste refined?"—*Rogers.*

We have already seen that an infinitive mood may be the object of a verb in the finite mood; as—

I love *to wander,*

where *wander* is an infinitive governed by *I love.* Now, instead of *to wander* you may supply a noun and say—

I love *wandering,* or I love *a stroll.*

The preposition *to,* you thus see, connects its object with a transitive verb, when that object is a verb. The preposition in such cases is a connecting word, but a connecting word which is essential to the import. That it is essential you may learn by removing it; thus, *I love, wander.* Here, too, the object *wander* is in immediate dependence on *to,* and only in remote dependence on *I love;* consequently, we may say that

The latter of two verbs connected together by the preposition TO *is dependent on, or governed by, that preposition.*

We may also lay it down as a fact that

The preposition TO *stands before a verb when it is used in its most general application, or in the infinitive mood.*

Now a verb so used is in meaning very near to the noun. It is, indeed, a verbal noun; as—

To learn to die is the great business of life.

Usage allows the preposition *to,* thus employed, to be in one kind of sentence strengthened by another preposition, namely, *for,* which, however, has its own object; as—

"For us to learn to die is the great business of life."

The preposition *for* thus set at the beginning, followed by an infinitive, forms a clause or member which is the subject of the finite verb.

As prepositions govern nouns, so may they govern whatever stands as, or is used with, the force of a noun, and consequently prepositions may govern (1) *A present participle used as a noun;* as, "He accused the boys *of fighting.*" (2) *A present participle and a noun;* as, "He accused the soldiers of *being cowards.*" (3) *A present combined with a past participle;* as, "He accused the soldiers of *having been cowards.*" (4) *A clause of a sentence or a phrase;* as, "He accused the troops of *having acted in a cowardly manner.*"

Prepositions in general stand before the nouns they govern, but by poetic licence they may be placed after; as—

"Wild Carron's lonely *woods among.*"—*Langhorne.*

In verbs used with separable prepositions, the preposition, when separated, may stand after its object, and even at the end of the sentence :—

"This you pride yourself *upon* and *this* you are ruined *by.*"

In some phrases the preposition follows the noun; as—

"Civil and religious liberty *all the world over.*"

Ellipses of prepositions have given rise to idiomatic phrases; as in this example :—

We rode (*over*) sixty miles (*on*) that day.
This looks very like (*to*) a paradox.

Like, near, next, and other adjectives and adverbs, are used with an object immediately dependent on them :—

"And earthly power doth then show *likest God's*
When mercy seasons justice."—*Shakespeare.*

Care must be taken not to confound prepositions with adverbs, especially with regard to the words which are used both ways. *Before* is an instance; as—

Adverb.—She entered before.	*Preposition.*—She entered before *me.*

You may ascertain whether in any particular case *before* (and similar words) is an adverb or preposition by considering what it goes with, a verb or a noun; as—

The king came near.	The king came near *the city.*

In the first place, *near* does no more than qualify *came;* in the second, *near* governs *the city.*

The prepositions *between* and *among* have specific meanings, and should be used accordingly. *Between* (twain, *two*) is *by two,* that is, two individuals, or two sets or classes of individuals. *Among* denotes distribution to several :—

He divided the apple *between* his *brother* and *sister.*
He divided the apples *among the children.*

Among differs from *in* in this, that while *among* denotes distribution, *in* denotes presence in a place, and so requires its object to be *one,* one individually, or one collectively; as—

In a great nation many are found *among* whom charity may find deserving objects.

POLITICAL ECONOMY.—III.

BY J. E. THOROLD ROGERS, M.A.

LABOUR AND WAGES.

A VERY slight acquaintance with the physical nature of man informs us that the continuance of his life is surrounded by a number of very strict conditions. He must breathe, eat, drink, be housed and clothed, and he must be supplied with these necessaries regularly. If his supply of air be withheld for a very few minutes, his food and drink for a very few days, clothes and shelter (in most parts of the earth at least) for a very few weeks, he would perish. Unlike any other living creature, too, he passes through a very protracted nonage, during which he needs the care and protection of others in order that he may subsist. During his whole life (though familiarity with the fact makes it less plain and obvious) he finds that the regular supply of his wants depends entirely on the mutual assistance which men give their fellow-men. By himself, as Bastiat has said, his needs are far in excess of the power of satisfying them; in the social state the supply is far in excess of his wants.

Ordinarily, one of the things which he wants is rendered to him so plentifully that he need be at no pains to procure it. Air, the first necessary of life, is dispersed everywhere by reason of certain physical laws. If, indeed, he gets into some place where these laws do not operate, or operate imperfectly, he would have to take pains to procure air, or to get some one to take the pains for him. If he goes to the bottom of the sea in a diving-bell, air must be pumped downwards to him; if he works in a deep mine, he must—in order to prevent the air from being vitiated—get it constantly changed or circulated. But, except under these circumstances, he gets air without trouble. And, similarly, he generally gets water without charge unless he dwells in a large town, the dense occupation of which either cuts off the local supply altogether, or renders it unwholesome. Everything else gives him trouble or labour before he can be supplied with it. If he lives, as some savage tribes live, by hunting, he gets his food only by great exertion and skill, and he gets it precariously. If he tames and keeps cattle, he has to find them pasture and protect them, and to use the produce of his herd or flock by the exercise of his labour. If he lives on the fruits of the earth, and on grain, his labour, though its products are vastly more abundant, is still more unremitting and continuous.

The demand for useful things, which cannot be procured without the expenditure of labour, constitutes the value of such things; and the amount of value—the proportionate quantity of other things also in demand and produced by labour, which any one thing can procure—is generally settled by the cost which the persons who produce it are, as a rule, put to before they can get it. There are objects which occasionally are of higher value than the labour required to get them in the first instance, and there are objects which are of lower value. For example, fifty books printed by Caxton or De Worde would bear a value at present which is wholly disproportionate to the original cost of making the paper, setting up the type, and printing the volumes. And on the other hand, fifty volumes of sermons printed a century ago would, if they could find a purchaser, sell for much less than their original cost of production.

The value of an article, then, depends, as a rule, on the labour expended on getting it. The reason why, weight for weight, a pound of gold is worth about fifteen and a half pounds of silver, is that it takes on an average fifteen and a half times as much labour to get a pound of gold as it does to get a pound of silver. The reason why a pound of wheat, when the quarter is worth 50s., is worth about two ounces of mutton, is that it takes eight times as much cost to get a pound of mutton as it does to get a pound of wheat. And the same rule holds good in the value of such services as a man renders another man. The reason, in general, why, if we assume that a physician on an average gets £800 a year for his services, and an engine-driver gets £100, this different value is assigned to their several services lies in the fact that on an average it costs eight times as much to make a physician fit for his work, as it does to make an engine-driver competent to perform his. Here, then, is a rule of general application, the exceptions to which virtually prove it, because the reason why they are exceptions is plainly apparent, that in all objects in demand the value of the article is relative to the cost of producing it; or, in other words, that value is the result of labour; and assuming that all labour is exercised with equal intelligence and precision, that difference of value in different objects is due to the comparative amount of labour *condensed* in them.

It will, however, be convenient to explain the exceptions to this rule, and at this place. Two things are requisite before value can be assigned to any object or service. The object or service must be required, or demanded, or needed, those who wish to have it being willing to give, or, in technical language, to exchange something for it, since a mere wish to have a thing, apart from some power of acquiring it or buying it, is no basis for such a transaction as Political Economy recognises. Next, there must be labour exercised on the object or service, for no one will give what he has worked for in order to obtain that which comes spontaneously and immediately in his way for his use. The cause which raises or lowers the demand is the difficulty or ease of acquisition; the cause which increases or diminishes labour is the greater or less cost of producing the article or service.

In June, 1870, a very eminent novelist, who was, moreover, in consequence of certain personal qualities, apart from his genius, very popular, died suddenly. He had ordered by his will that all his effects should be sold within a month of his decease. This author had many affectionate friends, and a still greater number of fervent admirers, all of whom were anxious to possess some souvenir of his memory. The number of such memorials was far less than the number of those who were ready to compete, by purchase, for these mementoes. In economical language, the demand was excessively keen, and the prices fetched at the sale were out of all proportion to the cost of producing the articles sold, or their equivalents. Here we have an example of the circumstances under which an exceptional demand completely alters the ordinary conditions of value, in which the cost of acquisition entirely obscures the cost of production.

Let us take another instance. A town is besieged by an enemy. The garrison is provided with food, but the inhabitants have to purchase what they may need from those who possess stores of provisions. If one person possessed all the provisions, he might exact whatever price he liked from those who needed them. He will not be willing, indeed, to raise the price so high as to take it entirely out of the reach of those who could buy, else his customers would starve; but in case the inhabitants did not constrain him to surrender his provisions to a common stock, he might exact any price he pleased short of that which the people were wholly unable to pay. Here, again, the urgency of demand, or the difficulty of acquisition, takes the article wholly out of the range of those, the value of which is determined by the cost of producing them. In a minor degree, but still notably, the same facts apply to a scanty or unfavourable harvest, the quantity of which cannot be supplemented from hoarded or foreign stocks.

Here, then, are two examples illustrating the fact, that when the demand for any article is urgent, and the supply cannot be increased at all, or when it can be increased only with great difficulty, the price will be wholly disproportionate to the cost of *producing* the article, and be measured only by the cost of *procuring* it; and this applies to services also. If the law did not tie them down to a uniform tariff, cab-drivers might exact triple fares during a thunder-storm, or when there is any other exceptional demand for their services. Physicians might do the same in a time of great sickness or mortality. Such prices are exacted by inn-keepers and lodging-house keepers when there is a sudden or urgent demand for accommodation in some particular place. The same fact accounts for the high prices occasionally paid for a seat commanding any view of a procession or other spectacle which excites great public interest. The price which people generally pay has been called by economists the natural price, that which is exalted or depressed by circumstances is known as the market price; and it may be said that in the long run, and upon an average, the market and natural price coincide, the average of the former being the amount of the latter.

My readers will remember that I have stated above, that what is true of the products of labour is true of labour itself. The wages of labour correspond to the cost of producing the labourer, and making him fit for the function which he fulfils. If the cost is high, the labour is highly paid. If the labour is supplied after little outlay on the part of the labourer, the labour will be remunerated at low rates. A short analysis of the remuneration of labour, which is called wages, will make this clear.

In the first place, then, a man's wages must include as a necessary item the cost of his maintenance. A man must live, *i.e.*, eat, drink, be clothed, and be sheltered from the weather in order to work, just as a horse must, just as a steam-engine must be supplied with coals. Nay, physiologists tell us that the energies of life are the slow combustion of food, just as the activity of a steam-engine is due to the rapid combustion of fuel. The supply of necessaries to a labourer is therefore an antecedent condition of labour; a competent supply is a condition of efficient labour. The work of an ill-fed labourer is as costly as the work of an ill-fed horse. Low wages do not mean cheap labour, nor do high wages, for the matter of that, represent dear labour.

A labourer sometimes receives nothing but the bare necessaries of life, in the form of a meagre and miserable diet. He gets no more when he is a slave. We have no slaves in England. He gets—or, rather, she gets—no more when plying a needle for a bare subsistence, for, owing to the very scanty number of employments open to women, the condition of many among those who work for their living is, as far as the means of subsistence go, individually inferior to that of slaves.

But it is plain that if the mass of labourers gained nothing but that subsistence which is absolutely necessary in order that they may continue their work, society, as far as they are concerned, must cease to exist within a generation. They must earn enough to support those who are to fill their places during such time as these successors are unable to contribute anything to the common stock. The wages of labour must be sufficient for the maintenance and education of children; and, furthermore, in order to keep the existing stock of labour in effective condition, and to save certain instincts of humanity, the wages must suffice to cover the risks of sickness, and to make provision against the event of that incapacity which attends old age. Wages, then, must cover the cost of maintenance, both of the labourer and of his children, and must ensure him against sickness and old age. If wages are of such an amount that they rise and fall with the price of food, we may be sure that they are generally no more than is necessary to supply these three requisites, and that it is probable that they are insufficient to supply even what is requisite, but must be supplemented from some other source.

In England they are supplemented from Poor-Law relief. The English law recognises the claims of destitution on the resources of those who are able to spare from their funds. Such a system is a gain to humanity, since it inculcates the duty of a moral obligation to relieve distress. But it no doubt tends to lower wages, by obviating the necessity of making provision against contingencies, and by continually supplying a number of labourers who compete for wages with other labourers, but who have been brought up at the public charge, and who, therefore, by reducing the total amount expended in supplying common labour, lower the compensation paid to labourers, and which is paid in accordance with the rule given above, that the wages of labour are on the whole, or on an average, proportionate to the cost of supplying the labour in question.

I have taken the case of such labour as that the wages of which are supplemented by the charity of the Poor Law. Exactly the same rule holds good in the case of those whose education—in the sense of the instruction which fits people for employment or wages—has been supplemented by endowments. If any profession is assisted on so large a scale by permanent endowments, that the cost of learning the profession is reduced by one-half, the emoluments of those who follow the profession will be proportionately reduced. During the time that the endowments of the two great English universities were practically limited to clergymen, the supply of candidates for the clerical profession was abundant. About sixteen years ago this provision was made matter of open competition, and the supply of academical graduates to the clerical profession was immediately diminished. The incomes of Roman Catholic priests, especially in Ireland, are very small; but, on the other hand, until a recent year the vast majority of these priests were educated at the pnblic charge in Maynooth. It is quite certain that the gratuitous education and the lowness of the stipend are related facts, and that if the former be made expensive hereafter, the latter will rise, or the number of persons entering into the calling will be diminished.

The rate of wages then being at any one time the proportion between the number of persons seeking employment and the amount of employment available for them, the theory of labour and wages is closely connected with two other economical circumstances, the principle of population, and the remedy for low wages. If population is in excess of employment, wages will fall; if some mechanism can be discovered by which this fall may be prevented or arrested, the remedy for low wages will be discovered.

Many economists of great repute have given way to the most gloomy forebodings as to the increase of population. They picture to themselves a thoughtless and improvident people, the members of which increase more rapidly than the means of life possibly can, and they conceive that this increase can go on till a day of unremitting toil leaves the scantiest subsistence to the unfortunate people whose numbers are so inauspiciously large. Now in my opinion, and for reasons which I shall proceed to give, much of this alarm is groundless.

The theory of population commonly accepted by economists contains one or two unquestionable truths. A nation grows up to the means of the ordinary or average subsistence of its individual members, or, to vary the language, the majority of a community live up to their income, and are satisfied if they can leave their children no worse off, and perhaps a little better off, than they were themselves. Again, when a community is so well off that the earnings of its industrial classes are on an average vastly in excess of what they need for their subsistence, the growth of population, should the climate of the country be healthy and favourable to life, is very rapid.

But though a community will increase up to the average means of subsistence, it does not increase beyond these means. If the people of Great Britain are found to be more numerous at every census, this fact does not of itself prove that the people are reckless or improvident, but that the efficiency of labour has so far increased that more can be maintained by it than were maintained before. It is not the fact that with this growth of population an increase of agricultural produce is obtained by an increase of labonr. The fact is precisely the reverse. The increase has been obtained by less labour. If, indeed, the community gives up a more expensive kind of food, and betakes itself to a cheaper or inferior, population will increase, and the condition of the people will have been lowered; but no one needs to be told that the English people, in the mass, has not lowered its standard of living within the last twenty years, but that it has rather bettered it.

In a rough kind of way, population does accommodate itself to the means of subsistence in its possession or in its power. It is fonnd that when food is dear there are fewer marriages and fewer births.

There are, however, two events which have, on their occurrence, an important effect on an existing generation of labourers seeking employment, since they indnce the phenomenon of an excessive population, *i.e.*, of a demand for employment which is in excess of supply. These are scarcity and distrust.

A man's wages are not only the money which he earns, bnt the articles which money will buy. When food gets dear, though the labourer's money wages remain unchanged, his real wages—that is, what he can buy with his money—are diminished by the difference between the average and the present price of these necessaries. He seeks to work harder, and he is obliged to economise. The first condition makes him more eager to compete for his own employment, the second makes him less able to purchase what other labourers produce. A scarcity at home always depresses home trade, and a scarcity abroad has the same effects on foreign trade. When the cost of maintenance increases, the margin of earnings, from which a man might buy comforts or luxuries, is curtailed. Temporarily, then, there is an excess of population over the means of subsistence and employment.

A period of distrust has the same effects. Not a little of the means which an employer devotes towards carrying on his business, and by which he is able to give employment to labourers, or at least to keep them engaged, is capital borrowed from others. But in order to borrow, a man must have credit, that is, they who lend must be convinced of his ability and his willingness to repay that which has been lent him. There are, however, times in which confidence is so shaken, owing to reckless speculation, that lenders are shy and timid, and their capital remains unproductive. This phenomenon has happened several times of late years, and at one or two of these crises labourers have suffered from the faults of employers to a very great extent.

Again, the distrust may be the fault of the labourer. I have already said that high and low wages do not mean dear or cheap labour; but that cheap labour is that which is very effective, dear that which is ineffective. If a man is paid ten shillings a day, and his work is worth fourteen, he is a cheaper labourer than a man whose wages are five shillings a day, and whose work is worth only six. Now a labourer, and, for the matter of that, a combination of labourers, may wilfully make their work dear. They may lower the quality or the quantity of their work by sluggishness and carelessness, they may make their labour uncertain because they quarrel with their employer unreasonably, they may drive a particular industry actually ont of the conntry by a variety of expedients which they think will heighten their wages, but which ultimately destroy their wages altogether by destroying their employment. Such acts of industrial suicide, so to speak, though not very common, have happened. If a man who embarks in any calling finds that this calling is surrounded by extra risks, he will either compensate himself for his risks by charging the public a higher price for the productions which he sells, or he will abandon his calling altogether.

In all cases, however, it is not so much the excess of population which is to be dreaded, as its being immovable. Wages vary very much in quantity at places not very far apart, and vary excessively in localities which are distant indeed, but can easily be reached by enterprise. A labourer who is half-starved in England may get abnndant wages in every sense of the word in Canada, Australia, or the United States. Ages must pass before the New World is peopled as densely as England is, and in the interval, not to speak of other regions, there is no general, but only a local or even temporary, excess of population.

The English labourer is kept poor, not because he can find no employment, but because he is slow to move, or unable to do so. A man who lives from hand to mouth has little or no power to change the place of his employment for one in which he will be better paid. If he took care to keep some reserve by him, which would be at hand as a means by which he could transfer the labour which he has to sell from a worse to a better market, he could speedily mend his condition. What should we think of a manufacturer who was so heedless that he did not retain funds enough in his possession to pay the carriage of his goods to the place where he could sell them? Labourers in England, unfortunately, for the most part are in this helpless condition, and therefore are powerless, and obliged to put up with whatever may be offered them. A man who cannot wait for his market or seek the best market, always sells at the greatest disadvantage; and what is true of goods is true of labour.

My readers will anticipate, therefore, that the best means—perhaps the only means—by which the low wages which follow from an excess of labour may be remedied or removed, is by tnrning the excess into a deficiency. It is easy to illustrate this by an example.

The rate of agricultnral wages is in the southern English counties very low. It is, perhaps, not mnch lower, it may be even higher, than it was twenty years ago; but still it is very ill paid. I know no labourer who can do so many things so well as a thoroughly good farm hand can. He frequently knows as much abont land, its qualities, how it should be tilled, and what it will bear, as his employer does, and speedily learns the uses and value of manures. But besides this, he does a variety of operations which require very considerable training and skill. If any of my readers were to try for the first time to drive a straight furrow, they would find it as hard as to play on an instrument which they had never handled before. They would find an equal difficulty in shearing a sheep, in making and thatching a rick. It is no easy thing to mow, to reap, to sow corn, and to thresh it, though these parts of the hind's craft are gradually being superseded by machinery. But in many parts of England such a man earns only twelve shillings a week. He cannot move from his native village, and he is consequently obliged to take wages which, as compared with his skill and what he could get in the colonies or in the United States, are miserably scanty.

Suppose that all young men in such a village were to determine that they would save half their wages till they were thirty years of age, and therefore would remain single till such a time. Assume that the wages I have given began when the labourer was eighteen years of age; and, without reckoning interest, each man would have very little short of £200 in his possession by the time referred to. With such a sum he could easily make his fortune in a new country. We will consider that he is gone, with half the other labourers of the village, and there immediately ensnes a scarcity of labour, and conseqnently an immediate rise in its price.

This rise wonld not be all loss to the employer of labour. It wonld partly be compensated by renewed activity on the part of the labourers, for a well-fed labonrer is a better workman than a starved hand. It would partly be met by an increased use of machinery. In certain parts of Ireland labourers have almost disappeared, and the Irish farmers, many of them being very small occupiers, are using machinery in agriculture to a far greater extent than English farmers do.

There is no expedient beyond that of bringing abont a scarcity of labonr which will raise wages, and no special or local scarcity will raise general wages. If the persons who engage in a particular calling agree to limit their own numbers, they may, perhaps, raise their own wages; but they will do so only by driving a larger number of persons into other callings, and so lowering the wages in such callings.

There are other remedies suggested for raising wages. The emigration of a section from all classes of society would do so; bnt it mnst not be imagined that if the best workmen in a country have left it, the residue will therefore be better off, or that an excess of labonr over employment characterises mechanical labour only. It belongs quite as much, if not more, to professional labour. But the chief remedy proposed is that which has been glanced at above, a combination, namely, among labourers. Bnt I shall be better able to exponnd this subject when I treat of profits, as I propose doing in my next lesson.

TERMS USED IN COMMERCE.—XI.

TRADE, BOARD OF.—A department of the Government organised to control all matters having regard to the trade of the country and to the Colonies.

TRAVELLER.—A person engaged by wholesale houses and manufacturers to canvass for orders, collect money, and represent their interests away from their place of business.

TRET.—An allowance of 4 lbs. on every 104 lbs. on certain articles of merchandise for dnst, etc.

TRINITY HOUSE.—An establishment incorporated by charter in the interests of navigation and commerce; it is empowered to erect lighthouses, appoint pilots, settle the rates of pilotage, conduct the examination of mariners, and regulate, in many respects, the marine affairs of the conntry.

TROVER.—An action for the recovery of personal property, or for damages.

TRUCK SYSTEM.—The system of paying the whole or part of workmen's wages in goods instead of money.

TRUSTEE.—One who is entrusted with the care or management of property or a bnsiness for the benefit of others.

ULLAGE.—The quantity deficient in casks of liquids.

UNDERWRITER.—In marine insurance, generally applied to the individual insurers at Lloyd's and elsewhere, who underwrite or subscribe their name to each policy they are concerned in.

USANCE.—The established custom or usage of different places as to the periods for which foreign bills of exchange are drawn. The following are the usances at the respective places:—

Amsterdam .	1 month's date.	Leghorn .	3 months' date.
Antwerp .	1 ,, ,,	Leipsic .	14 days' sight.
Altona .	1 ,, ,,	Lisbon .	30 ,, date.
Augsburg .	15 days after sight.	Madrid .	2 months' sight.
Barcelona .	60 days' date.	Malta .	30 days' date.
Berlin .	14 ,, sight.	Milan .	3 months' date.
Bilboa .	2 months' date.	Naples .	3 ,, ,,
Bremen .	1 ,, ,,	New York .	60 days' ,,
Bordeaux .	30 days' ,,	Oporto .	30 ,, ,,
Cadiz .	60 ,, ,,	Palermo .	3 months' ,,
Dantzic .	14 ,, sight.	Paris .	30 days' ,,
Dresden .	14 ,, ,,	Rio Janeiro	30 ,, ,,
Frankfort-on-the-Maine .	14 ,, ,,	Rotterdam.	1 months' ,,
Geneva .	30 ,, date.	Sydney .	30 to 90 days' sight.
Genoa .	3 months' ,,	Trieste .	14 ,, ,,
Gibraltar .	2 ,, sight.	Venice .	3 months' date.
Hamburg .	1 ,, date.	Vienna .	14 days' sight.

USURY.—The legal rate of interest in England being formerly 5 per cent., any excess of charge upon that rate, excepting as regarded bills of exchange, was denominated usurious, and by the usury laws rendered illegal. These laws having been abolished, money-dealing in this respect is entirely unrestricted.

VENDOR.—The person on whose behalf a sale is effected, or who is himself the seller, is termed the *Vendor;* and the one for whom a pnrchase is made, or who is himself the purchaser, the *Vendee.*

VOUCHER.—Documentary evidence or proof in writing of the payment or receipt of money or of other transactions.

WAREHOUSING.—A system of storing imported goods in public warehouses nnder bond, on their being landed from the vessels, pending their disposal for home consumption or re-exportation.

WARRANT OF ATTORNEY.—A power given by a client to his attorney to appear and plead for him, or to suffer judgment to pass against him by confessing the cause of the action to be just. Also generally applied to power, given by one person to another, to transact any specified form of business at the risk of the person giving such power.

WARRANTY.—In marine insurance, certain expressed exceptional conditions affecting the subject-matter of the policy, such as the periods of a ship's sailing, or the liability of the insurers for average claims. In life assurance, the stipulation contained in the policy to the effect that the declaration as to health, etc., signed by the assured, shall become part of the policy.

WASTE BOOK.—Another name in bookkeeping for the *Journal.* Under the old Italian system it was a book in which the Journal entries were collected and roughly made.

WAYS AND MEANS.—An expression implying the resources of an individual or concern applicable for certain purposes, and the mode of applying them.

WHARFAGE.—A charge for receiving and removing goods on the quays of the various docks or wharves, either on their shipment or landing.

WINDING UP.—A term applied to the closing np of any transactions or business. An Act of Parliament compels the winding np of the affairs of public companies under certain circumstances.

LESSONS IN ETHNOLOGY.—V.

THE MONGOLIAN RACE.

THE physical characteristics of Blnmenbach's Mongolians were detailed in a former paper. Their faces are not like our own—oval, bnt broad and square. Their skulls are of the shape which Prichard calls pyramidal. The nose and the features generally are flatter than in most Europeans. The eyes are situated obliquely, and turn up at their outer extremity, as may be well seen in the Kalmuck figured at page 73. The facial angle is not so high as among the civilised Western nations, but it exceeds that of the negro. The mouth does not greatly project. The hair is generally dark, as also are the eyes. The complexion varies according to the locality. It is often called yellow, and sometimes olive; but the latter term is an objectionable one, for olive has in it a certain mixture of green, a hne not ordinarily found in the hnman conntenance.

Blnmenbach's Cancasians, it will be remembered had to be separated into two great divisions, on the evidence afforded by language. It is almost certain that the Mongolians must be similarly treated, for there are great distinctions among the tongues which they speak. As a first step to understanding the matter, it is necessary to explain the fundamental principles on which languages have been classified. Readers comprehend what is meant by calling a word a root. The import is that it is a simple word, like *love, head, sun,** which cannot apparently be resolved into any more primitive one from which it may be supposed to have sprung. Roots in language remind us of the simple substances in Nature, such as iron, silicon, or potassium, which chemists have not yet succeeded in proving to be made up of two others. Professor Max Müller affirms that in all languages the roots are monosyllabic. He divides them into two classes, predicative roots, that is, those which assert something or other—as *eye, star, cold;* and demonstrative roots, meant to point something out, as *there, who, what, thus, that, thou, he.* It is believed that in every language the roots were at first separate from each other. No two had coalesced, but all stood out in absolute isolation. The Chinese is notably in this predicament still. "It is a language," says Professor Müller, "in which no coalescence of roots has taken place; every word is a root, and every root is a word. It is, in fact, the most primitive stage in which we can imagine human language to have existed" (pp. 259, 260 of "Lectures on the Science of Language." London: Longman, Green, and Co., 1861). Language in this "radical stage," that is, this root-stage, he calls *monosyllabic*, or *isolating.* The isolation in which the roots stand to each other explains the latter of these two terms, while the fact, already mentioned, that all real roots are monosyllables, accounts for the former. Many languages have, however, gone beyond the radical, and reached the "terminational stage." In their case two or more roots have coalesced to form a word. Of these, however, one has invariably lost its original independence, and sunk into a mere termination. In the English term, "breastwork," there are the two roots, *breast* and *work*, not, as in Chinese, standing apart from each other, but one (*work*) figuring as the termination of the other (*breast*). This kind of union is called *agglutinative*, from the Latin word gluten, *glue*, as if two separate roots were glued together. With the exception of the Aryan, the Semitic, and the Chinese, with its cognate dialects, all the languages of Asia belong to the agglutinative division. The next and highest stage of all—the "inflectional" one, is that in which the two roots in conjunction have thoroughly coalesced, both having lost their substantive independence, so that they cannot now be easily dissevered. In the English word *is*, for instance, there must be two roots, the one (predicative) asserting the existence of a person or thing; and the second (demonstrative) indicating that the entity pointed at is not in the first or the second, but in the third person. Languages of this character are called *organic*, or *amalgamating.* Those which answer to the description now given are the forms of speech used by the Aryan and Semitic races.

To confine our attention now to the Mongolians. Language cannot render us so much service here as it did in the case of the inflectional class, in which similarity of inflection, it will be remembered, was deemed a better proof than resemblance in roots that tongues now distinct had formerly been identical. But in most of the Asiatic languages there are no proper inflections, and it is an extremely vague character to say that some Mongolian nations speak monosyllabic and others agglutinate languages. It appears to us that this classifies them rather according to the degree of linguistic development which they have reached, than according to their ethnological affinities. How many families like the Aryan and Semitic Caucasians will ultimately be made out of the vast Mongolian chaos, it were difficult at present to say. We should suppose several, especially if the Americans and the Malays of Blumenbach are regarded as simply more or less modified Mongolians. All that can at present be done, however, is to follow existent lights, and separate the Asiatics belonging to the comprehensive division of mankind now under review into two sections, those speaking monosyllabic, and those using agglutinate tongues.

* It was needful for clearness that we should give some specimens of roots; but we would carefully abstain from asserting that those actually selected may not yet be curtailed or otherwise simplified by future analysis.

The Chinese, as already stated, stand as the most typical specimens of the first division. Thus, where in Latin the expression would be used, *baculo*, "with a stick," the Chinese say *y cang*, meaning "employ stick." The physical appearance of this interesting people is well known, though some pictures exaggerate rather than correctly represent its peculiarities. The Chinese have the Mongolian eye more manifest in them than in the tribes and nations around, that is, they have eyes linear in form and situated obliquely, so that the outer extremity is turned up. The beard is scanty. The population of the Chinese empire is supposed to amount to 400,000,000, about a third of the human family. The vast majority of these are of the genuine Chinese race. If we mistake not, this great nationality is destined to affect the world more powerfully in the future than it has done in the past. Its isolation is giving way, and emigrants, whom the pressure of population drives from its shores, are beginning to pour in thousands into other lands. Many of them return home, the main reason being that their wives are not allowed to accompany them to foreign countries. When this barrier to settlement abroad is removed, then the stream of emigration, even at present of respectable dimensions, will become a flood overflowing many territories. The dominant religion in China is Buddhism, a faith which originated with an Aryan prince in India.

We pass next to the remaining divisions of the Mongolian race. After Max Müller has disposed of the Chinese and its cognate dialects, he divides all the other languages spoken by Mongolians, at least of the eastern hemisphere, into two great sections—the northern and the southern divisions of the great Turanian family of tongues. Ages have elapsed since the name *Turan* was first opposed to *Arya*, or rather *Aria*, the former being used to designate the wandering Mongols, while the latter stood for the more settled Brahmans and Iranians, who were believed to be of superior race. All the languages now mentioned are held by Müller to be agglutinate, though some of them, such as the Thibetan, the Karen, the tongues of Siam, Laos, and Cambodia, are transferred by Farrar, as indeed had been done by Latham and others previously, to the monosyllabic class. To turn now to the Northern Turanians.

From time immemorial the great table-land of Central Asia, from the confines of Europe to the borders of China, has been traversed by wandering shepherds, vaguely described by the ancients as Scythians, and by mediæval Europeans as Tartars. Occupying the very latitudes which in another continent developed the powers of the conquering Teutons, perpetually out in the open air, and preserved by their mode of life from the enervating vices of cities, they became admirably adapted for military service, and whenever they obtained a leader of genius to heal their petty feuds, and force them for a time to act in common, they had it in their power to overturn old empires and establish barbarous sovereignties of their own amid the ruins they had made. Thus did Attila and Jenghis Khan and Tamerlane and others, one and all of them of the North Turanian or Tartar race. The word "Tartar," it is said, should be *Tatar*, the *r* being inserted during the Middle Ages to give colour to the charitable statement or conjecture that the dark and ugly Asiatics who battled so hard against the warriors of Europe, had come from Tartarus.

The North Turanian forms of speech are five in number—the Tungusic, the Mongolic, the Turkic, the Samoyedic, and the Finnic (Uralic) tongues. An interest attaches to each of the five. From the Tungusic branch of the Turanians came the Mandshoo Tartars, who in the seventeenth century conquered China, and still retain supreme authority in that great land. The Tai-ping revolt was a rise in arms of the native Chinese against their Tartar rulers. It was nominally the Mongolians proper, though really a medley of Turanian tribes, among whom, however, the Mongolians were the most prominent, who under Jenghis Khan conquered a great part of Asia, while his successors carried their arms into Europe itself. All are familiar with the title "the Great Mogul," as applied to the Delhi emperors, and one section of the Indian Mahometans are still called Moguls; but the Turks were really more prominent than the proper Mongols in that conquest of India which led to the establishment of the Delhi-Mogul throne.

The Turks follow next in order. They are associated in most minds simply with the Sultan and his dominions, but in reality they are widely spread throughout all Western and Central

Asia. So much is this the case that, as before stated, Independent Tartary is now often called Independent Turkestan, and even Chinese Tartary, Chinese Turkestan. *Stan*, or *sthan*, is a Persian word, meaning "place," as Affghani*stan*, "the place of the Affghans," Hindoo*stan*, "the place of the Hindoos." Turkestan, then, is the place or the country of the Turks. The Mongolian physical characteristics have become greatly softened down in the case of the Turks resident in Europe. Intermarriages with Circassian and Greek Aryans have had much to do with this. Besides, as Prichard shows, a nomad race settling down in a fixed habitation, and becoming more civilised, so alters that the square face and the pyramidal skull of the old pastoral Turks would almost of necessity be modified for the better, even without Aryan intermarriages, by their advance in civilisation.

The Samoyedes follow next in order. They are a polar race akin to the Esquimaux. They occupy a vast tract of land in the north of Europe and Asia, extending along the shores of the Arctic Ocean from Archangel on the White Sea to Cape Tcheliuskin and Khatanga Bay. This conducts us once more to European ground, and here the Finnic subdivision of the Northern Turanians brings up the rear. The Finns and the Laplanders belong to the group. So do the Magyars of Hungary. The affinity of the Finns and the Magyars is thoroughly proved by the similarity in their respective languages. The Magyars have been in Europe for only about 1,000 years. They entered it as conquerors in the ninth century, and seized on the territory which they at present occupy. Possibly many of the same race may have been in that part of Europe previously, descended from the wild Huns, with whom Attila had scourged the nations centuries before. Both Attila's Huns, and their successors the Magyars, were so Mongolian in appearance when they first came to Europe from the Asiatic steppes, that the Europeans whom they encountered looked on them as perfectly hideous; but on them, as on the Turks, centuries of civilisation have told with no inconsiderable power, and the Mongolian visage has been considerably softened down. If Kossuth were a pure Magyar, and an average specimen of the race, then that once uncouth tribe, or at least its aristocratic members, have become all but Caucasian.

Fig. 6.—NEW ZEALANDERS—THE CHIEF HEKI.

Unlike the Magyars, whom we have seen to be recent invaders from Asia, the Finns are perhaps the oldest inhabitants of Europe. It is suspected that they once overspread a great part of our continent, though so little of it remains to them now. The Laplanders are of Finnish descent. Possibly the Basques in the south of France and the north of Spain belong to the same family. They were once held to be Celts, but this view has long been abandoned. In all likelihood they are Turanians, though oddly enough their language has some affinity, not in its roots, but in its polysyllabic character, to the North American tongues.

The South Turanian family of speech resolves itself into four divisions—the Tamulic, in the south of India; the Bhotâya, or the dialects of Tibet and Bhotan; the Taïc, or those of Siam; and the Malayic of the Malay peninsula, the Eastern Archipelago, and the Pacific Islands.

As before mentioned, the great mass of the Hindoos are not Aryan, but Turanian. The languages of the south of India—the Tamul, the Teloogoo, the Canarese, the Malayalam, and others unequivocally show this. Though it be less easy to prove the point, yet it is believed to be the same with the tongues of Central and of Northern India, albeit their original character has been entirely disguised by the great infusion into them of Sanscrit words. Thus, in the Mahratta spoken in Central India, one-fifth of the words are not of Sanscrit origin. In the Hindee of India north of the Nerbudda, where Brahminism has more or less flourished during the last 2,000 years and more, one-tenth of the words are derived from some language different from the Sanscrit. In fact, nearly all the military history of India, for centuries after the Brahmans established themselves in the Punjaub, consisted of little more than a series of desperate combats between the invading Aryans and the native Indian Turanians. The discovery of a language akin to Tamul, the Brahui, in Beloochistan, would lead one to think that it was through that country that the Turanians first entered India; but further research is needful before this can be considered a settled point.

The only other group of South Turanian languages that we shall notice is the Malay, that spoken by the race so named in Blumenbach's arrangement, and by him regarded as one of the primary varieties of mankind. For its physical characteristics we would refer our readers to a former paper. A very interesting point connected with it is that, as the evidence of language shows, it is not confined to the Malay peninsula or archipelago, but is spread from Madagascar on the one side all through the Pacific islands to the expanse of water severing these from the coast of America. Among many other tribes it includes the New Zealand Maories, of whom a chief, by name Heki, who in his day gave our troops no slight amount of trouble, is represented in the engraving.

At the opening of the next paper we shall treat of the American Red men, the only remaining portion of the extensive Mongolian race.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XXI.—INFLUENCE OF THE CRUSADES UPON COMMERCIAL INTERCOURSE.

In order to trace the influence of the crusades upon commerce, a succinct review of the previous conditions of society must be entered npon. The crusades were the collision of Western and Eastern fanaticism. The Arabs, who swarmed round the standard of the Prophet, were at first as rude as the Goths of Europe. But the facility with which the Oriental character adapted itself to industry, and the precepts enforced by the Koran, refined the Children of the Desert wherever they settled, and made them keen to perceive the capabilities of different regions. Wealth rewarded Arab industry and intelligence, and for some ages civilisation was kept alive almost solely in their dominions. They revived a Chaldean splendour in their cities. From Bagdad to Granada, science, art, and letters flourished, while innnmerable luxuries, unknown to the races out of the pale of Arab conqnest, were enjoyed by them in abundance. In their dominions commerce became free; for, as they were almost sole masters, to restrict the trade at any place was to impose a penalty upon themselves. They broke up the system of concentrating wealth upon one gorgeous capital till it sank under the weight of its voluptuous burden; they made their whole dominion a hive of industry. Moorish Granada enjoyed a state of prosperity never since witnessed in Spain, the era of fictitious wealth due to the discovery of the American gold and silver mines not excepted.

Contrasted with Asia as represented by the Arabs, Europe is obscured in a mist of prejudices, superstition, and ignorance. Literature was almost unknown to the barbarous successors of the polished Romans. The native inhabitants were reduced to serfdom, and the land became the property of chieftains, who divided it under feudal tenure among their vassals. Labour, as of old, was servile, and therefore degrading to free men. Being the heritage of slaves, whose interest was to do as little as possible, there was in work no elevating principle to match with the dignity supposed to attach to war. Greece and Rome held the false belief that idleness and fighting were the worthiest human occupations, and this not from any want of capacity on the part of the citizens, as witness their military engines and roads, their canals and aqueducts, temples, palaces, and sculpture.

The degradation of serfdom was for a long while unrelieved, for lords and their slaves were equally ignorant. The only ark of hope and safety was the Church. Industry, like learning, was free in the hands of the monks. Whether imposed for the purpose of self-mortification, or adopted with a true insight into its humanising inflnences, it was pursued with pious devotion, and became an important element in the salvation of Europe. Then arose monastic guilds and grades of handicrafts, from masonry with its mystic symbolism, developed in cathedrals too grand for our imitation, to the simple cultivation of the soil, and devotion like that of Otho, Bishop of Bamberg.

This good Bishop, who is styled in the legends the Apostle of Pomerania, visited that country in 1124 for the purpose of converting the inhabitants: he observed that the art of making hydromel was well understood, bnt it was thought unbecoming to substitute that liquor instead of wine in the sacrament of the Lord's Supper. When he returned in 1128, he brought with him a large cask filled with young vines, which were planted by his directions, in order that he might be enabled to administer wine to the converts; for at that period laymen as well as ecclesiastics partook of the communion in both kinds. It is owing, without doubt, to the same cause, that the culture of the vine was introduced with Christianity into several northern countries. Moehsen makes an important and curious remark on this subject: he affirms that the difficulty of obtaining wine in the north, otherwise than by commerce or an expensive cultivation, gave rise to the custom of communicating in one kind. "Thus," says that writer, "necessity brought about a sophism, by which the most solemn of all the institutions founded by the Author of Christianity was changed in its mode of administration."

The crusades extended over 200 years of European history —a period of many important social changes. Great as was the loss of life and treasure in the crusades, many benefits therefrom accrued to Europe, which with its spirit, sinews, and Christianity, had few of the arts of civilisation to give, but many to learn.

To commence:—First, the natural resources of Europe bore no comparison with those of Asia and Africa. From the soil were obtained the bare necessaries of life, securing in the rudest fashion the essentials of food, warmth, and rest. Of substances used for food there were grain, flesh, and salt, in coarse abundance; but the indigenous fruits were few, and unimproved, while the finer sorts had to be introduced from a distance. Wine was scarcely known, and the taste for spices had yet to be acquired. For clothing, linen and wool were the only fabrics woven. Cotton and silk were as little worn as diamonds and pearls. Acquaintance with these things, formerly confined to courts, excited a desire for them on the part of the Christians who had seen their profusion among the more refined nations of the East.

The Venetians and the Genoese, together with the Pisanese and the citizens of Marseilles and Barcelona, became the purveyors of food, clothing, and arms, as well as the owners of the transport vessels for the crusaders, and reaped thereby large profits. Following in the wake of the armies, they rivalled each other in concluding treaties, erecting factories, and founding settlements even on the enemy's shores; and the products of their enterprise were dispersed through Europe. Jealousies amongst the Italian cities, giving rise to wars, could not destroy the great advantage derived from the new produce imported into Europe, nor its general diffusion. Silk dresses, spices, perfumes, came into common use among the wealthy; and food, clothing, and household arrangements underwent a complete revolution. Commerce became almost entirely free. Woollens employed a multitude of workmen in Florence and Catalonia. The rearing of the silkworm gave rise to a staple of wealth in Italy and France. The Levantine commerce vivified the manufactures of Flanders, and the northern commerce in turn enlivened that of the Levant. Navigation, pursued with an ardonr never before witnessed, received the greatest impetus, when men learnt, from the Saracens, the French, or the Italians—for all claim the merit, and with some show of reason—to guide their course by the mysterious power of the magnet.

To keep pace with the growth of commerce, capital was economised, and credit used as a great agent of production by means of bills of exchange, interest on loans, and banking. The promiscuous customs, or unwritten law of the sea—the ancient usages of the Mediterranean states—were systematised, and agreed to by them all in the church of St. Sophia at Barcelona, as the established maritime code, or statutes of the sea (*consolato del mare*).

As religious fanaticism wore itself out, treaties of commerce began to be framed with the Saracen rulers in Syria, Tunis, Tripoli, and other parts of the Asiatic and African coasts, and thus the maritime traffic became extended and improved. The result on the land traffic of Europe was even more remarkable. Every Mediterranean port served as a centre for the diffusion of the fruits of labour. Commerce was incompatible with feudalism. The wealth arising from industry and trade, which belonged to a class whose property was at the mercy of their lords, was distinguished from land or real property by the name of chattels or movable property. The traders in towns, anxious to retain the produce of their labour, learnt to take advantage of their lord's necessities, and to make bargains with him for privileges, whenever he demanded from them a grant in aid. The burden of the crusades fell upon the burgher class, and during their continuance the demand for an aid was often repeated, with growing power on the part of the traders to make terms, and with lessening capacity on the part of the barons to resist. Towards the end of the period, the barons were reduced in numbers and resources; the kingly power had increased; but there had arisen a more enlightened and opulent middle class, by whom the future of Europe was destined to be controlled. Briefly, the crusades are memorable for the blow given to feudalism; for the dignity conferred on manual labour; for the assertion of municipal rights; and for the recognition of a new power in the state—that of personal property, in contradistinction to the ownership of land held by the different feudal tenures.

CHAPTER XXII.—COMMERCE AND INDUSTRY OF FRANCE.

The history of commerce and industry in France during the Middle Ages resolves itself, as in Italy, into the history of separate towns, rather than that of a united kingdom. These towns were situated in the maritime provinces bordering respectively on the Mediterranean Sea, the Bay of Biscay, and the English Channel. The Mediterranean division contained three commercial towns, Marseilles, Aigues-Mortes, and Montpelier, with a large number of towns engaged in woollen manufactures in the province of Languedoc.

Marseilles has always been the chief commercial city and seaport of France. It was originally a Greek colony under the name of Massilia, a flourishing rival for a long while of Carthage; and during even the worst of the Dark Ages, it maintained its commercial character. Its convenience as a port for the Holy Land caused many of the crusaders to choose it for their point of departure. The municipal authorities encouraged this passenger traffic by rigid laws of inspection, to ensure the comfort and proper treatment of the voyagers. Such restrictions applied to an exceptional trade were of great service, but failed of their purpose when the authorities attempted to legislate in a similar way for the permanent commerce of the town. With the hope of fostering the growth of native industries, they made it illegal to import foreign commodities, but thereby they diminished both their foreign trade and their home manufactures. The making of coarse woollens could alone be said to be flourishing. The wool was obtained from the Barbary states, and it employed the looms of all Provence as well as of the city of Marseilles. The cloths were dyed of bright colours with logwood, madder, and carmine, and for their strength and durability found favour in Italy and Greece. The cultivation of the mulberry and the manufacture of silk were introduced with success, but attempts to raise the sugar-cane failed. Marseilles has grown in prosperity with each succeeding age. Its commerce and manufactures are now very great, and they promise to become still greater.

Aigues-Mortes was once a considerable harbour. Louis IX. sailed from this port on his crusade. It is situated amongst the salt of the Rhone marshes, and is now four miles inland. On account of the stagnant or dead waters by which it is surrounded, and whence comes the name (aquæ mortuæ), its climate is unhealthy. The marshes are, however, turned into a source of wealth by the manufacture of salt and potash. The distilling of brandy (eau de vie) similarly distinguished an adjacent town with the name of Aigues-Vives. The commerce of Aigues-Mortes was chiefly that which it derived as a depôt for spices and other Eastern goods, to be interchanged with the woollen and linen textures of the northern provinces of France. The port being undesirable as a residence, the factors and bankers transacted their business at Avignon, higher up the Rhone, where the warehouses of the Italian and other foreign merchants were also to be found.

The towns of the province of Languedoc were famous, and still remain so, for their silk and woollen manufactures, especially of those dyed scarlet, rose, and azure blue. Montpelier, Narbonne, Nismes, Beziers, Carcassonne, Perpignan, and Toulouse, were the chief industrial towns. Fairs were held at Beaucaire and Montpelier, at which places the Florentines bought English wool and the Venetians obtained French cloths for their commerce in the Levant.

Still more important was the cloth trade of the provinces adjoining Flanders, and in the district of France anciently called Armorica. Troyes, the capital of Champagne, was a manufacturing town in the fifth century, and a fair was established there at least as early as 1118. Known as the Remigius Market, this fair for 300 years grew in importance, and drew traders from every commercial state; German, Dutch, Flemish, Lombardian, Florentine, and Venetian merchants were invariably present. Troyes was the entrepôt of the manufactures of Champagne and also of the neighbouring provinces of Picardy, the Isle of France, and Normandy. The products of industry to be found there were of a very varied character, though none of them in value approached the textile fabrics.

The following list of towns includes the seats of the cloth industry in each province:—

Champagne.—Troyes, Chalons, Rheims, Provins, Sens, Vitry, St. Dizier.

Isle of France.—Pontoise, St. Denis, Paris, Lagni, Senlis.

Normandy.—Rouen, Louviers, Bernai.

Picardy.—St. Quentin, Aubenton, Amiens, Abbeville.

Troyes obtained cloth from the South Netherlands as largely as from the French provinces. The following Flemish towns were thus in commercial intercourse with Troyes:—Cambray, Valenciennes, Maubeuge, Avesnes, in Hainault; Arras, Douai, Lille, Tournay, Dixmuide, Ghent, Bruges, Ypres, in Artois and Flanders; Malines, Brussels, Louvain, Brest, and Huy, in Brabant and Liege.

Amongst the miscellaneous commodities reaching the markets at Troyes, were leathern goods from the south of France, and horses from Lombardy and Germany. Eastern produce from remoter parts, such as spices, formed a large part of the merchandise of the Venetian traders; for the French merchants at this time charged themselves with little business beyond what was brought to their shores.

Merchandise converging from so many places upon Troyes, made the town rich and influential. Two causes combined at length to diminish its trade: first, merchants were deterred by the unwise imposition of heavy dues from bringing their goods; and next, in 1298, when the overland route for Oriental commerce, by way of Syria and Constantinople, was closed to the Venetians, and they re-opened the old route through Egypt, goods were conveyed by sea direct to England and the Netherlands, without passing through France. Bruges was the first of the Flemish cities thus favoured by direct intercourse with the East; Antwerp followed in 1318. Troyes clung to its privileges and prohibitions till it fell into utter decay; while other towns, till then insignificant, began to share its failing trade and profits. Charles VII. in 1445 conferred upon Lyons, a city much more conveniently situated for the trade of southern France, the privilege of holding three markets. Of the northern seaports, Harfleur, at the mouth of the Seine, was at this time the seat of a trade which attracted thither the Portuguese and Castilians.

Although the harbours of the western coast of France are admirably suited for commerce, their sea-trade did not attain any magnitude till long after Marseilles had risen to be an active and important port. The two principal ports were Bordeaux and La Rochelle.

Till the year 1312, when they were deprived of the immunities which they had previously enjoyed, the Templars conducted much of the trade of Rochelle. Its exports consisted largely of wine. The Flemings alone bought at this town 40,000 casks annually. One consignment, the vessels conveying which were captured by the English, consisted of 9,000 casks.

Bordeaux is an ancient city, having under the name of Burdigala been rebuilt by the Romans, A.D. 260, after its destruction by fire. It is well placed for foreign commerce, and it sent wine to England in 1302. Its traffic with the interior became developed from the facilities afforded it by the Garonne, the Dordogne, and their tributaries. The articles of commerce sent from Bordeaux increased in number enormously, until the city became second to Marseilles in commercial importance.

The French government of the period ordered foreign goods to be brought into the country in French vessels only, under the idea that navigation would thus be promoted, and the profits of the trade be confined entirely to citizens of France. But other results ensued; competition and emulation were weakened, and contraband traffic was encouraged.

PLANE TRIGONOMETRY.—VI.

APPLICATION OF TRIGONOMETRY TO MEASUREMENT.

The object of this lesson is rather to suggest than enumerate the practical uses of the science. Apart from its connection with Navigation—upon which more will be said in the papers shortly to be devoted to that subject—Trigonometry is mainly employed in the practical work of measuring (1) heights and distances, (2) areas, and (3) contents of solids. By way of example we will take one or two of its simpler applications to the measurement of heights and distances, space forbidding even the enumeration of the many problems which may arise in measuring and surveying—most of which may, however, be solved, directly or indirectly, by the formulæ already arrived at.

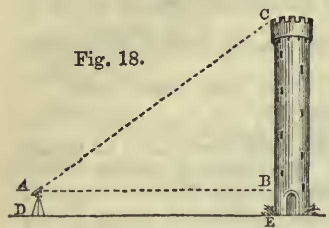


Fig. 18.

Problem I.—To find the height of an accessible object situated on a horizontal plane (Fig. 18).

Let the tower, E C, be the object. Measure from it a convenient distance, E D, and observe the angle B A C. The right-angled triangle A B C can now be calculated (B C = A B . tan. B A C; see Section X.), one side, A B (equal to E D), and one angle being known. To B C add E B, the height of the observer's eye above the horizontal plane, and we obtain the height of the tower.

Exercise 8.

1. A person, whose eye is 5 ft. 6 in. above the ground, having receded 125 ft. from the base of a tower, finds that its angular elevation is 52° 34′. Calculate its height.

2. From the other side of a street 42 ft. wide, I observe that the elevation of the front of a house is 49° 28′. What is the height of the house, the height of my eye being 5 ft.?

Problem II.—To find the distance on a horizontal plane of an object of known height.

Let the tower in Fig. 18 be the object, and its distance from D—*i.e.*, the length of A B—be the information sought. The angle B A C being found as before, this case differs from the preceding only in that a different side of the triangle is given, and it is calculated with equal ease by the means pointed out in Section X.

Exercise 9.

1. The angle which a man's height subtends at the eye is 10′. If his height is assumed to be 6 ft., calculate his distance.

2. The pyramid of Cheops is 490 ft. high. From a distant point of the plain on which it stands, the elevation of its apex is observed to be 13° 49′. Calculate its horizontal distance.

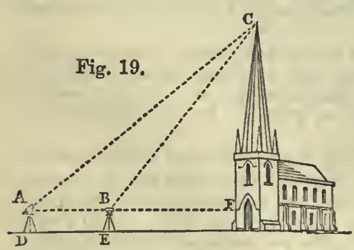


Fig. 19.

Problem III.—To find the height and distance of an inaccessible object on a horizontal plane (Fig. 19).

The simplest way to do this is to observe its elevation at two points, A and B, in line with the object, measuring their distance apart. Let the observed angles be α and β respectively. Angle A C B $= \beta - \alpha$; whence, by the *rule of sines*,

$$\text{BC} = \text{AB} \times \frac{\sin.\ \alpha}{\sin.\ (\beta - \alpha)};$$

$$\text{but FC} = \text{BC} .\ \sin.\ \beta;$$

$$\therefore \text{FC} = \text{AB} \times \frac{\sin.\ \alpha \sin.\ \beta}{\sin.\ (\beta - \alpha)};$$

$$\text{and similarly,}\quad \text{FB} = \text{AB} \times \frac{\sin.\ \alpha \cos.\ \beta}{\sin.\ (\beta - \alpha)}.$$

F C, added to height of observer's eye, gives the height, and F B gives the distance of the object.

Exercise 10.

1. Wishing to ascertain the height of a church steeple, to which close access cannot be had, I select two stations in line with it, 52 yds. apart. At those stations I find the elevations to be 58° 14′ and 36° 42′ respectively. The height of my eye above the ground is 4 ft. 6 in. What is the height of the steeple?

2. What is the height of a hill, its angle of elevation at the bottom being 52°, while 300 yds. from the bottom, measured horizontally, its elevation is found to be 28° 30′?

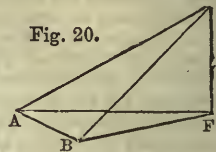


Fig. 20.

If the nature of the ground prevents two observations being taken in line with the object, they may be taken as at A B in Fig. 20. Measure A B and the angles B A C, A B C, and F A C, which we will call α, β, and ϕ respectively. (The two former must be measured by a sextant). Then, since A C B = supplement of $\alpha + \beta$, $\therefore$ sin. A C B = sin. $(\alpha + \beta)$;

$$\therefore \text{AC} = \text{AB} \times \frac{\sin.\ \beta}{\sin.\ (\alpha + \beta)}.$$

$$\text{But FC} = \text{AC} .\ \sin.\ \phi;$$

$$\therefore \text{FC} = \text{AB} \times \frac{\sin.\ \beta \sin.\ \phi}{\sin.\ (\alpha + \beta)};$$

and similarly for the distance.

Problem IV.—To find the distance of an inaccessible object without measuring its elevation, and whether on a horizontal plane or not (Fig. 21).

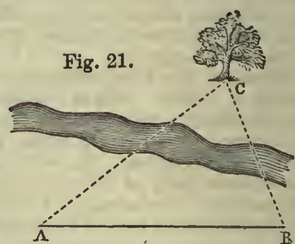


Fig. 21.

Let C be the object and A the point of observation; select any other point, B, and measure A B and the angles C A B and A B C. A C may be calculated by Section XXI., par. 3. If B be taken so that A B C be a right angle, the case, of course, is still simpler.

Exercise 11.

1. In order to ascertain the distance of a windmill on the opposite side of a river, I observe the angle between the windmill and a flagstaff, which is 356 yds. distant, and find it to be 53° 4′. Proceeding to the flagstaff, I find the angle between the windmill and the first station to be 49° 10′. What is the distance of the windmill?

2. Wanting to know the breadth of a river, I measure along the bank a base of 250 ft., the extremities of which we will call A and B. At the extremity A I find the angle made by B and a tree on the opposite bank is 63° 31′; at the extremity B I find the angle between A and the tree is 57° 28′. What is the breadth of the river?

3. To find the distance of a battery from an outpost, I make 200 paces in a direction at right angles to the line which connects it with the outpost, and then find that it makes an angle of 67° 23′ with the outpost. How many paces is it distant from the latter?

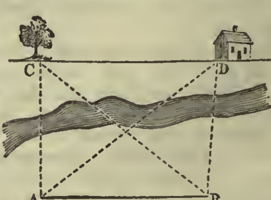


Fig. 22.

Problem V.—To find the distance from each other of two inaccessible objects (Fig. 22).

Let C and D be the objects. Measure a base line, A B, and observe the angles A B C, A B D, B A C, B A D. Calculate A C and A D as in the last problem. Then, since C A D = B A C − B A D, we have the necessary materials for calculating the triangle A C D (Sec. XXI., par. 2). Hence we obtain the distance, C D.

Exercise 12.

1. To ascertain the distance between two batteries in an enemy's works, a base line of 500 yds. is measured, and the angles which each battery makes with the base-line are observed to be 118° 20′ and 46° 14′ at one extremity, and 88° 48′ and 33° 12′ at the other. What is their distance apart?

There is an ingenious way of finding the converse of this problem—viz., the distance between A and B—by observations upon C and D, the distance between *the latter* being known. *Assume* A B = 1000; then, on that supposition, calculate C D, without reference to its real value. Then, as the *calculated* value of C D is to the *real* value, so is 1000 to the real value of A B.

Exercise 13.

1. In a coast survey, observations are made from two rocks, A and B, at sea, on a lighthouse and a headland, which are 2857 yards apart. At A the lighthouse bears 78° 32′ and the headland 36° 24′ from B. At B the headland bears 65° 15′ and the lighthouse 28° 42′ from A. Required the distance between the rocks, and their bearings from the lighthouse and the headland.

PROBLEM VI.—To find the height of an inaccessible object situated above the plane of observation, and its height above that plane (Fig. 23).

Fig. 23.

Take two stations, A and B, in line with the object, and measure A B; observe the angles B A C, F B C, F B D. From the first two the total height, F C, and the distance, F B, may be obtained, as in Problem III. F B and F B D being known, F D is obtained as in Problem I. F D = height above plane of observation, and F C − F D = height of object.

Exercise 14.

1. In order to find the dimensions of a window of a cathedral, which is inaccessible, I select two stations in front of it, 54 ft. apart. From the far station the elevation of the top of the window is 31° 30′; and from the near station the elevations of the top and bottom are 48° and 36° 30′ respectively. What is its height, and how high above the ground?

2. A castle standing on the top of a cliff is observed from two stations at sea, which are in a line with it, and a quarter of a mile apart. The elevation of the top of the castle, seen from the remote station, is 16° 28′; the elevations of the top and bottom, seen from the near station, are 52° 14′ and 48° 38′ respectively. What is its height, and what its elevation above the sea?

A variety of useful miscellaneous examples will be found in "Galbraith and Haughton's Trigonometry," from which the foregoing exercises have been taken.

KEY TO EXERCISES IN LESSONS IN PLANE TRIGONOMETRY.—III., V.

Exercise 2.*

1. A = 61°; B = 29°; c = 35·065.
2. A = 61°; a = 297·5; b = 164·815.
3. A = 36°; a = 3·2715; c = 5·56.
4. B = 29°; a = 39·71; c = 45·38.
5. A = 15°; B = 75°; c = 2588·2 ft.
6. A = 36°; B = 54°; b = 2426·5.
7. B = 15°; a = ·00483; b = ·001295.
8. A = 29°; B = 61°; a = ·485.
9. A = 40°; B = 50°.†
10. 34°; 60 ft.
11. 605 yds. and 748 yds. respectively (omitting fractions). As these distances were traversed in equal times, the speeds were proportional to the distances; hence the speed of the faster train was nearly 24⅞ miles per hour.
12. 67 yds.; 60°.
13. 386·4 yds.; 103·4 yds.

(*No Key is required to Exercise 3.*)

Exercise 4.

1. A = 36° 49′ 36″; B = 45° 37′; C = 97° 33′ 24″.
2. A = 48° 38′ 53″; B = 45° 9′ 17″; C = 86° 11′ 55″.
3. A = 45° 33′ 34″; B = 59° 40′ 43″; C = 75° 45′ 40″.
4. A = 96° 53′ 16″; B = 48° 46′ 24″; C = 34° 20′ 17″.

Exercise 5.

1. A = 96° 18′ 24″; B = 45° 20′ 16″; c = 136·1.
3. A = 34° 8′ 53″; B = 19° 15′ 1″; c = 76·14.
3. B = 119° 34′ 58″; C = 38° 11′ 32″; a = 75·24.
4. B = 54° 2′ 20″, or 125° 57′ 40″; C = 83° 32′ 40″, or 11° 37′ 20″; = 191·5, or 38·83.
5. A = 42° 22′ 49″; B = 100° 54′ 41″; b = 77·203.
6. A = 104° 53′ 34″; C = 12° 42′ 6″; c = 49·37.
7. A = 90°; B = 51° 41′; b = 78·46.

Exercise 6.

1. A = 60° 57′ 10″; b = 206·65; c = 220·55.
2. A = 22° 52′ 45″; b = 2221·8; c = 1543·1.

Exercise 7.

1. 929·54452 sq. ft.	3. 1·335.	5. 692·337.	7. ·03816.
2. ·47523 sq. miles.	4. 40535.	6. 150769.	8. 1·710.

* The above answers are only approximately correct, the table of ratios in Section X. having been purposely restricted to three places of decimals, to render calculations less difficult.

† Certain ratios of these angles were accidentally omitted from the table.

LESSONS IN GERMAN.—LXXIV.

§ 132.—RULE.

A noun or pronoun which is the *immediate* object of an active transitive verb is put in the accusative; as, Der Hund bewacht das Haus, the dog guards the house.

OBSERVATIONS.—(1.) The accusative, as before said, being the case of the *direct* or *immediate* object (§ 129. 1) is used with all verbs, whatever their classification in other respects, that have a *transitive* signification. Accordingly, under this rule come all those impersonal and reflective verbs that take after them the accusative; all those verbs having a *causative* signification; as, fällen, to fell, *i.e.*, to *cause* to fall; as also nearly all verbs compounded with the prefix be. The exceptions are begegnen, behagen, bestehen, beruhen, beharren, and bewachsen.

(2.) Lehren, to teach; nennen, to name; heißen, to call; schelten, to reproach (with vile names); taufen, to baptise (christen), take after them *two* accusatives: as, er lehrt mich die deutsche Sprache, he teaches me the German language; er nennt ihn seinen Retter, he calls him his deliverer. (See Section LII.)

(3.) The accusative is used with such terms as wiegen, to weigh; kosten, to cost; gelten, to pass for; werth, worth; schwer, heavy; reich, rich; lang, long; weit, wide, to mark definitely the *measure* or *distance* indicated by these words; as, dieser Stock ist einen Fuß lang, this stick is a foot long; er ist vier Monate alt, he is four months old. In the earlier German, those words of measure or distance were put in the genitive; as, einer Spanne weit, a span wide.

(4.) As words expressing time indefinitely are put in the genitive (§ 128. *Obs.*), so those denoting a particular point, or duration of time, are put in the accusative; as, ich wartete zwei Tage, I waited two days.

§ 133.—RULE.

A noun or pronoun, used merely to explain or specify that which is signified by a preceding noun or pronoun, is said to be in apposition, and must be in the same case; as, Cicero, ein großer Redner, Cicero, a great orator; der Rath meines Bruders, des Rechtsgelehrten, the advice of my brother, the lawyer.

OBSERVATIONS.—The proper names of months, countries, towns, and the like appellatives, are put in apposition with their common names, where, in English, the two words stand connected, for the most part, by the preposition *of*; as, der Monat August, the month (*of*) August; die Stadt London, the city (*of*) London; die Universität Oxford, the University (*of*) Oxford.

§ 134.—THE PRONOUNS.

RULE.—A pronoun must agree with the noun or pronoun which it represents, in person, number, and gender; as, Der Mann, welcher weise ist, the man who is wise; die Frau, welche fleißig ist, the woman who is diligent; das Kind, welches klein ist, the child that is small.

OBSERVATIONS.—(1.) The neuter pronoun es is used in a general and indefinite way to represent words of all genders and numbers; as, es ist der Mann, *it* is the *man*; es ist die Frau, *it* is the *woman*; es ist das Kind, *it* is the *child*; es sind die Männer, they are the *men*, etc. In like manner, also, often are used the pronouns das, (*that*); dies, (*this*); was, (*what*); as also the neuter adjective alles, (*all*); as, das sind meine Richter, these are my judges.

(2.) When the antecedent is a personal appellation formed by one of the diminutive (*neuter*) terminations chen and lein, the pronoun, instead of being in the neuter, takes generally the gender *natural* to the person represented; as, wo ist Ihr Söhnchen? Ist er (not es) im Garten? Where is your little son? Is *he* in the garden? The same remark applies to Weib (*woman*) and Frauenzimmer (*lady*). When, however, a child or servant is referred to, the neuter is often employed.

(3.) A collective noun may in German, as in English, be represented by a pronoun in the *plural* number: as die Geistlichkeit war für ihre Rechte sehr besorgt, the clergy were very anxious about their rights.

(4.) The relative in German can never, as in English, be suppressed; thus in English we say, the letter (*which*) you wrote; but in German it must be, der Brief, welchen du schriebst.

(5.) The neuter pronoun es, at the beginning of a sentence, is often merely expletive, and answers to the English word "there" in the like situation; as, es war Niemand hier, there was no one here; es kommen Leute, there are people coming.

(6.) The English forms, "he is a friend *of mine*," "it is a stable *of ours*," etc., cannot be literally rendered into German; for there we must say, er ist mein Freund, he is my friend; or, er ist einer meiner Freunde, he is one of my friends, etc.

(7.) The definite article in German is often used where in English a possessive pronoun is required; as, er winkte ihm mit der Hand, he beckoned to him with his (*the*) hand.

(8.) The datives of the personal pronouns are often in familiar style employed in a manner merely expletive; as, ich lobe mir den Rheinwein, I like Rhenish wine *for me*, *i.e.*, I prefer Rhenish wine.

§ 135.—THE ADJECTIVES.

RULE.—Adjectives, when they *precede* their nouns (expressed or understood), agree with them in number, gender, and case; as, diese schöne Dame, this handsome lady; ein gütiger und gerechter Vater, a good and just father; den zwölften dieses Monats, the twelfth (*day*) of this month, etc.

OBSERVATIONS.—(1.) This rule, of course, has reference to those adjectives which are used *attributively*; for predicative adjectives, it will be remembered, are not declined. For the several circumstances under which adjectives are varied in declension, consult §§ 27, 28, etc.

(2.) This rule applies equally to adjectives of all degrees of comparison; as bessere Bücher, better books; der beste Wein, the best wine; des besten Weines, of the best wine, etc. So, too, it applies equally to all classes of adjectives; as adjective pronouns, numerals, and participles.

(3.) The word "one," which in English so often supplies the place of a preceding noun after an adjective, cannot be translated *literally* into German; its office being rendered needless in the latter tongue by the terminations of declension.

(4.) So, also, the English "one's" is a proper equivalent of the German sein in such cases as the following: gibt es etwas Edleres, als seinen Feinden zu vergeben? is anything more noble than to forgive one's enemies?

(5.) When the same adjective is made to refer to several singular nouns differing in gender, it must be repeated with each and varied in form accordingly; as, ein gelehrter Sohn und eine gelehrte Tochter, a learned son and a learned daughter. The adjectives are also often repeated, though the nouns be all of the same gender.

§ 136.—THE VERBS.

RULE.—A verb must agree with its subject or nominative in number and person; as, jeder Augenblick ist kostbar, every moment is precious; die Bäume blühen im Frühling, the trees bloom in spring.

OBSERVATIONS.—(1.) When the subject is the pronoun es, das, or dies, used indefinitely (see § 134. 1), the *predicate*, if a noun, determines the number and person of the verb; as, es sind die Früchte Ihres Thuns, these are the fruits of your actions.

(2.) In the *second* person (singular and plural) of the imperative mood, the pronoun which forms the subject is commonly omitted; as gehet hin und saget Johanni wieder, was Ihr sehet und höret, go and tell John what ye see and hear.

(3.) When the verb has two or more singular subjects connected by und, it is generally put in the plural; as, Haß und Eifersucht sind heftige Leidenschaften, hatred and jealousy are violent passions.

(4.) When the subject is a collective noun, that is, one conveying the idea of many individuals taken together as unity, the verb must (generally) be in the singular; as, das englische Volk hat große Freiheit, the English people have (*has*) great liberty. In a few cases only, as ein Paar, a pair; ein Menge, a number; ein Dutzend, a dozen, the verb sometimes stands in the plural.

(5.) When a verb has several subjects, and they are of different persons, the verb agrees with the first rather than the second, and the second rather than the third; as, du, dein Bruder und ich wollen spazieren gehen, thou, thy brother, and I will go take a walk; du und dein Bruder vermöget viel, you and your brother avail much.

§ 137.—USES OF THE TENSES.

RULE.—The *present tense* properly expresses what exists or is taking place at the time being; as, die wahre Tapferkeit beschützt den Schwachen, true valour protects the weak.

OBSERVATIONS.—(1.) The present in German, as in other languages, is often, in lively narrative, employed in place of the imperfect; as, die Sonne geht (for ging) unter, da steht (for stand) er am Thor, &c., the sun goes down, when he stands at the gate, etc.

(2.) The present is not unfrequently used for the future, when the true time is sufficiently clear from the context, or when, for the sake of emphasis, a future event is regarded and treated as already certain; as, ich reise morgen ab, I start (that is, *will* start) to-morrow; dies Schloß ersteigen wir in dieser Nacht, this castle scale we (that is, *will* we scale) this very night; bald sehen Sie mich wieder, soon you (*will*) see me again; wer weiß, wer morgen über uns befiehlt, who knows who commands (that is, *will* command) us to-morrow?

(3.) It should be noted that the present is, moreover, the proper tense for the expression of general or universal truths or propositions; as, die Vögel fliegen in der Luft, birds fly in the air.

(4.) In English we have several forms of the present tense; as, *I praise*, *I do praise*, or *I am praising*. In German there is but one form (ich lobe) for the expression of these several shades of meaning.

(5.) The present, in connection with the adverb schon (already), often supplies the place of a perfect; as, wir wohnen schon sieben Jahre hier, already dwell we here (that is, *have we dwelt*) seven years.

(6.) In English we say often "I *do* walk," "I *did* walk," and the like, where the verb *do* (present and imperfect) is employed as an auxiliary. This cannot properly be done with the corresponding verb (thun, to do) in German.

KEY TO EXERCISES IN LESSONS IN GERMAN.

EXERCISE 188 (Vol. IV., page 14).

1. In spite of the trouble which the teacher gave himself, the children would not make any sound progress. 2. He made considerable progress in the German language, after he had overcome the first elements. 3. He is without the most needful books. 4. A poor family is often without the most necessary household furniture. 5. The tranquillity of this accused man rests on the consciousness of his innocence. 6. The captain told us yesterday, that the young Italian had shot a ball through his head. 7. He shot a ball through the bear's head. 8. I prefer travelling by way of Bremen or Hamburg, instead of by way of Havre. 9. I prefer riding on horseback to walking, and riding in a coach to riding on horseback. 10. I am more comfortable in a warm room than in a cold one. 11. It is most agreeable to him to be able to smoke his cigar after dinner. 12. To boys it is most pleasing and also most healthy to take half an hour's walk after dinner. 13. I had an unpleasant sensation all the morning. 14. The princes of Germany have again usurped the government. 15. The uncle contrived to usurp his nephews' property by degrees. 16. It is some time since I saw him. 17. Is it long since he fell ill? 18. Yes, it is more than three weeks already. 19. Stay at home till I come to you; I shall call on you for a walk. 20. Death calls away not only the old man, but also very often the man in his prime, the youth, and the child in the cradle. 21. As I knew that my friend would arrive by the steamboat, I went to the landing-place for him. 22. I called at the post-office this morning for this letter. 23. On my journey I stayed at different inns, but I cannot praise any one of them particularly. 24. I generally call on my friends when I go to town.

EXERCISE 189 (Vol. IV., page 14).

1. Ich machte bessere Fortschritte in der deutschen Sprache, nachdem ich die ersten Anfangsgründe überwunden hatte. 2. Der Onkel sucht das Vermögen seiner Neffen an sich zu reißen. 3. Ist es lange, daß Ihr Bruder krank wurde? 4. Nein, es ist nicht länger, als einige Tage. 5. Werden Sie zu Hause bleiben, bis ich bei Ihnen vorspreche? 6. Es ist mir angenehmer, einen Spaziergang auf das Land zu machen, als zu Hause zu sitzen. 7. Wenn ich nach der Stadt gehe, so spreche ich gewöhnlich bei einigen meiner Freunde ein. 8. Er zieht das Studieren allen andern Beschäftigungen vor. 9. Ich ziehe das Gehen dem Reiten, und das Reiten dem Fahren vor. 10. Während der Schlacht ritt der General die Reihen entlang, um seine Soldaten anzufeuern. 11. Kindern ist es gesund, wenn sie nach der Schule spazieren gehen können. 12. Die Räuber rissen sich um die Beute, welche sie den Bürgern genommen hatten.

EXERCISE 190 (Vol. IV., page 68).

1. The creditors have compounded with the debtor at fifty per cent. 2. The two merchants could not agree as to the price. 3. I have compared the two together. 4. He has let the house to him for five years. 5. The young man has hired himself out as servant. 6. It is sur-

prising that such a thing can happen in our times. 7. It surprises me that he has survived and did not die. 8. Cicero delivered an address against Catiline. 9. He likewise delivered speeches on Friendship, on Old Age, and on various other subjects. 10. Cæsar delivered an address to his soldiers. 11. The scholar repeated once more at home that which he had heard at school. 12. We heard a repeated crying. 13. The price of these wares has risen considerably. 14. The corn has risen considerably on account of the war. 15. Prudence sometimes commands even the brave man to avoid an enemy who seeks to quarrel with him. 16. The political fugitive is obliged to avoid his fatherland. 17. One should avoid the society of a depraved man. 18. The physician visits the sick person every other day. 19. Every other day he goes hunting. 20. He acted with the same levity as a man as he had done as a youth. 21. When the Hungarian heroine Jagella and other Hungarian heroes arrived in New York, they alighted at an hotel. 22. At dinner was brought in for dessert a tower, ornamented with warlike implements, made of confectionery, on which were the words, in the German language: "Long live the Hungarian heroes and heroines."

EXERCISE 191 (Vol. IV., page 68).

1. Der Gläubiger hat sich mit seinem Schuldner auf zwanzig Procent verglichen. 2. Ich konnte mich mit meinen Gläubigern wegen des Preises nicht vergleichen. 3. Haben Sie die Güte, eins mit dem andern zu vergleichen. 4. Ich habe mein Haus auf fünf Jahre vermiethet. 5. Ein fleißiger Schüler wiederholt das, was er in der Schule gehört hat. 6. In Kriegszeiten steigt der Preis der Lebensmittel bedeutend. 7. Es wundert mich, daß er die Gesellschaft solcher Leute nicht meidet. 8. Wir sollten die Gesellschaft derjenigen meiden, welche keine guten Grundsätze haben. 9. Ich besuche meine Schwester einen Tag um den andern. 10. Er handelt gerade, wie er in seiner Jugend handelte. 11. Alle Waaren sind dem Kaufmanne genommen worden, weil er sich mit seinen Gläubigern nicht vergleichen konnte. 12. Waffne dich Tag für Tag mit mehr Weisheit, Jüngling, denn die Blume der Jugend verblüht

LESSONS IN ENGLISH LITERATURE.—XXIII.

ADDISON AND THE ESSAYISTS.

IT was one of the especial tasks of the generation of which we are now speaking, to popularise the higher kinds of literature. The drama, no doubt, in every age in which it flourished, had always relied upon a wide popular support, and from the very nature of things it must be so. But the popularity of the drama has been among spectators, not among readers. Particular books, too, had from time to time, for special reasons, acquired a wide-spread popularity, as was the case with "Hudibras." But for the most part the greatest writers had addressed themselves either to the learned alone, or, at least, to that very limited class of the population which may be called the cultivated class. But by the reign of Queen Anne some degree of taste and culture had become much more widely diffused than before, and an immense step in the progress of literature was made when literary men found a way to meet this extended taste, and supply this increased demand for literary enjoyment, by means of short essays published periodically, adapted by their brevity to attract the mass of those who would be repelled by an elaborate philosophical treatise, and by their literary merit to suit the taste of the most fastidious reader. Addison was not the originator of this kind of writing, but he was so far the most brilliant and successful of its cultivators, that he will always be regarded as the best representative of the periodical essayists in the age when the periodical essay was in its greatest perfection.

Joseph Addison, the son of the Rev. Launcelot Addison, rector of Milston, Wilts, was born in 1672. He received his earlier education at the Charterhouse, from which he removed in due course to Magdalen College, Oxford. Before his university career had finished, Addison had acquired a reputation extending beyond the limits of the university, as a most finished scholar and a young man of rare promise. He was early taken under the patronage of the great Lord Chancellor Somers, and thus obtained the means necessary to enable him to travel for several years upon the Continent. On the death of William III., and the accession of Queen Anne, Addison's friends ceased to be powerful, and for some time he felt the change severely; but in 1704 he was applied to by Godolphin, on behalf of the Whig Ministry then in office, to write a poem in honour of Marlborough's great campaign in Germany, which had culminated in the victory of Blenheim. This was Addison's first really important literary venture. The moment was very favourable; the party in opposition were making persistent efforts to depreciate Marlborough's achievements; the Ministry were very anxious to meet these efforts quickly, and secure popular opinion on their own side; and they attached great importance to the projected poem. Addison's work was a complete success. To a modern reader it is almost intolerably stilted and unnatural, and in truth deserves what was said of it not long afterwards, that it was a "gazette in rhyme." But it suited the somewhat stiff and formal taste of the day. Indeed, the connections which it contributed to establish were the foundation of most of Addison's subsequent advancement. Addison's advancement in the public service was steady and rapid. He became first Secretary for Ireland. In 1716 he was married to the Dowager Countess of Warwick, a union which does not seem to have conduced to his domestic happiness, however it may have assisted his rise in the public service. In 1717 he was advanced to the dignified and responsible post of Secretary of State. But Addison's diffidence, and even awkwardness of manner, making him a very inefficient speaker in Parliament, disqualified him in many respects for this office; and there can be little doubt that a consciousness of his defects must have combined with his declining health in inducing him to relinquish office and retire upon a pension, after a short period of service. He died soon afterwards, in 1719.

Amongst Addison's poetical works, we have already mentioned the one which was at the time the most successful, "The Campaign." He was, besides, the author of many short occasional pieces of inferior interest. The words written by him for the opera of "Rosamond" are of much the same character as other pieces of the same kind, and would scarcely have been remembered now, had any one of less reputation than Addison been the author.

In the more formal drama, Addison's two attempts are the comedy of "The Drummer"—a slight piece, displaying much of Addison's humour, but scarcely to be called a success as a play—and the far more ambitious tragedy of "Cato." Few plays have excited more attention, or have been, in one sense, more successful than this celebrated tragedy. The immense and well-earned reputation of its author, its easy application to the political controversies of the day, and the influence of Addison's numerous friends of all classes, secured crowded audiences night after night, as long as "Cato" was on the stage. Nor was the popularity of this play exhausted by a first success, as we can easily discern by the perpetual quotations from it, and references to it, by contemporary writers. But the play has really little to recommend it. It is, no doubt, rigidly correct, according to the most exacting classical standard: the unities are strictly observed; the language is dignified and impressive; the versification faultless. But dramatic action or interest it has none; development of character it scarcely attempts; it is a tissue of pompous declamation rather than a play.

It is as a prose writer, and not as a poet, that Addison has earned immortality. His longer treatises—his "Travels in Italy," and his "Essay on Medals," of which the object was to show the importance of ancient medals, as throwing light upon ancient history—give evidence upon every page of Addison's delicate taste, finished scholarship, and minute acquaintance with ancient literature; and their style is beautifully clear and simple. But these works are at the present time almost forgotten. Those by which Addison is now known are his numerous short essays contributed to the three successive series, published under the titles of the *Tatler*, the *Spectator*, and the *Guardian*.

The *Tatler* was projected and started in 1709 by Sir Richard Steele, Addison's colleague in many a literary work. It was published three times a week in the form of a small sheet. Its success was very great, though its fame has been eclipsed by that of its more celebrated successor. The *Tatler* lasted for nearly two years, and was then discontinued. In 1711 Addison and Steele together started the *Spectator*. This was a bolder speculation than the former, being issued every day. It was continued till the close of the following year. Its success was immediate and unbounded. The *Tatler* had been commenced not less as a vehicle for news—a record of all that could interest the town from day to day—than for the purpose of serious criticism and discussion. The *Spectator*, on the other hand, was from first to last the same in character. The daily sheet contained always an essay on some subject literary or social, a satire on some popular vice or folly, a story, a fable, sometimes even a religious meditation. The whole is connected together by the slight framework of a group of ideal characters, whose impressions and opinions are brought before us in successive numbers. The imaginary Spectator himself, who provides us with this fare, is a man who has seen much of the world, who, now living in London, takes his part in all its pleasures and pursuits, but who through all remains a silent observer. He is at home and at ease only in the society of the club, formed by a small circle of intimate friends. Among these friends the most notable is Sir Roger de Coverley, a beautiful picture of an old-fashioned country gentleman. The Spectator himself, with his bashful silence, his close observation of men and things, and his quiet humour, has been thought to be a portrait of Addison himself drawn by his own hand.

The *Spectator* had many contributors; but it was to Addison's genius that its popularity was mainly due, and it is his genius that gives it its permanent value. He contributed more than one-third of the whole series of papers.

The *Spectator* was succeeded by the *Guardian*. But the new periodical never achieved, and indeed never deserved, anything like the success of its predecessor. Addison had little share in it; at the commencement, none. Within a year it ceased to appear. In 1714 Addison, no longer in literary partnership with Steele, revived the *Spectator* for about six months, issuing three papers in the week. With the final extinction of the *Spectator*, Addison's connection with this form of literature closed.

Nothing is more remarkable about Addison's *Spectators* than their variety of range—the infinite fertility of imagination and thought of which they give evidence. A considerable number of them deal with subjects of pure literary criticism; and so different is the taste of the present day from that of Addison's time, that these critical papers have comparatively little value to a modern reader. But they were of great service in instructing the judgment and forming the taste of those for whose immediate use they were written. In a series of essays, Addison examined with the eye of a critic and in the spirit of genuine admiration the works of Milton. And there can be little doubt that these essays did more than anything else to restore the great Puritan poet to that deserved eminence from which he had been swept by the tide of popular passion and prejudice at the Restoration, and from which ignorance and oblivion had ever since excluded him.

Those of the essays which treat of grave questions of morality, and other like subjects, have a dignity and simplicity very characteristic of their author. In truth, there has seldom been a great writer whose life and writings are so entirely in harmony, whose works so accurately reflect not only the more deliberate thoughts but the whole spirit and character of the man. And in such papers as those of which we now speak we see in strong relief that purity and elevation of thought and feeling, that singularly calm judgment and conscientious spirit, which distinguished Addison from all other writers of his day; those qualities which secured for him the respect, almost the veneration, even of his bitterest opponents, in an age when controversy was unusually bitter; and enabled him alone, amid all the heat of political controversy, to abstain from anything approaching to personal unfairness towards his antagonists.

A large number of Addison's papers in the *Spectator* are addressed to topics of the moment, the changes of fashion, and the amusements, habits, and follies of the hour. These have, for us, lost much of their interest and attraction, for the fashions and follies of the present day are not the fashions and follies which Addison saw and laughed at. But these essays are absolutely perfect of their kind. No man, perhaps, has ever been so consummate a master as Addison of satire in its purely kindly form, without one drop of the bitterness and contempt the presence of which changes its whole nature and curdles it into poison. No man has ever used so effectively that gentle raillery which can expose and reprove a vice or a folly, and show it in its most ludicrous form, without wounding or irritating those whom it seeks to instruct.

But the genius of Addison shines at its brightest in those of his writings which are purely imaginative, and in which he portrays human nature, and appeals to our human sympathies. All the papers devoted to Sir Roger de Coverley are among the most delightful in the whole series. The character of Sir Roger was, in the first instance, roughly sketched out by Steele; but it at once passed into the hands of Addison, and the picture as it stands is the work of his pencil. The lifelike, though very brief sketches of his daily life, his conduct in church, his dealings with his affectionate tenantry, his journey to London, his visits to Westminster Abbey, and his impressions from the various scenes and circumstances in which he is placed, are all as fresh and natural as if they had been drawn but yesterday. The description of the old man's death, from the pen of his faithful servant, is one of the most touching passages in all literature. Scarcely inferior to the old country gentleman is Will Honeycomb, the superannuated man about town, who, after the knight, forms the most striking figure in the group of the Spectator's friends. Of the imaginative papers of another class, an admirable example is the celebrated "Vision of Mirza."

In no way perhaps has Addison exercised so strong and lasting an influence as by the example of his exquisite style. His language and expression are not only always in harmony with his subject, but they are in marvellously close accord with the whole character of his mind. His style is easy, pure, simple, without effort, but without monotony, admirably expressive of the finest shades of thought or feeling, and at the same time perfectly natural. Addison has long and justly been regarded as a model of good English writing, and the effect of his influence upon public taste has been singularly beneficial.

Of Sir Richard Steele we have already had occasion to speak in connection with his illustrious friend and fellow-labourer Addison. And, in fact, his main title to fame with posterity is the fact of his having established those periodicals which became the medium for Addison's genius. Steele was, however, a writer of no mean power himself. He was born in Ireland in 1675; but was educated at the Charterhouse, where he was the schoolfellow of Addison, and where the devoted affection and almost reverential regard which he showed for Addison throughout life commenced. Steele's whole career was one of extravagance, dissipation, and debt, alternating or combined with at least occasional fits of strong religious enthusiasm. In addition to a very large number of papers in the *Tatler*, *Spectator*, and *Guardian*, he was the author of very numerous political and party pamphlets and articles; for, like Addison, Steele was one of the literary champions of the Whig party. He also published a treatise on religion under the title of "The Christian Hero." He died in great poverty in 1729.

Sir William Temple occupied in his own day a conspicuous place in the world of letters, but he owed it more to his social position and political eminence than to any real genius for literature. He filled distinguished public posts, both at home and abroad, under the government of William III.; was a great patron of literary men; and wrote a large number of essays, much admired at the time, but of no permanent value.

Among the minor essayists of this period, one of the most brilliant was Atterbury, Bishop of Rochester. He formed one of the distinguished circle of wits and men of letters of which Pope and Swift formed the centre; and he took part with them in the series of papers published under the name of "Martinus Scriblerus." He bore an active share, too, in the famous Boyle and Bentley controversy, which Swift has immortalised in his "Battle of the Books." Atterbury was a vehement Jacobite, and being at last impeached for the treasonable practices in which he had been concerned on behalf of the exiled Stuarts, was condemned, and sentenced to banishment. He died in exile.

Lord Shaftesbury was grandson of the Shaftesbury who, as we have seen, was the great object of Dryden's satire. His "Characteristics," which treat mainly of speculative questions upon ethical and metaphysical subjects, enjoyed a high reputation during their author's life. They are now, however, little read.

To a very different school belongs Bernard Mandeville, a physician by profession. Mandeville was a bold and sceptical thinker, whose theories, moral and social, were attacked by a host of eminent writers, as subversive alike of religion and morality. The most celebrated of his works is the "Fable of the Bees," written to develop his theories of morals and his ideas as to the basis of the social system.

LESSONS IN NAVIGATION.—I.

DEFINITION OF THE ART—DEAD RECKONING—LOG: PRACTICAL WAY OF KEEPING THE LOG—DEFINITION OF TERMS.

NAVIGATION may be defined as the art by which the mariner is able at all times to ascertain the position of his vessel upon the earth's surface, the course she has pursued and distance traversed in any given time, and the course which she must follow to reach a given point. The wider definition sometimes given, and which, indeed, the name suggests—the art of conducting a ship from place to place—is misleading, since it would seem to include a thousand arts of practical seamanship lying quite beyond its province.

Assuming the navigator to be provided with charts showing the distance and course between any two given points, it is obvious that his first and greatest necessity is the power of fixing his position at any time upon the "trackless waste" as represented by his chart, for, knowing his position, he has evidently the means of tracing his past and planning his future course.

There are two ways of fixing a vessel's position, one by observations of the heavenly bodies (nautical astronomy), the other by what is called *dead reckoning*—that is, by deduction from a close record of the vessel's movements since her place on the chart was last determined. The elements of this record are the observed speed and the course or courses sailed—the former obtained by "heaving the log" at intervals, and the latter by watching the compass. A ship at sea is so much the sport of winds and waves, tides and currents, that this record (which is called the *log** or journal) is liable to serious error, and the ship's position, as deduced from it every day at noon, needs to be checked as often as possible by the more certain but troublesome and not always feasible method of celestial observation. As cloudy skies and violent storms often forbid observation for days together, the importance of a well-kept log cannot be overrated, and the accurate keeping of the *log-board* may be called the first or *practical* division of the science. The daily deductions from the log may, on the other hand, be called the second or *theoretical* part of the science. The remaining branch—the observation of the heavenly bodies to check deductions from the log—involves practical skill and theoretical considerations of an equally high order.

I. To commence with the practical work of *keeping the log*.

The nautical day runs from noon of one day to noon of the next. During that time the ship's movements at every hour, as nearly as can be estimated, are noted on the *log-board*—*i.e.*, the course or direction followed at each hour, and the speed through the water. The completed record is called *the day's work*, and from it, at noon, is computed the *dead reckoning*, or *longitude and latitude by account*. The particulars of the log-board are then transferred to a properly ruled page in the *log-book* or *journal*, together with the computed position, the position as found by observation, the distance made during the day, and the general course steered (*i.e.*, the nett result of the various courses and distances made, if the ship, as is often the case, has not held one straight course throughout); particulars as to weather, wind, currents, variation of the compass, amount of sail set, duties of the crew, etc., and the distance and bearing of the land next expected to be seen.

The *speed of the ship* is noted every hour. A thin piece of wood, shaped like a quadrant of a circle, and so loaded as to stand upright in the water and offer resistance to being drawn along, is cast overboard. This is called the *log*, and to it is attached a thin cord called the *log-line*. In the latter are a series of *knots* (or pieces of coloured cloth) about fifty-one feet apart, and the number of these which run out during half a minute gives the number of *nautical miles* (hence called knots) at which the ship is then moving per *hour*, fifty-one feet being about the 120th part of a nautical mile. The nautical mile is the sixtieth part of a degree of latitude (= 1 minute), or about 6,080 feet; the statute mile is 5,280 feet, or about one-seventh less. The common log here described is far from being a perfect apparatus, though still generally used; various improved forms are manufactured.

The *course steered by compass* is also noted every hour, or as often as changed. It is now necessary to explain the compass card, of which a diagram is annexed in Fig. 1.

Standing at any spot on the earth's surface (except the poles, which are practically out of the question), and facing the *north*, an observer has on his right the *east*, on his left the *west*, and behind him the *south*. In order that the direction of any line on the earth's surface may be quickly described, in language universally intelligible, the whole horizon is divided into thirty-two *points*, eight of which lie in each of the spaces between north and east, east and south, etc. Half-way between north and east comes north-east, half-way between east and south comes south-east, etc. The principle on which the points are named is apparent from the diagram. The eight most important are N., N.E., E., S.E., S., S.W., W., and N.W. A combination of two of these indicates half-way between the two; thus, S.S.W. (south-south-west) is two points on west side of south and two south of south-west. Again, one of the eight principal points *by* another means one point away from the first-named towards the other; thus, N.b.E., one point to eastward of north; S.W.b.W. (south-west by west) means one point to west of south-west. This accounts for the names of the whole thirty-two, but a still greater degree of accuracy may be thus attained:—N.E.b.E.¼E., north-east by east one quarter east, equal to 5¼ points eastward of north. This might with equal truth be called E.N.E.¾N., or ¾ of a point northwards of E.N.E. The horizon, like other circles, is also divided into 360°, whence each point = 11° 15′; a half point = 5° 37′ 30″; a quarter point = 2° 48′ 45″.

Fig. 1.—THE MARINER'S COMPASS.

Sailors always describe a ship's course by the "point of the compass" towards which she is steering; but in computing position, etc., the course is described as so many degrees and minutes from the line running north and south through the spot from which she sails: thus, S. 11° 15′ W., equivalent to a course S.b.W., or one point westward of south.

Beneath the compass card, in the north and south line, is fastened a magnetised needle, and the card being free to revolve, and the apparatus hung so as to be little affected by the motion of the ship, the bearing of every part of the horizon is accurately shown, a certain known correction being made for what is called *variation of the compass*. The *magnetic pole* to which the needle points does not quite correspond with the actual north pole of the earth, and, indeed, varies slightly from year to year. The variation in England is about 2¼ points to westward of north. Hence *true north* is shown by the compass as N.N.E.¼E., and the *true* bearing of any object is obtained by adding 2¼ points to the left of the *compass* or magnetic bearing. If the ship's head point N.W. by compass, we know that her *true course* is W.N.W.¼W. The *compass course* is, however, noted on the log-board, and correction made afterwards in "working off the log." The compass course is found by simply noting to what point the ship's head is directed as shown by the compass card on board. Similarly, if we

* This name is also given to an instrument for finding the speed of the ship.

wish to steer true N.E., we add $2\frac{1}{4}$ points to the *right* to find the *compass course* to be steered, knowing, as we do, that N.E. on the card is really that distance to the left of the true N.E.: thus we steer, *by card*, E.N.E.$\frac{3}{4}$ E. The variation of the needle in any given part of the world is easily found by nautical astronomy.

But besides the variation of the needle, easily allowed for, there are two grave sources of error in the courses noted on the log-board—viz., *lee-way* and *currents*. Lee-way is caused by the ship drifting sideways under the pressure of a side wind. Its amount varies greatly with the bnild of ship, force of wind, etc., and can only be estimated roughly by the angle which the vessel's apparent course—*i.e.*, the direction in which her head points—makes with the real course, as shown by the line of broken water in her "wake." The estimated amount is noted on the log-board. Currents are still more troublesome, and no estimate of them can be thoroughly relied on; an estimate of their force and direction, if any, must, however, be noted on the log-board. Its value depends upon the jndgment and experience of the observer. A common mode of estimating currents is to render a boat stationary by lowering a heavy weight from it to a great depth, and seeing how fast, and in what direction, the ship drifts from the boat. But it not unfreqnently happens that this test is fallacions, from the boat having dropped its weight into some under-current, which canses it to move, even if the surface be quite still.

Fig. 2.

Having during twenty-four hours put upon the log-board the materials he can, in his character of practical observer, the navigator next proceeds, as mathematician, to apply the rules to be developed in the ensuing sections.

II. *Definition of terms.*

The earth is assumed, for simplicity's sake, and with sufficient accuracy for purposes of navigation, to be a perfect globe or sphere (strictly it is not so, as it slightly bulges ont at the equator, and is flattened at the poles).

The *axis* of the earth is the diameter upon which it revolves, an imaginary line passing through the centre (N S in Fig. 2). The points on the surface at which this line terminates are called the *poles* (N, S in the figure).

A *great circle* of a sphere is any circle of the same radius as the sphere, and consequently having the same centre as the sphere. Every sphere may bear upon it an infinite number of great circles, cutting each other in all directions, but they clearly must all be of the same size—that is, the greatest size which any circle traced npon the sphere can attain. With any other point in the interior of the sphere for a centre, one circle only can be traced upon the surface, which will be smaller than the great circle in proportion as its centre is distant from the centre of the sphere. Examination of a terrestrial globe will explain this: the equator and meridians of longitude are all great circles, the parallels of latitude are small circles.

The *equator* (E Q) is a great circle surrounding the earth exactly midway between the poles. Every point on the equator is therefore equidistant from the north and south pole.

A *meridian*, or *meridian of longitude*, is half the great circle which passes through any given place and the two poles, or, in other words, is an imaginary line drawn north and south through any place, and prolonged to the poles. Such line is called the meridian of the place or spot in question: N X S, N Y S, N Z S are the meridians of A, B, and C respectively, and of all other places situated on the same north and south lines.

A *parallel of latitude* is a "small circle" drawn throngh any place, encircling the earth *parallel to the equator*. The farther the place is from the equator, of course the smaller the circle. P L is the parallel on which A, B, and C are situated.

The *latitude* of a place is its distance north or south from the equator, and is measured by the length of that portion of any meridian included between the equator and its parallel of latitude, or, which is the same thing, by its distance from the eqnator, measured along its own meridian. Thus the latitnde (north) of B is B Y (or A X or C Z), and if we assume B Y to be the sixth part of the meridian N B Y S, which, as a semicircle, contains 180°, we can immediately define its position as 30° north latitude. Obviously the meridional arc from the equator to either pole is 90°, or the fonrth of a circle; consequently latitude is never expressed in figures higher than 90°.

The *longitude* of a place is its distance east or west of some special meridian arbitrarily chosen as a standard of reference, there being no meridional great circle with natural claims to pre-eminence, such as the equator has amongst parallels of latitude. The English reckon the longitude of all places as so many degrees east or west of the meridian of Greenwich (the national observatory); the French count from Paris, and so on. The longitnde of a place is thus *its distance from the meridian of Greenwich* (not from Greenwich itself), measured along its own parallel of latitude, or, as some put it, the arc of the equator lying between its own meridian and that of Greenwich. Thus the longitude of B, assuming N Z S to be the meridian in which Greenwich is situate, is B C west. Assuming B C to be the sixth part of the circle P L (360°), we can now define B's position exactly; it is lat. 30° N., long. 60° W. The longitnde of Y, or any other place on the meridian N Y S, is also 60° W. Seeing that all meridians gradually approach each other towards the poles, it is evident that a degree of longitude (measured as it is upon a circle of uncertain size) varies in length from nearly seventy statute miles at the equator to nothing at the poles; whereas a degree of latitude, measured always upon a meridian (a great circle), is constant, and is the same as a degree of longitnde at the equator. Each degree, of course, contains 60 minutes (nautical miles), and each minute 60 seconds.

The student must guard against the common error of viewing degrees of longitude and latitude as mere measures of length, comparable only with miles and furlongs. They are also *measures of angles*; thns, "B is in 30° N. lat." means that B subtends with the eqnator an angle of 30° at the centre of the circle of which its meridian forms part (necessarily also the centre of the globe). Regarding the definition of B's position as 30° lat. N. as simply signifying that it lies 1,800 nautical miles to the north of the equator, the expressions "sine of latitude of B," "cosine 30° lat.," would be unintelligible; but viewing it as the measure of the angle B O Y, they offer no difficulty. Similarly, the 60° of longitude between Y and Z are the measure of the angle Y O Z. (A knowledge of Trigonometry, as given in this work, as far as the solution of right-angled triangles, is assumed in the student.)

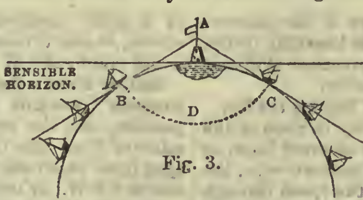


Fig. 3.

The *difference of latitude* between two places, whether on the same meridian or not, is the arc of a meridian intercepted between their respective parallels of latitnde. If they are both north or both south of the equator, the difference is found by subtracting the less latitude from the greater; if one has north and the other south latitude, the two must be added to give the difference. Similarly with *difference of longitude*: if both east or both west of Greenwich subtract the less from the greater; if one east and the other west, add the two amonnts together. Thus the difference of longitude between a place 40° W. and another 130° W. is 90°; between a place 40° W. and another 110° E., the difference is 150°. Between the place 130° W. and that 110° E. we do not, however, describe the difference as 240°. Obviously the greatest possible difference is 180°, half the circumference of the globe, so that where the difference amounts by the rule to over 180°, we take the difference between the amount found and 360°, the whole circumference of the globe. Thns 360° − 240° = 120° = difference between the places named. A little consideration will show this to be the proper difference, as the two places are so far from the Greenwich meridian that they begin, so to say, to approach each other on the other side of the world.

The *horizon*, in popular language, is the line formed by the junction in the distance of the sea and sky. Strictly, the horizon of any place is a plane imagined to touch the earth, tangent-fashion, at that place, and to extend infinitely in every direction. This is called the *sensible horizon*, but it is never sensible except to the eye of a swimmer when level with smooth water. The *visible* horizon is not a plane at all, but a conical surface, of which the apex is the observer's eye, as at A (Fig. 3), where, owing to the great elevation of the observer, a very large extent of the earth's surface is included in the cone, of which B A C is a perpendicular section. Here the visible horizon is a circle, B D C, beyond which the earth and the heavens alike dip out of sight. The angle at which the lines A B, A C dip below the sensible horizon is called the *dip*, and depends upon the elevation of A above the surface. There is a simple practical rule for finding the dip of the horizon for any given height above the surface of the sea, based on Trigonometry. It is—*The square root of the height expressed in feet is equal to the dip expressed in minutes.* The higher the observer is placed, and the greater the dip, the more distant becomes the visible horizon. Here is a rule for the distance:—*To the height of the eye in feet add half the height, and extract the square root of the sum; the result will be the distance in statute miles.* We have not space to give the simple proof of these rules, which will be found in "Galbraith and Haughton's Trigonometry."

KEY TO EXERCISES IN PLANE TRIGONOMETRY.—VI.

EXERCISE 8.

1. 168·8 ft. | 2. 54·12 ft.

EXERCISE 9.

1. 2062·65 ft. | 2. 1992·4 ft.

EXERCISE 10.

1. 220·45 ft. | 2. 848·6 ft.

EXERCISE 11.

1. 275·6 yds. | 2. 220 ft. | 3. 480 paces.

EXERCISE 12.

1. 761·9 yds.

EXERCISE 13.

1. Distance apart = 4403 yds. At the lighthouse, A bears 106° 33′, and B 33° 47′ from the headland. At the headland, B bears 109° 40′, and A 31° 19′ from the lighthouse.

EXERCISE 14.

1. Height of window = 21·639 ft.; height above ground = 49·187 ft.
2. Height = 60·82 ft.; height above sea = 445·23 ft.

LESSONS IN LATIN.—LVII.

IDIOM.

IDIOM is a word of Greek origin, signifying *what is one's own.* Hence idiom, as applied to a language, denotes that which is peculiar to that language.

In the study of languages we find that which is common and that which is peculiar. The union and systematic arrangement of what is common to languages gives rise to general grammar. The selection and exhibition of the qualities which are peculiar to any one language form what is called the idiom of that language. On general grammar and on idiomatic usages is founded the philosophy of language, which is commonly called *philology*, whose business it is to discover and set forth the universal principles of language considered as the chief instrument of thought, considered also as a picture of the human mind, and a guide in *ethnology*, or the science which treats of the derivation of nations; and considered, moreover, as an auxiliary in general history.

A full treatise on Latin idiom would require a volume. Already have many idiomatical usages been pointed out and explained. To a great extent the laws of Latin syntax are an exhibition of Latin idioms. Several of those laws, however, have their counterparts in other tongues. These accordingly belong to general grammar. Other usages are in strictness peculiar to the Roman writers and their imitators. For instance, the *ablative absolute* is not found in other languages; in Greek the *absolute* case is the *genitive*; in English, the *absolute* case (rarely used) is the *objective.*

I subjoin a few idiomatic usages with accompanying explanations, more for the sake of directing and encouraging the learner than to impart systematic instruction. With a few remarks on the collocation of words, a very important branch of idiom, I shall close these lessons, and therewith terminate a treatise, in which I have endeavoured to simplify the Latin grammar and facilitate the acquisition of the Latin language; aiming not so much at completeness as usefulness; for those who have diligently and intelligently accompanied me in this course of instruction, will find no difficulty in carrying forward their studies with the aid of the ordinary manuals. While, however, I do not profess to have exhausted the subject, I have, I believe, omitted nothing of consequence which ought to enter into an elementary treatise designed to assist the untaught, the half-taught, and the self-taught to read the Latin prose classics.

When two nouns come together of which one denotes a class and the other some members of that class, the former in Latin as well as in English is generally put in the genitive case; as—

Militum quam plurimi interfecti sunt.
Of the soldiers very many were killed.

In Latin, however, instances occur in which the former noun, the noun representing the class, is in the same case as the noun representing the members of the class; as—

Duæ filiæ, altera occisa, altera capta est.
The two daughters, the one was killed, the other taken.

The two daughters, in English, would be *of the two daughters.* Here is another example:—

Mauri, impetratis omnibus rebus, tres Romam profecti.
The Moors, all things being obtained, three proceeded to Rome.

The Latin, admitting of greater compression of style than the English, sometimes employs, as attributives, nouns or adjectives in cases where the sense in our language requires some explanatory word or words; as—

C. Junius ædem Salutis, quam *consul* voverat, *censor* locavit, *dictator* dedicavit.
C. Junius, when censor, erected, and when dictator dedicated a chapel in honour of Salus, which he had vowed when he was consul.

There are occasions when, in the Latin, the explanatory word is given; as—

Cicero cecinit ea *ut vates* (Corn. Nep.).
Cicero sang these things as a prophet.

The word on which a genitive depends is sometimes omitted. The omission takes place when the word can be easily supplied from the context. Thus the governing word is left out in a second clause or number of a sentence when it can readily be taken from the previous one; as—

Quum Atheniensium opes senescere, contra Lacedæmoniorum crescere viderent.
When the resources of the Athenians seemed to waste away, those of the Lacedemonians, on the other hand, seemed to increase.

The genitive *Lacedæmoniorum* depends on *opes*, understood from the *opes* which appears in the former part of the sentence. Observe, by the way, that the English requires the leading verb *seemed* to be repeated; whereas the Latin *viderent* governs both *senescere* and *crescere.* This is an advantage which ensues from throwing the verb to the end of the sentence.

The Romans employed adjectives of number, etc., instead of adverbs; as—

Ego primus hanc orationem legi, *I first read that oration;*

where, in the Latin, *primus* agrees with *ego.* Here you have a case of agreement, that is, an adjective agreeing with a pronoun, which you should compare with what has been said under the second head of *agreement* (Vol. V., page 282).

Considerable care is necessary to render these instances of idiom correctly; for example:—

Hanc primam orationem legi.

The words literally rendered are, *I read this first oration*, or *I read this oration first.* Neither of these renderings gives the meaning, which is—

This is the first oration which I read.

The pronouns in Latin present many instances of idiom, of which the more simple will be found already explained under the proper heads. Some that may involve difficulty to the student may be here noticed.

The adjective, which in sense belongs to the antecedent, is separated from it, and put after and in concord with the relative; for example:—

Consiliis pare, *quæ* nunc pulcherrima Nautes dat.
LIT.—*To the counsels yield, which now very excellent Nautes gives.*
IDIOM.—*Obey the very excellent counsels which Nautes now gives.*

Here, in construction, the adjective *pulcherrima* agrees with the relative *quæ*, whereas in sense it is to be taken as if in concord with the antecedent *consiliis*. In rendering such passages, the beginner will do well to alter the arrangement so as to make it correspond with the sense before he begins to construe, thus:—

Consiliis pulcherrimis pare, quæ nunc Nautes dat.

The Romans, fond of the relative, frequently use it when, in English, we employ a demonstrative pronoun; and being also inclined to put together, for the sake of broad contrast, two related words, they in questions place a relative and an interrogative side by side; as—

Quo quid potest esse turpius?
What can be more base than that?

When the relative refers to a fact or a clause of a sentence, it frequently takes before it the demonstrative pronoun, and thus arises the form *id quod;* as—

Num me fefellit res tanta, et, *id quod* magis est admirandum, dies?
You do not think, do you? that so important a fact, and what would be more wonderful, the day escaped my notice?

The pronoun *is, ea, id,* is used in the sense of our phrases *and that, and that too;* for example:—

Unam rem explicabo, *eamque* maximam.
One thing I will explain, and that not the least.

The pronoun *is*, or *hic*, is often not found in Latin in forms of speech where the English usage would lead you to expect it; as—

Xerxes proposuit præmium qui invenisset novam voluptatem.
Xerxes offered a reward to him who should discover a new pleasure.

Ei (to him) would be looked for before *qui;* its absence is idiomatic.

When the demonstrative is employed, it may stand, not, as in English, *before*, but *after* the relative; as—

Tarquinius non novam potestatem nactus, sed *quam* habebat, *eâ*, usus est injuste.
Tarquin obtained not new power, but he used the power he had unjustly.

Important idiomatic usages are connected with the *Latin participle*. That of the *ablative absolute* has been sufficiently spoken of. Another idiom or two may here be noticed.

The Latin has no *participle perfect active*, corresponding to our *having read;* the meaning may be given by a verb and a conjunction, as, for example, *Quum* epistolam *legisset*, *abiit Cicero* (*Cicero*, *having read the letter*, *departed*). The past participle of deponent verbs has an active signification; as—

Cæsar milites *hortatus* castra movit.
Cæsar, having exhorted his soldiers, moved his camp.

The passive participle in *dus* agrees with the noun or pronoun with which it is connected; for example—

Legendi sunt libri, *books are to be read.*
Causâ legendi libri, *for the sake of reading a book.*
Ad legendum librum, *to read a book.*
In legendo libro, *in reading a book.*
Ad legendos libros, *to read books.*
In legendis libris, *in reading books.*

After the verbs *curare, dare, sumere, relinquere,* etc., this participle is common in a usage which requires attention; for example—

Hanc domum ædificandam mihi conduxi;
I have contracted to build this house.
Hanc domum ædificandam tibi locavi;
I have let to thee the building of this house.

The present participle active is used after a verb instead of an infinitive, when it is intended to show that the act is at the moment proceeding; as—

Infinitive.—Te *ridere* vidi, *I saw thee laugh.*	*Pres. Part. Active.*—Te *ridentem* vidi, *I saw thee laughing.*

The force of the participle in *rus* cannot be given in English without a circumlocution; for example:—

Tiberius *trajecturus* Rhenum commeatum præmisit.
Tiberius, when on the point of passing the Rhine, sent before him all his supplies.

The participle perfect passive is used after *habeo, teneo, possideo*, etc., to give the idea of an act so past as to have become a settled condition; as—

Illud *exploratum habeto*, nihil fieri posse sine causâ.
Account this a settled point, that nothing can take place without a cause.

In sentences constructed in English with two independent verbs, the Latins prefer employing one verb and the passive participle; for example:—

Dionysius Syracusis expulsus Corinthum se contulit,
Dionysius was expelled from Syracuse and went to Corinth;

or thus,

When Dionysius was expelled from Syracuse he went to Corinth.

The participles in Latin have sometimes a causal form, which can be fully given in English only by the aid of a conjunction; as in this example:—

Nihil affirmo *dubitans* et mihi ipse *diffidens*.
I assert nothing, because I doubt and because I distrust myself.

The passive participle in *us* is sometimes used with a noun in such a way as to require to be put into English by a noun; the compound phrase demands two nouns in a state of regimen; thus, occisus Cæsar (literally, *Cæsar being slain*), must be rendered, *the slaying of Cæsar;* as—

Occisus dictator Cæsar aliis pessimum, aliis pulcherrimum facinus videbatur,
The slaying of Cæsar, the dictator, appeared to some a very shameful, to others a very noble deed.

Hence arise the phrases, post Christum natum; literally, *after Christ born;* that is, *since the birth of Christ;* ab urbe conditâ, *from the foundation of the city* (of Rome).

POLITICAL ECONOMY.—IV.

BY J. E. THOROLD ROGERS, M.A.

INTEREST AND PROFITS.

I HAVE stated in a previous lesson that the rudest and most rudimentary human society is possessed of some wealth. A man, however savage his condition may be, must have the means by which he can get his livelihood—the instruments, say, of the chase; he must have also some stock of food by him, by which he can maintain himself during the time in which he is engaged in getting more food; and, thirdly, he must be able to get so much by his implements, and by the food which supports him, as to be able to support those who depend on him for their subsistence, and who will hereafter perpetuate the vigour which he now possesses for his own needs, and on behalf of those for whom he labours. In other words, he must possess both of these forms of capital on which economists have written and said so much; and he must invest a portion of his earnings in the form by which labour can be permanently supplied. Now the weapons of a savage, the dried meat which he carries with him when he hunts, and the food which he has spared from his own sustenance in order to support his children, differ only in quantity and in quality from those accumulations of wealth which are, in any civilised community, devoted to what is called productive labour.

And here I may observe, that when economists talk about productive labour or expenditure, they mean that kind of labour or art which, either directly or indirectly, tends towards enlarging the material wealth of society. A man who increases by his labour the stock of food on which mankind can subsist, adds, obviously and directly, to the resources by which society is sustained. Another, who devotes his industry to the manufacture of articles necessary for the convenience and comfort of his fellow-men, is similarly adding to their material well-doing. A third, who busies himself in constructing those machines by which human labour is economised or lightened, is adding also to the wealth of man. Nor are those less actively engaged in production who are educating human intelligence, prolonging human life, or adding to that security which is a condition necessarily antecedent to any accumulation of wealth whatsoever. Unless men are subserving some vicious propensity, or some indulgence which neither directly or indirectly aids in sustaining, increasing, or prolonging the industrial energies of mankind, it is not easy to assert that their labour is intrinsically unproductive, or barren of all material results. Even those who merely minister to amusement, may play an important part in the economy of human industry, for recreation may so refresh the person who can take it, as to send him back to his work with redoubled energy and largely increased effectiveness.

Here, too, I may observe by the way, that even if part of the outlay of human labour is devoted towards those objects or services which are neither directly or indirectly conducive to material products, or to the industry which supplies such products, it does not follow that such an outlay of labour is to be deprecated. It is not desirable that a life of mere labour, unrelieved by any enjoyments beyond those essential to the continuity of labour itself, and always burdened with anxiety, that such perpetual toil should be the lot of each person, should be continually before the mass of mankind, or even before a number of persons, however small that number may be. If men live a penurious or ascetic life for the sake of some great and worthy object, they are doubtlessly to be commended. If they live such a life from sheer love of hoarding, they are suffering under a delusion, which is at once contemptible and perverse. But that a whole society should be determined to live coarsely and meanly, to abjure all that is beautiful or elegant, to repudiate all art and refinement, is simply to prefer barbarism to civilisation, to set up a low instead of a high ideal, and ultimately to bring about a great deal of general misery. There are forms of expenditure which are waste and mischief; but the general distribution of comforts and conveniences is as much a means for elevating men, as it is in accordance with the manifest designs of a beneficent Providence.

That which a person saves, in order to make provision on behalf of those perpetual or continual needs of his life, or in order to provide against occasional emergencies, he either employs or hoards. Every individual who is above the practice of merely living from hand to mouth, possesses some accumulation, the purpose of which is to afford some security against the risks of sickness, or suspended employment, or the loss which his death might inflict on his family. The man who subscribes to a benefit society, or who insures his life, or keeps a balance at his bankers, hoards against emergencies. It is an accident that his accumulations yield him interest. It is possible to conceive a state of society in which the disposition to save might be excessively strong, the necessity of saving very urgent, but in which no opportunity might be given for any profit in the shape of interest on such savings. It is important to notice this, because not a few eminent economists have argued as though the disposition to accumulate was entirely dependent on the interest which the person who saves could get for his savings. It is true that in a country like our own, where a very perfect, and, on the whole, trustworthy system exists, under which loans may be made, they who save do get an addition to their savings, from the interest paid by borrowers; but if such a machinery did not exist men could still save, and might save largely. That such a practice does prevail, has been proved of late years more than once, by the success with which the French Government has negotiated loans by the small subscriptions of the poorer classes in France. These loans have been met out of the hoards of the people, and the amount offered was far in excess of the amount which the Government wished to raise, and did raise. At the present moment, a very large part of the specie which exists in the world has been absorbed by the exigencies of war, partly as the most convenient machinery by which to meet extraordinary expenses, but also as a hoard. A hoard, in short, is wealth reserved in the hands of those who own it, or which, at least, is put in some place from which it can be easily and safely recovered. We shall see, by-and-bye, that the fact that some part of the savings of a country is always invested in such a form as to be easily recoverable, carries some very important results.

Men, then, save with an object, and this object is to provide against emergencies. If they are obliged to hoard their savings, they will, on the anticipation of these emergencies, save just as anxiously and carefully. If an additional motive is presented to them, that of making or getting an advantage out of what they have saved, all the better. In a country like our own, where the machinery exists by which these savings can be turned to account to the profit of the individual, what can be saved is generally turned to account. And we should remember, also, that what a man can save is all that remains over and above the cost of maintaining himself and his children, and of making provision against his own old age or other incapacity.

Wealth which is saved and used is called capital. Economists make a distinction between that capital which is *circulating* and that which is *fixed*. The former of these phrases is awkward and ambiguous, and the distinction itself is not very important. It is sufficient to say that by circulating capital is meant that wealth which is exhausted or (economically speaking) consumed in a single act, while fixed capital is that which performs a succession of acts. Thus the grain which a farmer sows is the former, the machine with which he sows it is the latter. The coals which feed the fire of a steam-engine are the former, the engine itself is the latter. But the expression "circulating" is very ambiguous. Nothing circulates so much as a shilling or a sovereign; for each piece of money performs, in the economy of society, an infinite number of operations. But it does circulate so freely and so readily, because it can perform so many operations—that is, because it is so eminently fixed. Perhaps it would be better to call these two processes of capital *exhaustive* and *recurrent*.

Though savings may be collected with a view to security, wealth is generally hoarded with a view to profit. In order, however, to have any clear idea on this subject, the true interpretation of which gives the solution of many among the most intricate problems of Political Economy, we must see what profit means.

It is the common practice to say that profit includes the interest of capital, the wages of managing the employment of this capital, and insurance against the risk of losing all or any part of it. And no doubt, in the ordinary use of the word—that is, as implying the advantage which a person gets for carrying on his business—these three facts always enter into the calculations of such a person; and it is no less clear that a person whose energy enables him to exercise a considerable management over large affairs, and whose acuteness assists him to calculate and obviate many risks, will procure a far greater profit, in the ordinary sense of the word, than other traders do. For there is no doubt that all the persons who are engaged in any business get an average rate of profit, and that they who get more than this rate are more acute and intelligent, while they who get less are less fortunate or less capable than the average.

It is manifest, however, that the wages of management are regulated by exactly the same causes which control other rates of wages. If no natural, legal, or social hindrance is put in the way of a man who works, the wages of labour conform to the cost of producing the labourer, and to the effectiveness of the labour itself. But the qualities of a man of business do not differ, except in degree and direction, from the qualities of any other person who works for wages. It is true that the mind can often do a multitude of things, while the hands can only do one; and that, therefore, unless the management be too vast for one man's control, the wages of management may be indefinitely increased. But a thoroughly good man of business has to be trained, is greatly prosperous only by a vigorous selection from other men of business, and is in reality an exceedingly effective labourer. Unless, therefore, we are to confuse wages with profit, we must account in this way for the wages of management.

Again, risk is an element which can either be calculated on a general average, or which is more or less subject to the control of acuteness and foresight. Some persons have gone so far as to say that every kind of risk or contingency is subject to some law, which determines the average recurrence of the risk. Perhaps this is a paradox; but it is certain that when taken on a large scale, and with a sufficient margin over which the average may oscillate, and with some care in estimating the character of the objects to which the risk attaches, the risk is practically capable of calculation. This, as we all know, has long been effected in the insurance of ships, of lives, and of property from fires and other accidents. But of course, even here, the examples from which the average is calculated have to be selected. No underwriter would insure an unseaworthy ship, no agent would take a thoroughly unsound life, or insure a powder-mill. So again, in a much more delicate matter, insurances of character are effected, when persons who are put in situations of confidence cannot obtain any other kind of guarantee. Those who insure character are, I presume, obliged to take a considerable margin in order to cover risks; but they are, no doubt, much more anxious to inquire into the character or antecedents of those who treat with them. No such association or office would insure the integrity of a man who had been convicted of peculation or fraud, and would probably look very suspiciously on a person whose relations had a bad name.

But no one insures against risks which prudence can obviate, because such an insurance would put an end to the motives for prudence. It would not be possible, except to a very limited extent, to insure against theft or fraud, because it is everybody's business to be on the alert, and watchful against those risks. But it would be wholly impossible to insure against bad debts, as this would be a premium on indolence and thoughtlessness. It is plain, then, that risk is for the most part within a calculable quantity, which may be avoided by sharing what an individual cannot escape from, but an association may share among themselves, or something which may be avoided by prudence or discretion. In the former case, it is part of the cost which must inevitably be incurred by those who undertake any industry; in the latter, it is part of the labour of management, and is remunerated on just the same principles as those which regulate the wages of management. In no case can it be properly be said to be part of profits.

The only remaining element, then, in what is popularly called profit, is interest. Interest has been defined to be the wages of abstinence. The definition is metaphorical, but is not a little suggestive. Under a system which brings borrowers and lenders together, the former stipulate to replace that which the latter advance, and with it some such sum as may be agreed on as a compensation which the former pay the latter for not using their own property themselves, but allowing others the use of it. The amount of such compensation is determined by competition. We must assume that the loan will be repaid, or that no reasonable doubt exists that it will be repaid. Then the amount of interest will depend on the proportion which subsists between the amount of property to be lent and the number or demand of those who wish to borrow. When the amount to be lent is great, the rate of interest will be low; when the number or demand of borrowers is great, the rate of interest is high.

Now all this is so plain, that it seems almost superfluous to state it. But plain as it is, it is only lately that it has been made intelligible, and that the legislatures of civilised countries have been willing to accept the conclusions derived from the fact. For centuries the law strove to forbid the payment of interest at all; and when the law did permit it, it attempted to fix the amount payable.

We do not now need to be told that people take little pieces of yellow and white metal, not because they want these objects, but because they want something else, which these bits of metal will more certainly procure than anything else. In other words, money is not desirable for its own sake, but for the sake of that which it will obtain. When, therefore, one man lends another a sum of money, he lends him the power of purchasing other objects, and, in effect, lends him other objects. Now there can be no doubt that if a man lend another the land which he cultivates, or the seed which he puts into the land, the lender of these necessary instruments of husbandry would expect to be compensated, because he foregoes that which he could have used to his own advantage, and permits another to use it instead. But for a very long time persons who were otherwise eminent for their abilities argued, that as money does not grow it is unjust to demand anything for its use. To take what Antonio, representing the current opinion, calls "a breed of barren metal," was thought to be rapacious and immoral, and the act was discountenanced.

Usury was forbidden by the Jewish lawgiver, at least between Israelites. The ancient polity of the chosen people discouraged the accumulation of excessive wealth by any individual or family. The lots which were assigned to the settlers were inalienable, except for a term of years. Pledges had to be restored. The perpetual servitude of one Israelite to another was disallowed. With the same object, foreign trade was forbidden. Humanly speaking, the object of the Jewish lawgiver was to establish in Palestine a hardy race of yeomen proprietors, whose institutions should be as unchanging as possible. The civil regulations of this polity, and especially that which forbade usury, were transferred to the codes of Christian communities.

I have stated elsewhere that there is hardly a fallacy ever broached on social subjects which does not possess a germ of truth in it. In the present instance, the ordinance which made usury illegal, and forbade it, had for its object the maintenance of a general equality in a peculiar society. In more modern times, enactments forbidding usury, or limiting its rate, had for their justification the undoubted rule, that it is the business of civil government to protect the weak against the strong, and therefore to interpret such contracts as the law recognises and enforces on equitable grounds; and they assumed, what is much more doubtful, that money was exactly that kind of object the lender of which could drive a hard or unfair bargain with the borrower. Hence, as soon as the law began to enforce contracts in which the payment of interest was stipulated, it prescribed the maximum rate which the borrower should pay.

There are some contracts which the law of civilised communities will never enforce at all. There are some persons whom civilised communities will either disable from making contracts at all, or will allow to make contracts only under certain conditions and certain precautions. And lastly, there are certain circumstances under which the law will annul contracts altogether, though under ordinary circumstances it would have enforced them. Thus no civilised community will allow a man to sell himself as a slave, nor will it give validity to the contracts of children or incompetent persons; nor, if we can take an instance, now happily fictitious, of the last case, does it seem likely that in case a town was besieged, and so cut off from all external supplies, the law would allow a contract to be enforced, by which a single person, whom I will suppose to be the sole owner of food, stipulated that, in exchange for his property, the besieged inhabitants should give him their whole substance. It could be doubtlessly argued that the rights of property are protected in the interests of society, and that to enforce such a contract as I have described at such a crisis, is to sacrifice society itself to one of its incidents. Now it is impossible to conceive any set of circumstances under which the possessor of money would be able to exercise as much control over lenders, as the sole owner of provisions in a besieged town could over those who were resident within the town.

The old usury laws, however, inflicted serious losses on those whom they intended to protect. The rate of interest, as I have said above, is determined by the proportion between the power of lenders and the demand of borrowers. Now there are times in which a borrower will be content to pay, not only the ordinary or average rate of interest, but to sacrifice a part or the whole of his so-called business profit, in order to meet an emergency. To legally deprive him of this power is to force him to evade the law, and to transact business with others who are also willing to evade the law. Under such circumstances he is sure to suffer two losses: first, a roundabout way, or an evasion of some regular process, is sure to be more costly than a regular transaction; and next, they who make it their business to break the law are certain to exact some compensation for the offence which they have committed, and for the disrepute which is certain to cling to those who are known to commit such irregularities. For these reasons, therefore, we have, though only a few years ago, abandoned all attempts to fix a legal rate of interest, and have merely retained a machinery by which every contract is liable to an equitable interpretation.

The usury laws led, it seems, to the adoption of a method by which mercantile bills are discounted, instead of being made liable to interest. Here, however, it will be necessary to give a short explanation of these bills. In doing so, we shall see how it is that the rate of discount is liable to great fluctuations, while the rate of interest hardly varies at all.

A trader may, and frequently does, carry on his business with nothing but his own capital, never borrowing, either from other traders, or from bankers or money-dealers. But such a kind of business is impossible in foreign trade, and is unusual in home trade. A trader who stands in good repute in the mercantile world can always increase his capital by his credit; and very few traders are possessed of so much capital, that they are willing to forego that extension of their business which credit will enable them to effect. Hence most traders will give commercial bills, *i.e.*, instruments under which they pledge themselves to pay a given sum at a given date; or obtain credit from bankers, who act as a kind of go-between to lenders and borrowers, receiving the deposits of the one, and making advances to the other. The possessor of this commercial bill may keep it by him till it becomes due, or he may carry it to his banker and discount it—that is, sell it for something less than the amount which the person who gives the bill stipulates to pay at a given time. The rate of this discount depends partly on the credit of the individual, but the only variation with which we are concerned is that which arises from the state of the money market.

Like the rate of interest, the rate of discount depends on the proportion between lenders and borrowers. But there are other causes which govern the rate of discount, and which either do not appear, or appear in a very different way, when money is lent at interest.

In the first place, the amount of money lent at interest is immeasurably in excess of that which is lent in discounting bills. It is impossible to guess its amount; it includes public funds, moneys lent on mortgage or debenture, and a variety of similar investments. Most of this amount, too, is lent for an indefinite period. But there is little doubt that the amount of property or money lent at interest is a hundred times as much as that fund which is supplied for the purpose of discounting mercantile bills, and which is in the hands of bankers, in the shape of customers' deposits and shareholders' capital. In ordinary times, the amount held by these persons is amply sufficient for purposes of trade.

These funds, however, are liable to sudden and excessive demands upon them. There are times in which the disposition to borrow, for trade purposes, is greatly in excess of the average, as when the fever of speculation is on, or when traders wish to save themselves from risk. Under such circumstances, the supply of loans falls short of the demand of borrowers, and the rate rises. The demand of borrowers may rise to a famine, and a *panic*, as it is called, ensues in the money market.

Other circumstances, the explanation of which would be too elaborate and difficult for elementary lessons such as these, affect the rate of discount. They arise from that artificial system of currency which exists among us, and which tends to render the variations in the rate more sharp and more frequent. Thus, for example, for a great part of the year 1866, the rate was ten per cent.; then it sank for a long period, more than a year, to two per cent. But in August, 1870—that is, just after the beginning of the Franco-German war—it again rose from three and a half to six per cent.

It is a common saying among economists, that the rate of profit rises and falls with high or low prices of labour, being high when labour is cheap, and low when it is dear. Cheap and dear labour must not, however, be understood to mean, as has been said before, high and low wages. A labourer may be very highly paid, and be very cheaply paid; and, on the other hand, he may get very low wages, and be a dear bargain at the money. The real test of dearness and cheapness is the efficiency of labour.

But we shall now see what the saying means, that the rate of profit rises and falls with low and high wages. That part of profit which consists of interest is unaffected by the efficiency of labour. Again, that portion which covers risk is equally unaffected. But the remaining portion, the compensation for superintendence or management, is powerfully affected by the comparative efficiency or inefficiency of labour.

The manager of a great business is like a general conducting the operations of an army. The prospect of success or victory in his undertaking depends on his own skill, and on the capacity of his troops. He may have the highest abilities, but his materials may be worthless. He may have excellent materials, and be deficient in strategical power. So the manager or master of some great business may have excellent workmen, and be deficient in the intelligence and acuteness needed for successful trade or manufacture; or, having this capacity, he may be disabled from using it by the stupidity or caprice of his workmen. But in any case, he is paid wages for the service which he does in controlling the details of his business, just as the workman is paid wages for the work he does. The only difference between the two is, that the wages of the manager or employer are disguised under the name of profits.

A conflict, therefore, between workmen and employers is a struggle as to who should get most wages. No attempt on the part of the former will succeed in lowering the rate of interest; nor will it affect that part of profits which covers risk, but, on the contrary, will tend to augment it. All that the workmen can do is to diminish the amount which the employer receives for his own superintendence or management. But they cannot do this unless the employer's remuneration is reduced all round. All workmen cannot get more, unless all employers get less. Otherwise, the general tendency of profits being to an equality, the less favoured calling would be deserted for one that is more so.

In those countries where wages are highest profits are highest. The reason will now be manifest. Deduct risk and interest, and profits become wages, and share in the rise which wages achieve under the circumstances. Now in those countries where labour is scarce, land is plentiful; and the opportunities for occupying land advantageously being abundant, wages and profits are equally high. Such is ordinarily the case in our own colonies, where diligence and perseverance will easily secure to settlers competence at first, and finally wealth. For the same reason, in these countries, the rate of interest is high, for everybody can employ capital advantageously; and everybody is willing to borrow, while few are willing to lend.

VOLTAIC ELECTRICITY.—XIX.

THE DISCOVERY AND HISTORY OF SELENIUM—ITS SENSITIVENESS TO LIGHT—DR. SIEMENS' SELENIUM EYE—THE PREPARATION OF A SELENIUM CELL.

PROFESSOR GRAHAM BELL, whose beautiful magnetic telephone has already been fully described in these pages, has given to the world another wonderful instrument, which, if not at once destined to work out practical alterations in methods of intercommunication, may possibly form the nucleus of important work in the future. The telephone, as we know, conveys speech between distant places by means of a connecting line wire. The photophone, as the new instrument is called, utilises for this purpose not a metallic wire, but a ray of light! Before describing the construction of the instrument by which this marvellous result is achieved, it will be necessary to give a brief history of a substance which hitherto has been little known or heard of beyond the precincts of the laboratory—we allude to the non-metallic element called selenium.

In the year 1817 this substance was discovered at Gripsholm, in Sweden, in the refuse of a sulphuric acid manufactory, by Berzelius, but since that time it has been found widely distributed, but can only be obtained in small quantities from the source already indicated, from iron and copper pyrites, from silver furnaces, &c. It is obtained in two different forms, one of which is soluble in carbon disulphide, the other being insoluble in the same medium. The first is known as red or glassy selenium, conducting heat badly, and being a non-conductor of electricity. The other variety is known as black or metallic selenium, and it conducts heat, and under certain conditions will form a good conductor of electricity. To this last kind of selenium only we wish to call our readers' attention. Up to within recent years, selenium was looked upon merely as a curiosity. Medallions stamped with the likeness of its discoverer were commonly to be obtained, and were doubtless put away by collectors as specimens of a rare mineral which was curious, but had no particular use or application. In 1873, Mr. Willoughby Smith made a strange discovery with reference to this substance. He found that it had a peculiar property which no one had before detected. Its electrical resistance varied with the amount of light to which it was subjected, the difference of these variations being very great indeed. In other words, the material when experimented with in darkness gave great resistance to the passage of electricity, but when exposed to light, the resistance was brought quite low. Mr. Willoughby Smith utilised this curious property of selenium in connection with the laying of long telegraphic cables, his position as electrician-in-chief to the Telegraph Construction and Maintenance Company giving him an opportunity of seeing its value in that capacity. Dr. Siemens, Professor Adams, the Earl of Rosse, and other scientific men, took up the subject, and made many other curious observations concerning this comparatively new element. Thus much was known respecting selenium when Professor Graham Bell, in association with Mr. Sumner Tainter, three years ago produced the photophone.

In previous experiments the variation of resistance in selenium, according to the amount of light submitted to it, had been tested by a galvanometer, the needle of which was of course more or less deflected according to the resistance afforded. The inventor of the telephone inferred that if that instrument were to be substituted for the galvanometer, it would probably emit sounds as the variations in resistance reached its coil-covered magnet. He was led to this conclusion by the consideration that the telephone gives no sound so long as a steady current traverses the circuit of which it forms part, but that it is necessary for the current to experience rapid changes or variations. Then sounds are transmitted by it. He argued that if an electric current could be thus varied by varying the intensity of a beam of light inpinging upon a selenium cell and that if such variations could be made to correspond to the variations of the air produced during the utterance of vocal or other sounds, the telephone could be made to reproduce such sounds.

We may pause here for a while to describe a wonderful little piece of apparatus contrived some years ago by Dr. Siemens, for it illustrates in a very perfect manner the sensitiveness of selenium to light rays. This is known as Dr. Siemens' selenium eye. It is in reality a miniature human eye, with a lens in front, and lids to close when it is weary, for, strange to say, it does, like its perfect prototype, become weary when long exposed to bright light. The lens causes any light to which the eye is exposed to be concentrated in the interior of the eyeball, and at this spot is placed a selenium grating. This grating, no larger than a threepenny-piece, is made of two fine wires running together in zigzag fashion, but not actually touching one another. Upon these wires is placed a melted drop of selenium, and the ends of the wires are joined up with a galvanometer and battery. If the eye has been closed and at rest for some time, it is sensitive to the smallest gleam of light, even that little which can be reflected into it from a blackened sheet of paper. But if it has been exposed to a bright light, the lids must be closed for a long time before it is again sensitive to feeble rays. Such experiments as these show the great sensitiveness of selenium, but Professor Graham Bell has prepared cells giving far more wonderful results.

Before the selenium is in a fit state for these delicate experiments, it requires to go through a process of annealing. The old plan of doing this was to place the cell (the structure of which it is not necessary here to describe) in a vessel of linseed oil, together with a thermometer, at the same time connecting it with a battery and galvanometer, the whole being heated over a gas stove. After a heat is reached of about 210° C., the cell is kept at that temperature for several hours, being afterwards packed up in a box so that it would cool down very gradually to the temperature of the air. The entire operation occupied about three days. In the modern form of cell adopted as the best by Professor Bell after trying a number of different patterns, this long annealing process is done away with, and the same effect is produced in a few minutes.

This new form of cell is cylindrical in shape, and is in appearance not unlike a reel of cotton. It is made of a number of discs of brass, separated by slightly smaller discs of mica, so that when the cylinder is joined up, these differences in diameter constitute a number of grooves round its surface. These grooves, about one hundred in number, are filled in with selenium. By means of two bolts passing through the cylinder from end to end the discs are placed in metallic connection, the discs 1, 3, 5, 7, &c., being in communication with one bolt, the even numbers being placed in like relation to the other bolt. These may be regarded as the terminals of the cell, allowing it to be connected electrically with the telephone and other necessary apparatus.

The annealing process is very simply managed. The little cylinder is kept in rotation in a lathe while a gas flame is burning beneath it, but separated from it by a metal plate. The brass gradually gets hot enough to melt a stick of selenium when applied to it, and is thus covered all over with that substance and allowed to cool. So far it is a non-conductor, or at least may be said to have a very high resistance. To make it tractable, it is once more re-heated over a gas stove, and now a strange change comes over it. The black amorphous substance becomes crystalline, and looks like a metal. The heating is continued until the substance shows signs of melting, when the operation is concluded, and the selenium is sensitive to light. It may be mentioned here that the cylindrical form of cell is the most convenient for introducing into the focus of a parabolic reflector, in which situation it is placed in all these experiments.

In our next lesson we propose to explain how this selenium cell was utilised by Professor Graham Bell in the construction of the photophone.

ACOUSTICS.—IV.

LAWS OF VIBRATING STRINGS—SONOMETER—MARLOYE'S HARP—VIBRATING PLATES—SAND FIGURES.

We will now direct our attention to the vibrations of strings or cords, and inquire into the laws which govern them. This subject is an important one, as many of our musical instruments consist merely of strings, which are made to vibrate. The apparatus usually employed in these investigations is called a *monochord* or *sonometer*, and is represented in Fig. 15. It consists essentially of a single wire or cord, m n, the length and tension of which can be altered at pleasure. One end of this is fixed to a peg at the extreme left of the instrument; the other end passes over a pulley, and has a number of weights suspended from it, by means of which the tension can be altered at pleasure. Two bridges, o and n, are placed under the cord, one near each end; these form its virtual extremities, and rest upon the hollow sounding-box which forms the base of the instrument. When the wire is set in vibration, the pulsations are conveyed through these bridges to the sounding-box, and thus to the body of air contained in it. In this way the power of the sound is very materially increased.

If we were merely to suspend the cord from a fixed hook, placing a weight at the lower end to keep it stretched, and then to set it in vibration, we should easily discern its vibration by the eye, but scarcely any sound would be produced, as there is no vibrating body to which its motion would be imparted. In the sonometer the cord vibrates in just the same way, but the sounding-box enables us to hear as well as to see the vibrations.

At the back of the instrument is a rod, on which the distance between m and n is divided into one hundred equal parts, and a movable bridge, o, can be placed at any part of this, so as to touch the string in any required place, and damp its vibrations there.

If now we remove o altogether, and pluck the string in the centre, or draw a violin-bow across it, we shall obtain a sound which is the fundamental note of the string, the whole of which will be thrown into vibration, as shown at A (Fig. 16). Now place the bridge, o, at the division of the scale marked 50—that is, midway between m and n—and excite one division of the string by means of the bow, as before. Both parts will at once be thrown into vibration, and the cord will present the appearance shown at B; but the note produced will be found to be just an octave higher than the fundamental note of the string.

Now move the bridge, o, to nearly the division marked 33, so as to be one-third of the way along the cord, and draw the bow across the segment, a b. We shall now obtain the note a fifth higher than the octave, and the portion b d of the cord (Fig. 16, C) will be seen to be divided into two ventral segments, as they are termed, separated by a node, c. The existence of this may easily be shown by placing three bent pieces of paper astride the cord at the points e, c, and f, and then exciting it as before. Those placed at e and f will at once be jerked off, while that at c, being placed at a node, will remain unmoved, showing that the cord there is at rest.

By moving the bridge to the division 25, we shall find the whole length of the cord divided into four segments (Fig. 16, D). The sound produced in this case will be just two octaves above the fundamental note. The division of the cord may be rendered manifest, as before, by placing pieces of paper on the wire.

In these experiments we may dispense with the bridge altogether, and damp the cord at any required place by lightly touching it with a feather. As a result of them all, we find that the shorter the vibrating segments are, the higher will be the note produced. By diminishing their length a half we raise the note an octave, and, as we have already seen, this is produced by doubling the number of vibrations in any given time. We thus obtain the following fundamental rule:—*The number of vibrations in the same time varies inversely as the length of the string, the tension remaining unaltered.*

The next thing that modifies the note produced by a string is its tension. Experimental proof of this fact can easily be obtained by altering the weight at w, or, easier still, by varying the pressure by the hand. By carefully experimenting in this way we shall find that, by increasing the tension fourfold, we raise the note an octave, that is to say, we produce double the number of vibrations. The second general law, then, may be stated as follows:—*The number of vibrations made by the cord* *in any given time varies as the square root of the tension.* It is by varying the tension of the wires that a piano is tuned; the wires usually yield a little by the constant blows of the hammers, and thus the notes become somewhat flat, and have to be tuned up to their former standard.

The diameter of the cord likewise affects its rate of vibration. If we take two cords of the same substance, similar in tension and length, but one of which has twice the diameter of the other, we shall find that the note produced by the thicker one is an octave below the other. The simplest way of showing this is to take four thicknesses of cord twisted together for the one string, and a single length of the same cord for the other. It is on account of this fact that the wires of a piano are much thicker in the bass than in the treble, and those for the lowest notes of all are frequently wound round with thin wire. The density of the cord also affects more or less the tone produced by it.

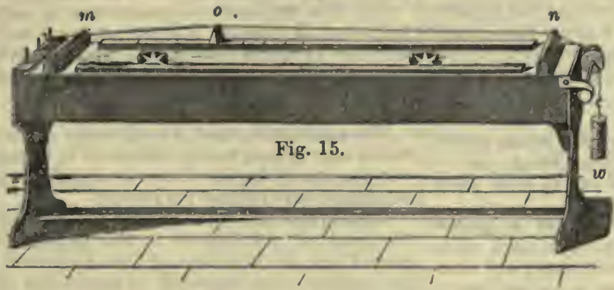


Fig. 15.

Rods of wood or metal vibrate in a very similar manner to strings, and have occasionally been used in the construction of musical instruments. Fig. 17 represents one of these, in which the sound is produced by the vibrations of some thin deal rods, fixed in a firm pedestal. This instrument is known as Marloye's Harp, and the different notes in it are produced by different lengths in the rods; the instrument is played by rubbing them longitudinally, the fingers being powdered over with resin. The vibrations here are longitudinal, instead of transverse, as in the case of the wires we have been considering.

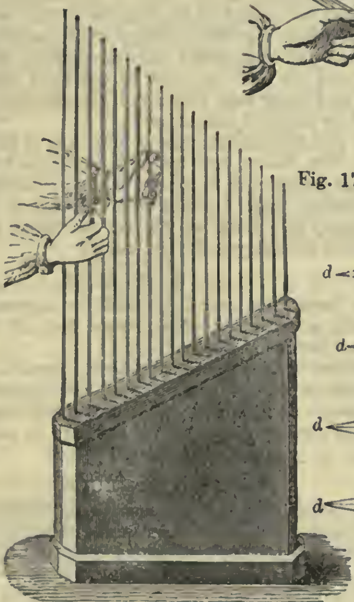


Fig. 17.

In a musical box the sound is produced by a number of narrow plates or tongues of metal, set in vibration by pins on a revolving barrel, which strike against them. In the harmonium there are somewhat similar tongues, but the motion is imparted to them by a current of air rushing past their edges.

Plates of glass or metal may easily be thrown into vibration and made to utter a musical note. When this is the case, we shall find that the vibrations interfere with one another, as in the case of strings, so that in some parts we find nodal lines, or curves, where the vibration seems altogether unfelt, while other parts correspond to ventral segments. A very simple and beautiful mode of rendering these vibrations visible was suggested by Chladni, and may very easily be carried out.

A plate of glass or of metal may be employed for the purpose, and should be held by the centre in a suitable clamp, or else fixed to a stand, as shown in Fig. 18. A violin-bow should then be drawn across the edge, and a musical note will be produced. When the vibrations have ceased, scatter some fine sand evenly over the plate, and then excite it as before. The sand will be shaken off the ventral segments, and will accumulate along the nodal lines, clearly indicating the mode of vibration.

If we damp one side near the middle by lightly touching it, and draw the bow across the edge near one of the corners, the sand will arrange itself in two straight lines across the plate, dividing it into four squares. By thus damping the plate in different places, an immense variety of beautiful forms will be produced, some of them being very complicated. The more rapid the vibrations, the greater the number of the nodal lines which will thus be traced upon the plate.

Stretched membranes vibrate in a very similar manner; the smaller and more tightly stretched they are, the higher will be the note produced by them. If a thin membrane be stretched in a frame, and held close to a sounding body (Fig. 19), the vibrations of the surrounding air will be imparted to it, and if sand be sprinkled on the membrane, they will at once be rendered visible by its accumulation at the nodal lines.

Fig. 18.

Fig. 19.

In a drum the sound is produced by the vibrations of a tense membrane. The hollow body of the instrument serves as a sounding-box to increase the power, and the note may be modified by altering the tension of the drum-head by means of adjusting screws frequently provided for that purpose.

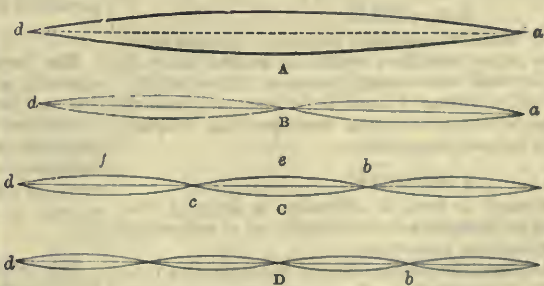


Fig. 16.

Vibrating plates are also sometimes employed in the construction of musical instruments. The glass harmonicon, in which the sounds are produced by strips of glass of various lengths affixed to cords, is an illustration of this. A similar instrument, made with strips of wood, is known by the French as a *claquebois*, and has a very agreeable tone. Both are played by striking them with a small hammer.

Bells may also come under the class of musical instruments, and, by suitable variations in their size and shape, and in the metal of which they are composed, an almost endless variety of tone may be obtained from them.

Finger-glasses may likewise be made to sound by rubbing the edges with a damp finger. With a carefully-collected series of these we have heard several airs played in a very pleasing manner. Even a pane of glass in a window may be made to vibrate and emit sound by rubbing it with a wetted finger; and the passage of a snail over a window-pane has been known to emit sounds of different intensity as the animal went nearer or further from the edge.

LESSONS IN GERMAN.—LXXV.

§ 138.—RULE.

The imperfect tense is used to express what existed, or was taking place at some past time indicated by the context; as, ich schrieb an Sie, als ich Ihren Brief erhielt, I was writing to you, when I received your letter.

OBSERVATIONS.—(1.) The imperfect is the historical tense of the Germans. Its proper office is to mark what is incomplete, or going on, while something else is going on. It is the tense adopted by the narrator, who speaks as an eye-witness; though it may be used by such as have not been eye-witnesses of the events narrated; provided the statement be introduced or accompanied by such expressions as, *he said* (sagte er), *it is said*, or *they say* (sagt man). When the speaker has not been an eye-witness, the perfect should be used.

(2.) From the use of the imperfect in expressing the continuance of a thing, *i.e.*, what was going on at a given time, comes the kindred power which it has, of expressing repeated or customary action; as, er pflegte zu sagen, he used to say, *i.e.*, was in the habit of saying.

§ 139.—RULE.

The perfect tense is that which represents the being, action, or passion as past and complete at the time being; as, die Schiffe sind angekommen, the ships have arrived; er ist vorige Woche gestorben, he died last week.

OBSERVATIONS.—(1.) The German perfect, as a general thing, corresponds closely to our imperfect, when used as an aorist; that is, when used to express an event simply and absolutely, and without regard to other events or circumstances. Hence it often happens, that where in English we use the imperfect, the Germans employ their perfect; thus, ich habe deinen Bruder gestern gesehen, aber nicht gesprochen, I *saw* your brother yesterday, but *did* not speak to him.

(2.) The auxiliary participle (worden) in the perfect passive is sometimes omitted. (See § 84. 2.)

§ 140.—RULE.

The pluperfect tense is used to express what had taken place at some past time denoted by the context; as, nachdem die Sonne untergegangen war, ging er weg, after the sun had gone down, he went off; er hatte während unserer Unterredung geschlafen, he had slept during our conversation.

§ 141.—RULE.

The first future tense is employed merely to express what shall or will take place hereafter; while the second future is used to denote what shall have occurred at some future period.

OBSERVATION.—The future tenses, both first and second, have their precise equivalents in the corresponding English tenses, and should be used accordingly.

§ 142.—RULE.

The indicative mood is used in affirming or denying that which is conceived to be certain or undoubted; as, er wird morgen zurückkommen, he will return to-morrow.

OBSERVATION.—Since the proper office of the indicative is to express reality, it is employed in all absolute or independent sentences. Even in conditional sentences, moreover, it is used, if the condition is assumed as a fact; as, bist du reich, so gib viel, art thou rich (that is, *if* thou art rich), give much.

§ 143.—RULE.

The subjunctive mood is used when that which is expressed by the verb is conceived to be uncertain, though possible; as, ich habe gehört, daß er die gewünschte Stelle erhalten habe, I have heard that he has obtained the desired situation.

OBSERVATIONS.—(1.) The subjunctive, from its very nature, stands chiefly in dependent clauses; and in these appears under various circumstances. Thus, it is employed—

(2.) When the design of the speaker is merely to repeat or quote a statement, without vouching for its accuracy; as, er meldete mir, daß er sich verheirathet habe, he told me that he had been married. When, on the contrary, the design of the speaker is to set forth the thing repeated or quoted, as something real or undoubted, the indicative must be used; as, er will es nicht glauben, daß sein Bruder gestorben ist, he will not believe that his brother is dead.

(3.) In like manner the subjunctive is used in subordinate clauses, after such verbs as hoffen, to hope; fürchten, to fear; wünschen, to wish; wollen, to desire; bitten, to ask; rathen, to advise; verbieten, to forbid; ermahnen, to exhort; since the event, in such cases, may be supposed to be always more or less uncertain; as, er fürchtet, daß er Strafe erhalte, he is afraid that he may be punished.

(4.) So also the subjunctive is employed in clauses which indicate an end, object, wish, or result; and which are introduced by daß, auf daß, damit, or by a relative; as, sprich laut, damit er dich verstehe, speak loud, that he may understand you.

(5.) In cases such as those explained in the observations above, the student must note, that that tense of the subjunctive is employed which corresponds with the one used by the subject of the dependent clause, at the time when he said or did that which is affirmed of him; as, er sagte, er habe diesmal keine Zeit, he said that he had (literally, *has*) no time at present.

(6.) The subjunctive appears also in asking *indirect* questions; as, ich fragte ihn, ob er mir das Geld geben könne, I asked him whether he could give me the money. When the question is made *directly*, of course the indicative is used.

§ 144.—RULE.

The conditional mood is used where a condition is supposed which may or may not be conceived to be possible; as, wäre ich reich, so würde ich ihm seine Bitte nicht abgeschlagen haben, were I rich, I would not have refused his request.

OBSERVATIONS.—(1.) Besides the two tenses ranged under the head of *conditional* in the paradigms, it must be observed that the imperfect and the pluperfect of the subjunctive are equally often employed in expressing conditional propositions.

(2.) Sometimes, in the way of exclamation, the condition is expressed, while that which depends upon it is omitted; in which case the whole expression, being of the nature of a wish or petition, is often introduced (in translation) by "oh," "I wish that," and the like; as, hätte ich doch diesen Mann nie gesehen! oh, that I had never seen this man! literally, had I never seen this man (how happy I should be)!

(3.) Not unfrequently the conditional of the auxiliaries mögen, dürfen, sollen, können, and wollen, is employed to render an expression less positive, or to give it an air of diffidence; as, ich wollte, Sie begleiteten mich, I could wish (instead of *I wish*) you would accompany me; dürfte ich Sie um das Messer bitten? might I (be permitted to) ask you for the knife?

§ 145.—RULE.

The imperative mood is used in expressing a command, entreaty, or exhortation; as, fürchte Gott und ehre den König, fear God and honour the king.

OBSERVATION.—Sometimes, by a peculiar ellipsis, the past participle is employed in place of the imperative; as, nur nicht lang gefragt! do not ask long! where the full phrase would be, es werde nur nicht lang gefragt! let it not long be asked! An die Arbeit gegangen, do you go to your work!

§ 146.—RULE.

The infinitive mood, either with or without the particle zu (to) preceding, is used to represent the being, action, or passion, in a manner unlimited; as, sterben ist Nichts, doch leben und nicht sehen, das ist ein Unglück, to die is nothing, yet to live and not to see, that is a misfortune indeed; der Wunsch gelobt zu werden, the wish to be praised.

OBSERVATIONS.—(1.) The infinitive without zu (to) appears—

(*a*) When, as a verbal substantive (§ 146. 3), it is made either the subject or the object of a verb; as, Geben ist seliger, als Nehmen, to give is more blessed than to receive; das nennt er arbeiten, that he calls working.

(*b*) When it stands alone, as in a dictionary; as, loben, to praise; lieben, to love.

(*c*) After the verbs heißen, to bid; helfen, to help; lehren, to teach; lernen, to learn; hören, to hear; sehen, to see; fühlen, to feel; finden, to find; as, wir lernen tanzen, we learn to dance; ich fühle den Puls schlagen, I feel his pulse beat. The verbs lehren and lernen form exceptions to the observation; admitting, as they do sometimes, the particle zu between them and an infinitive succeeding. The student will note also that the infinitive after all these verbs is in English often best rendered by a participle; as, er fühlte sein Blut gähren, he felt his blood *boiling*.

(*d*) After the auxiliaries of mood, mögen, können, lassen, dürfen sollen, wollen, und müssen, and after werden, when employed as an auxiliary in forming the future tense.

(e) After the following verbs, in certain phrases; as, bleiben, to remain; fahren, to go in a carriage; gehen, to go or walk; haben, to have; legen, to lay; machen, to make; reiten, to ride; as, er hat gut reden, he has easy talking, *i.e.*, it is easy for him to talk; er machte mich lachen, he made me laugh. Machen, however, cannot, as in English, be used to signify "to make or cause *by force*:" thus, to translate the English phrase, "make him go out," the Germans say, laß (not mache) ihn hinausgehen.

(2.) The infinitive with zu is employed—

(*a*) After nouns and adjectives which in English are followed either by the preposition *to* with the infinitive, or by *of* with a participle; as, ich war froh, ihn zu sehen, I was glad to see him; ich bin müde, es zu hören, I am tired of hearing it.

(*b*) After verbs, to express the end or object of their action; as, ich komme, mit Ihnen zu sprechen, I come to (*i.e.*, in order to) speak with you; in which case, also, the particle um often comes before zu, to render the expression more forcible; as, liebet die Tugend, um glücklich zu sein, love virtue, in order (um) to be happy.

(*c*) After the verbs following, and others of like import; as—

Anfangen, to begin.	Sein, to be.
Befehlen, to command.	Pflegen, to be wont.
Hoffen, to hope.	Hinreichen, to suffice.
Fürchten, to fear.	Scheinen, to appear.
Sich freuen, to rejoice.	Wissen, to know, etc.

(*d*) After the prepositions ohne (without) and statt or anstatt (instead of); as, ohne ein Wort zu sagen, without saying a word; anstatt zu schreiben, instead of writing.

(3.) The infinitive in German, as intimated before, often performs the office of a verbal substantive. It is then commonly preceded by the neuter of the article, and has all the various cases; as, ich bin des Gehens müde, I am weary of walking.

(4.) The infinitive active in German, after certain verbs, as, sein, lassen, verbieten, befehlen, etc., is not unfrequently employed passively; thus, laß ihn rufen, which (literally) means, let him *call*, may also signify, let him *be called;* es ist keine Zeit zu verlieren, there is no time to lose, or to be lost.

(5.) The Germans often employ the indicative or subjunctive, preceded by daß, where in English the infinitive, preceded by *to*, is used; as, ich weiß, daß er der Mann ist, I know him to be (literally, I know *that he is*) the man.

(6.) The infinitive in English, preceded by the words *how*, *where*, *what*, *when*, and the like, after such verbs as *tell*, *know*, *say*, and *teach*, cannot be rendered literally into German; the Germans, in such cases, always using the indicative or subjunctive of such verbs as sollen, müssen, können; as, lehren Sie mich, was ich sagen soll, teach me what *to* say. For the use of the infinitive of mögen, wollen, sollen, etc., in place of the past participle, see § 74. 3.

§ 147.—THE PARTICIPLES.

(1.) The participles in German are varied by cases; following the same rules of inflection as the adjectives. Having the nature of adjectives, the present in a few, and the preterite in many instances, readily admit the degrees of comparison.

(2.) The use of the participle as such, however, in German, is far more restricted than in English; for in English it is commonly used to form a distinct clause of a sentence; and is thus made to indicate the time, cause, or means of effecting that which is expressed in the main clause; thus we say, "Walking (that is, *by* or *when* walking) uprightly, we walk surely." This mode of expression can rarely, if ever, be adopted in German; into which language, if we desire to translate the above sentence, we must say, wenn wir aufrichtig wandeln, so wandeln wir sicher, that is, *when* we walk uprightly, we walk surely.

(3.) So, too, we say in English, "*Having given* him the money, he went away;" but since there is nothing in German to correspond to this English compound participle, it would be a gross error to attempt to render the sentence literally. Resort must be had, as in the other case, to a different structure; thus, als er ihm das Geld gegeben hatte, ging er weg, that is, *after* or *when* he had given him the money, he went away. In this way must all similar cases be managed; we must employ a verb in each clause, and connect the two together by means of suitable conjunctions; such as weil, wenn, als, da, and indem.

MINERALOGY.—V.

COMPOUND OXIDES.

UNDER this head we class all those minerals which are composed of one or more simple oxides, or are compounded of oxides of different substances.

Magnetic iron ore may be taken as an example of a body compounded of two simple oxides. Its chemical formula is Fe_3O_4. This is supposed to be made up of two oxides, FeO and Fe_2O_3. It is the loadstone, the only oxide of iron capable of being magnetised; and therefore, when found as an ore, it is always in a magnetic state, rendered so by the influence of the earth's magnetism.

Spinelle is similarly composed of two oxides, only one is alumina and the other magnesia. It offers us an example of *isomorphism*, which is the exact converse of dimorphism. The latter is the appearance of a mineral having the same composition in two crystalline forms, whereas isomorphism is the appearance of a mineral which varies in composition in the same crystalline form. For instance, the magnesia in spinelle is sometimes replaced by the oxides of iron, zinc, and manganese; but the only alteration in the appearance of the mineral is in its colour. It always retains its shape, an octahedron of the monometric system.

Adopting as a basis Professor Haughton's classification, the other important compound oxides may be arranged in seven classes:—

1. Silicates.	4. Carbonates.	7. Tantalates, Titanates, Vanadates.
2. Sulphates.	5. Phosphates.	
3. Nitrates.	6. Borates.	

SILICATES.

This important tribe may be arranged in seven families:—

1. Felspar Family.	3. Mica Family.	6. Andalusite Family.
2. Hornblende Family.	4. Talc Family.	7. Garnet Family.
	5. Zeolite Family.	

THE FELSPAR FAMILY.—*Felspar*, or *feldspar* (that is, "field-spar"), is a constituent of granite rocks, and appears in most rocks of igneous origin, and necessarily of rocks formed from them. Its constitution varies with the age of the rocks; and thus the composition of a felspar may indicate whether a rock be ancient or modern, geologically speaking.

Orthoclase, or *Potash Felspar*, is composed of silica, alumina, and potash. It is light-coloured, white, grey, or flesh-coloured; it may occasionally exhibit a green tint. It occurs in the *monoclinic* system, has a vitreous lustre, H = 6, and sp. gr. = 2·3—2·6. It can only be fused before the blowpipe on its edges; but with borax it forms a transparent glass. It defies the action of acids. *Adularia* is a white variety found on Mount Adula, the highest peak of the St. Gothard. When opalescent and exhibiting peculiar pearly reflections, it is *Moonstone. Glassy Felspar* is never found but in lavas. It appears in transparent crystals. *Aventurine Felspar* owes its characteristic appearance to minute scales of specular iron disseminated through its mass. It is well imitated in sealing-wax.

Kaoline is clay derived from the decomposition of felspar—a decomposition which was effected by the removal by water of the alkali, potash; and at the same time a little of the silica was dissolved out. This clay is found in beds in granite districts, especially South Devonshire, and is much used in the manufacture of porcelain.

Albite, or *Soda Felspar*, has the same composition as orthoclase, save that soda takes the place of the potash. It is very similar in every respect to that mineral. Its crystals are more oblique, being of the triclinic system; and when placed in the blowpipe flame it tinges the flame yellow. Its colour is whiter than orthoclase; hence its name, *albus*, white.

Oligoclase contains, instead of soda, both soda and lime. It is very like albite, and is an essential ingredient in many trap rocks. It is composed of 3 atoms of silica, 1 of alumina, and 1 of soda and lime mixed.

Labradorite contains more lime than any of the preceding felspars. Its composition is 2 atoms of silica to 1 of alumina and 1 of lime. It is generally dark-coloured, frequently offering a play of iridescent colours; there are, however, white specimens. It is sometimes used in jewellery, admitting of a high polish, and affording reflections of rich and delicate colours. It does not occur in granite, but is occasionally found in gneiss.

Anorthite contains 3 atoms of silica, 2 atoms of alumina, and

2 atoms of lime. It is nearly allied to albite. By referring to this table, prepared from the analyses of Dr. Haughton, the student will easily perceive the differences in the composition of these five prominent felspars.

	Albite.	Orthoclase.	Oligoclase.	Labradorite.	Anorthite.
	per Cent.	per Cent.	per Cent.	per Cent.	per Cent.
Silica . .	68·7	64·8	62·5	52·9	45·9
Alumina	19·5	18·4	23·8	30·2	35·0
Potash .	...	16·8	...	...	...
Soda. . .	11·8	...	7·2	4·6	...
Lime . .	...	...	6·5	12·3	19·1

Leucite and *Nepheline* are the felspars of volcanic lavas, and bear the same relation to each other as orthoclase and albite. The five felspars above occur in lavas which are too ancient to be reckoned the produce of volcanoes. Leucite crystallises in the *deltoidal octahedron*, a figure after which the mineral has been named the *leucitohedron*. The crystals are of a dull, glassy colour. Nepheline appears in hexagonal prisms. When digested in nitric acid they become cloudy; hence its name, *νεφελη, a cloud.*

The Hornblende Family.—When cooling from a molten condition, the constituents of the igneous rocks seem to have divided themselves into two main groups: all the alkalies, the lime, potash and soda, coalesced with the silicates to form the felspars we have just considered, while the iron and magnesia combined in varied quantities with the silica to produce the members of the hornblende family.

Hornblende itself occurs in oblique rhombic prisms, more or less modified, of the monoclinic system. It cleaves perfectly, in places parallel with the faces of the prisms. It is also found fibrous, sometimes coarse; at other times fine, with a silky lustre. It varies greatly in colour, passing from white through green to black, according to the quantity of iron it contains. Typical hornblende may be regarded as a compound of 3 atoms of silica with 4 atoms of magnesia, lime, or protoxide of iron, alterations in these latter constituents producing the varieties. The lighter-coloured members of the family are—*Tremolite*, usually found as long, white crystals, penetrating metamorphic rocks, especially the dolomite of Val Tremola, St. Gothard. *Actinolite* appears in the same way, but is light green. When a quantity agglomerates, a radiated structure results, and the colour darkens. It contains from 6 to 8 per cent. of the peroxide of iron. It is to this radiated structure that it owes its name, which is derived from *ακτιν, a ray.*

Asbestos is hornblende in slender fibres, which are easily separable. Usually it is white, occasionally green. It is noted for its resistance of fire, and is used in gas stoves for the flame to play against. The asbestos, becoming red-hot, assumes the appearance of live coal. It may be woven into fabric which is sometimes used as a covering where fire is to be resisted. The ancients are said to have used a fabric made of asbestos for napkins, because they need only be thrown into the fire to be cleansed. Also the wicks of the Temple lamps which burnt continually were of asbestos. *Mountain Leather* and *Mountain Cork* are but varieties of the same material, remarkable for being the lightest of mineral products.

The *dark-coloured* varieties are *Hornblende* itself, which we have described, and *Amphibole*, which is but another name for hornblende. Hornblende is an essential constituent of certain rocks, as syenite, trap, hornblende, slate. Tremolite is usually found in metamorphic limestone and dolomite; actinolite, in talc, steatite, serpentine, and other magnesian rocks, which also afford asbestos.

Augite consists of 2 atoms of silica, combined with 3 of magnesia, lime, or iron protoxide.

Pyroxene is augite proper, nearly allied to hornblende. It differs from it in its crystalline system, the monoclinic. It offers an example of isomorphism, its basis of lime, protoxide of iron, and protoxide of manganese, replacing each other without altering the crystalline form. It would seem that the main difference between augite and hornblende results from the manner of the cooling of the rock; the various conditions of rapid and slow cooling, or being under pressure, or in contact with water, are considered sufficient to account for the difference of structure. The tremolite of the hornblende is represented in the augites by *Diopside*, while actinolite corresponds to *Sahlite*. Speaking generally, hornblende is a constituent of the older igneous rocks, and augite of the more modern.

The Mica Family have a characteristic which at once distinguishes them from all other minerals; they have a remarkable power of foliation, or of splitting up into leaves. They are found in igneous rocks and rocks immediately derived from them; and, by the peculiar appearance of mica, it is a prominent constituent of any rock in which it is found. There are two kinds of mica, white and black; the former contains alumina and alkalies, while the colour of the latter is owing to the presence of iron, which is associated with magnesia.

Muscovite, or *white mica*, occurs in plates, which may be regarded as short rhombic prisms of the trimetric system. It is found in Siberia, where it is frequently used as a substitute for glass. It can be divided into thin, elastic laminæ of great tenuity. Its composition is 5 atoms of silica, 4 atoms of alumina, and 1 of potash.

Margarodite is a white mica which contains an atom of water. It is found in the Irish granite; but the Muscovite does not appear in the British Islands.

Lepidolite, or *lithia mica*, is of a pink colour. It is generally found in the neighbourhood of metallic lodes.

The above micas are binaxial; that is, they have two optic axes. An explanation of this property was given in our introduction to Mineralogy, where the physical properties, etc., of minerals were discussed.

Black mica is uniaxal, and is generally considered as belonging to the hexagonal system. In *Biotite* magnesia is a prominent constituent, and, according to Dana, it is not actually uniaxal, but the angle between the optic axes is but 1°, whereas in *Muscovite* it varies from 56° to 75°.

Lepidomelane mica is the only other variety of black mica. Its jet-black colour is due to the presence of manganese, of which substance it contains about $1\frac{1}{2}$ per cent. This is the black mica in our granites.

The Talc Family is constituted of three members—the *Talcs*, the *Serpentines*, and the *Chlorites*.

The Talcs.—Talc, when crystallised, which is rare, appears in rhombic or hexagonal prisms. Generally, however, it is massive, composed of minute, pearly scales. Like mica, it is eminently foliaceous, the laminæ being flexible, but not, like mica, elastic. The colour is occasionally white, but usually has a greenish tint. It is very soft, being easily scratched with the nail, and possesses an unctuous feel. Its typical composition is 5 atoms of silica, 6 of magnesia, and 1 of water.

Meerschaum is a talc, containing a little oxide of iron, and alumina. When first taken from the earth it is soft, and will, with water, make a lather. The Tartars use it for washing their linen. When heated, it gives off water with a fœtid odour, becoming a white, hard body. Its chief use is to make the bowls of pipes.

Soapstone, or *Steatite*, is a talc which owes its name to its soapy feel. It is generally white; sometimes a little yellow or greenish.

Saponite is not actually steatite, but an English variety containing more water. It is found at the Lizard, in Cornwall; and, according to Professor Haughton, its existence is accounted for by the intrusion of granite veins into serpentine rock, the former supplying the alumina, and the latter the requisite magnesia.

The *Serpentines* seem to be produced by a metamorphic action on limestones which contain magnesia. They are composed typically of 4 atoms of silica, 9 of magnesia, and 6 of water. Serpentine admits of being polished, and is much used in ornamenting buildings. Its most ordinary colour is a mottled green. Chromic iron disseminated through it adds red tints. Some specimens are so bright-coloured, and take so fine a polish, that they are used for brooches and bracelets. When veins of crystalline limestone shoot through green serpentine, the stone is called *verd-antique.* Many parts of Connemara and Donegal in Ireland, and Devonshire and Cornwall in England, yield serpentines.

Chlorite, the third member of the talc family, is always green, and of a pearly lustre. Usually, chlorite appears in dark, olive-green masses; but when crystallised, it is found in hexagonal crystals, foliated, like mica, with which it may easily be confounded; but the laminæ are not elastic. Its composition is 2 atoms of silica, 1 of alumina, 5 of magnesia, and 3 of water

The ZEOLITES owe their name to the fact that they intumesce, or *boil* (ζεω, *I boil*), when heated in the blowpipe flame. They consist of silica, alumina, an alkali, and water. It is in the giving off of this latter constituent that the boiling is produced. Zeolites are never found embedded in the rock in separate crystals, but usually are clustered on a surface. They are almost always found in volcanic and trap rocks; and water at a high temperature seems to have had something to do with their production.

Analcime sometimes appears in colourless, but usually milky crystals, which are deltoid octahedrons of the monometric system. Its name is derived from αναλκις, *weak*, alluding to its weak electric power when rubbed. It is found in cavities of old lavas, and is composed of 8 atoms of silica, 3 of alumina, 3 of soda, and 6 of water.

Apophyllite occurs in prisms of the dimetric system, terminated in a sharp pyramid. Its composition is 10 atoms of silica, 8 of lime, 1 of potash, and 16 of water. It is remarkable for the little alumina it contains, and also for occasionally having some fluorine.

Natrolite appears in right-rhombic prisms, trimetric, generally acicular, the crystals being like needles. It is a hydrated double silicate of alumina and soda. It is very common in the basalt of the Giant's Causeway. *Scolezite* is natrolite, but with lime in the place of soda.

Prehnite may be found in six-sided prisms, but usually it is reniform and botryoidal. It is easily known by its pale-green colour, which is due to the presence of the protoxide of iron. As prehnite receives a handsome polish, it is much used for inlaid-work.

Thomsonite occurs, like natrolite and prehnite, in radiated masses. Its colour is snow-white; its composition being 4 atoms of silica, 3 of alumina, 2 of lime, 1 of soda, and 7 of water.

Harmotone is noted for being frequently found in twin crystals or macles, so regular as to form in section a Maltese cross. It contains 3 atoms of silica, 1 of alumina, 1 of baryta, and 5 of water. *Phillipsite* is when potash and lime replace the baryta.

Stilbite occurs in monoclinic prisms, frequently in sheaves of crystals. It is a double hydrated silicate of alumina and lime. Its name is derived from the Greek for "lustre," as its cleavage faces are eminently pearly. *Heulandite*, or *epistilbite*, has one atom less water than stilbite. In *Brewsterite* the lime is replaced by baryta and strontia.

Chabazite, *hypostilbite*, and *laumonite* are also zeolites of no particular interest.

LESSONS IN SPANISH.—XXIII.

THE PREPOSITION.

THE prepositions are employed in such a variety of ways in Spanish and in English, that each one is not always to be rendered from one language to the other by the same word. Thus *de* is not always to be translated into English by *of*, nor *of* into Spanish always by *de*. The following observations will show the manner in which these prepositions are to be used:—

About, when it means *through*, is rendered by *por*; when it means *on*, by *sobre*; when it means *within*, by *en*; when it means *of*, by *de*; as—

Ella iba cantando por el lugar, *she went singing about the village.*

Locke escribió sobre el Christianismo, *Locke wrote about Christianity.*

Ellos están en el palácio, *they are about the palace.*

No habla de política en público, *he does not talk about politics in public.*

Above is rendered by *sobre*; as—

El ave vuela sobre la tierra, *The bird flies above the earth.*

Against, meaning *in opposition to*, or *contrary to*, is rendered by *contra*; as—

Ellos pelearon contra los Mejicanos, *they fought against the Mexicans.*

Contra la ley, *against the law.*

After, meaning *later in time*, is rendered by *despues de*; when it means *according to*, by *á* or *segun*; and when it means *immediately behind*, by *tras*; as—

Despues de las seis, *after six o'clock.*

Á la moda francesa, *after the French fashion.*

Segun este modo, *after this manner.*

Echa la soga tras el caldero, *he throws the rope after the bucket.*

According to is rendered by *segun*, and sometimes by *para con*; as—

Segun los órdenes de vmd., *according to the orders of your worship.*

Para con él no vale nada, *according to him it is worth nothing.*

Among, when it means *of the number of*, is rendered by *entre* or *para entre*; when it means *in the midst of*, by *en médio de*; and when it means *in*, by *en*; as—

Entre los hombres no hay uno, que sea recto, *among the men there is not one that is upright.*

Para entre amigos los cumplimientos son escusados, *among friends compliments are unnecessary.*

Yo os envio como corderos en médio de lobos, *I send you as lambs among wolves.*

En muchas naciones no habia rey semejante á él, *among many nations there was not a king like him.*

At, when it denotes *in* or *on*, is rendered by *en*; when it denotes proximity, precedes the price of anything or the time of day, or means *in readiness for*, it is rendered by *á*; as—

Ellos están en casa, *they are at home.*

Ellos están en paz, *they are at peace.*

Juan está en Roma, *John is at Rome.*

Ellos están en la mar, *they are at sea.*

Al puente, *at the bridge.*

Á la mano, *at hand.*

Á seis pesos la fanega, *at six dollars a bushel.*

Á las cuatro, *at four o'clock.*

Está á mi mando, *he is at my command.*

Al trabajo, *at work.*

Before, meaning *in the presence of*, is rendered by *ante*; meaning *in front of*, or the opposite of *behind*, by *delante de*; meaning *precedent in rank*, or *previous in time* (that is, the opposite of *after*), by *ántes de*; as-

La causa se llevará ante los jueces, *the cause will be brought before the judges.*

Iba delante de ellos para monstrar el camino, *he went before them to point out the way.*

Ántes del dia, *before day.*

Prostrado en tierra delante del arca del Señor, *prostrated on the earth before the ark of the Lord.*

Ántes de los Marqueses van los Duques, *the Dukes take rank before the Marquises.*

Ántes de anochecer, *before nightfall.*

Behind is rendered by *tras*, or *detras de*; as—

Tras la puerta, *behind the door.*

Detras de ellos, *behind them.*

Below is rendered by *debajo de*; as—

Debajo del lábio, *Below the lip.*

Between is rendered by *entre*; as—

Discernir entre lo bueno y lo malo, *To discern between the good and the evil.*

By, meaning *at* or *in*, is rendered by *de*; meaning future time, *when*, by *para*; meaning *close to* or *alongside of*, by *junto á*; and meaning *through*, by *por*; as—

Sírvase vmd. sentarse junto á la ventana, *please to seat yourself by the window.*

Se ha hecho rico por malos médios, *he has made himself rich by wicked means.*

Yo lo necesitaré todo para el sábado, *I shall need it all by Saturday.*

De dia, *by day.*

De noche, *by night.*

Concerning, meaning *about* or *in regard to*, is rendered by *acerca de* or *tocante á*; as—

Acerca de lo que hemos hablado, *concerning that which we have spoken.*

Tocante á esta pendéncia, *concerning (or touching) this affair.*

For, meaning *during*, *on account of*, *for the sake of*, or *in behalf of*, *in exchange for*, *for the purpose of getting*, as *by* (per), is rendered by *por*; and when it means *for the use of*, or *with the intention of going to*, it is rendered by *para*; as—

¿Puede vmd. darme un cuarto por esta noche? *can you give me a room for this night?*

Piensan que por mucho hablar serán oidos, *they think that for much speaking they will be heard.*

Murieron por su pátria, *they died for their country.*

Le daré mi flauta por su violin, *I will give him my flute for his violin.*

Ir por dinero, *to go for money.*

Ella le recibió por esposo, *she received him for a husband.*

Para un principiante lo ha hecho bien, *for a beginner he has done it well.*

¿Cuánta por dia? *how much for a day?*

Lo he comprado para mi muger, *I have bought it for my wife.*

Salió para España, *he set out for Spain.*

For is sometimes used in English when it would not be in Spanish; thus, I want to alight for a moment, *necesito bajar un momento.* *Por* is sometimes used in Spanish when it would be redundant in English; as, uno vale por muchos, *one is worth many.*

From, when it means *since*, or *from the time of*, and of *distance from*, is generally rendered by *desde*; in other cases by *de*; as—

Hay cincuenta millas desde Vera-Cruz á Jalapa, *it is fifty miles from Vera Cruz to Jalapa.*

¿Cuando ha vuelto vmd. del campo? *when did you return from the country?*

Desde la niñez aprendiste las sagradas letras, *from childhood thou hast known the Holy Scriptures.*

In, meaning *in the time of*, *within*, and *into*, is rendered by *en*; when it means *through the course of* or *during*, by *por*; and when, after superlatives or other adjectives, it means *of*, by *de*; as in these examples:—

Este bárrio es de los mejores de la ciudad, *this ward is one of the best in the city.*

En el invierno, *in the winter.*

Acre de génio, *austere in disposition.*

En España, *in Spain.*

Por la mañana, *in the morning.*

Instead of is rendered by *por*, and by *en lugar de* when it means *in the place of*; as—

Vino él por su padre,	*He came instead of his father.*
Arquelás reinaba en Judéa en lugar de Herodes su padre,	*Archelaus was reigning in Judea instead of Herod his father.*

Into, when it comes after the verb *enter*, and when it means *inside of*, is rendered by *en*; but after all verbs of motion (*to enter* excepted) it is rendered by *á*; as—

Entremos en este bosque,	*Let us enter into this grove.*
Eche vmd. aceite en la lámpara,	*Pour oil into the lamp.*
Vamos al comedor,	*Let us go into the dining-room.*

Of is rendered by *de*; as—

Un amigo del rey,	*A friend of the king.*

On or *upon*, meaning *along*, is rendered by *en*; meaning *through*, by *por*; meaning *by*, it is rendered by *de*; and meaning *in contact with the upper surface of anything*, by *sobre*; as—

Nada debe afirmarse por una mera probabilidad, *nothing ought to be affirmed upon mere probability.*

Está sobre la silla, *it is on* (or *upon*) *the chair.*

¿Hay peligro en el camino? *is there danger on* (or *upon*) *the road?*

El hombre no vive de solo pan, *man lives not on bread alone.*

Sometimes *on* is rendered by *á*; as, á caballo, *on horseback*; á pié, *on foot*; á bordo, *on board*. *Upon*, after the verbs *to count*, *rely*, etc., is rendered by *con*; as, conto con la amistad de Diego, *I rely upon the friendship of James.*

When *on* in English is used before the days of the week or month, it is not rendered in Spanish; thus, ella llegó allí el sábado, *she arrived there on Saturday.*

Out of, meaning *removed from*, *beyond and outside of*, is rendered by *fuera de*; meaning *on account of*, by *por*; meaning *from*, by *de*; as—

Fuera de mis alcances, *out of my power.*

Tengo habas que están fuera de tierra, *I have beans that are out of the ground.*

Por amistad, *out of friendship.*

Bebe de un vaso, *he drinks out of a tumbler.*

Fuera de peligro, *out of danger.*

Over is rendered by *encima de* when it means *above* and otherwise by *sobre*; as—

Encima de la ventana, *over the window.*

Lloró sobre la ciudad, *he wept over the city.*

Through, meaning *from one end or side to another* or *on account of*, is rendered by *por*; when it means *by reason of*, by *de*; as—

Por el temor de la muerte estaban en servidumbre toda la vida, *through the fear of death they were in bondage all their life.*

Viajó por España, *he travelled through Spain.*

Ella tiembla de temor, *she trembles through fear.*

Till is rendered by *hasta*; as—

La oficina está abierta hasta las diez de la noche,	*The office is open till ten o'clock at night.*

To, when preceded by *from*, in such phrases as *from bad to worse*, *from time to time*, is rendered by *en*; when it means *of*, by *de*; and in other cases generally by *á*; as—

De dia en dia, *from day to day.*

Un amigo de su pátria, *a friend to his country.*

Un tio de Juan, *an uncle to John.*

Dió el tintero á María, *he gave the inkstand to Mary.*

Towards is rendered by *hácia*; as—

Aquí viene hácia nosotros la señora de la casa,	*Here comes towards us the lady of the house.*

Under is rendered by *debajo de* or *bajo*; as—

Debajo del puente,	*Under the bridge.*
Bajo la mesa,	*Under the table.*

Under is rendered by *so* in the following phrases:—

So capa de, *under cover of.*

So color de, *under colour of.*

So pena de, *under penalty of.*

So pretexto de, *under pretext of.*

With, when meaning *of*, or *from*, or *by*, is rendered by *de*; in most other cases by *con*; as—

Estamos cubiertos de polvo, *we are covered with dust.*

Nos morimos de frío, *we are dying with cold.*

Juan le mató de un sablazo, *John killed him with a sabre-stroke.*

Con permiso del capitan, *with permission of the captain.*

Within is rendered by *dentro de*; as—

Lo necesitaré dentro de tres dias,	*I shall need it within three days.*

Without, meaning *destitute of*, *with exemption from*, is rendered by *sin*; and when it means *outside of*, or *beyond*, by *fuera de*; as—

Tráteme vmd. sin ceremónia,	*Treat me without ceremony.*
Comprar sin dinero,	*To buy without money.*
Le echaron fuera de la ciudad,	*They cast him without the city.*

Sin in Spanish is regarded as a negative preposition, and is therefore often followed by a negative conjunction; as—

Sin otro fin ni motivo,	*Without another end or* (*nor*) *motive.*

There are other prepositions in Spanish which, as they can be rendered in most cases by the corresponding English preposition, offer no difficulty to the learner. Such are—

Para con, *in respect to.*	Cerca de, *near to.*	En orden á, *with regard to.*
Además de, *besides.*	Frente á, *or* en frente de, *opposite.*	Junto á, *adjoining.*
A pesar de, *in spite of, notwithstanding.*	Durante, *during.*	Por el médio de, *across.*

The preposition entre, *between*, when it comes before personal pronouns, does not govern them in the objective case in Spanish, but is followed by them in the nominative; as, entre tú y yo (and not *entre tí y mí*), *between thee and me.*

Prepositions, as in English, are placed before the word which they govern.

Care must be taken to distinguish the use of the same word in English, whether employed as a preposition, or an adverb, or conjunction. Thus, in the phrases *after breakfast*, *before dinner*, the words *after* and *before* are prepositions, and are to be rendered by *despues de* and *ántes de*, respectively; while in the phrases *after I had departed*, *before I had dined*, the words *after* and *before* are adverbs, and are to be rendered by *despues que* and *ántes que*.

Segun, when used before a verb in Spanish, is not a preposition, but an adverb, meaning *according as*; as—

Segun creo, *according as I believe.*

Segun pareció, *according as it appeared.*

HUMAN PHYSIOLOGY.—XI.

VOICE AND SPEECH.

THE faculty of voice, or rather of articulate utterance, is one of the great distinctive features of the human being. Though in nearly all the air-breathing animals included in the division Vertebrata there are arrangements more or less complex for the production of vocal sounds, there is no reason to suppose, as far as observation has at present gone, that any animal but man is endowed with the wonderful gift of speech. Without this power, how different would be the condition of the human family! Without speech, learning and civilisation could hardly have existed, and life would have been robbed of its greatest charms. In the lower animals, the organs of sound vary much in character; in reptiles, the apparatus is situated at the junction of the windpipe with the pharynx, and is of very simple construction, consisting only of a slit bounded by two contractile lips; and in consequence, the only sound these animals for the most part are capable of uttering is a hissing one, which, from the great size of their respiratory organs, is often prolonged for a very considerable period. In birds, especially the singing birds, the vocal organs are of a much more complex character. In them, as in the reptiles, there is a narrow fissure at the superior extremity of the windpipe; but this, in their case, seems to be only concerned in the function of respiration; the true vocal apparatus is situated at the lower extremity of the trachea, just before it divides into the two bronchi, and is of this character: in shape it resembles a bony drum, formed by the last ring of the trachea with a cross-beam of bony structure; stretched over this, and attached to the osseous cross-beam, is a thin semilunar-shaped membrane. This drum communicates below with the apertures of the two bronchi, each of which terminates in two lips or vocal cords. Muscles, varying in number according to the species of the bird, are attached to the different parts of the drum, and these, by their action, stretch more or less strongly the membrane, and so modulate the sound. In the birds that have no voice, or rather have no song, these special muscles are absent.

The organ of voice in man, the larynx, is situated at the upper part of the trachea or windpipe, intervening between it and the posterior opening of the mouth. It is formed of various cartilages connected together by membrane. It will be necessary to describe these rather particularly, before we can understand the way in which the vocal sounds are produced. The cartilages of which the larynx are composed are five in number, in addition to which four small cartilaginous bodies are named; but these latter play no important part in this function. The five material cartilages are the thyroid, the cricoid, the two arytenoid, and the epiglottis. Of these the thyroid is considerably the largest; it consists of two square-shaped pieces of cartilage, joined together in front at an acute angle, and forming that projection in the middle line of the throat which is known as *pomum Adami* (Adam's apple). The posterior surfaces terminate both above and below in two cornua, or horns: the upper ones give attachment to the membrane which connects the thyroid cartilage with the hyoid bone, and the lower ones articulate with the cricoid cartilage. Posteriorly, the sides of the thyroid do not meet, but leave a considerable opening, which is completed partly by membrane and partly by the cartilage next to be considered. The cricoid cartilage derives its name from its shape, resembling that of a signet ring; it has the smaller part of the ring in front, and is altogether smaller but thicker than the thyroid, and forms the principal part of the posterior cartilaginous wall of the larynx. Its anterior half, which is narrow, gives attachment to numerous muscles, and the membrane which connects it with the inferior borders of the thyroid; its posterior half is broader, and fills up part of the space left vacant by the receding walls of the thyroid, with which it articulates. The upper border of its posterior surface presents two little facets, each of which articulates with one of the arytenoid cartilages.

The arytenoid are small pieces of cartilage, pyramidal in shape, and are attached by their bases to the posterior upper border of the cricoid cartilage, and thus help to complete the hinder wall of the larynx; the articulation they form with the cricoid is one in which considerable freedom of movement is permitted, and is a most important provision for the performance of the vocal function.

The epiglottis is a thin leaf-shaped piece of fibro-cartilage, of yellowish colour, placed behind the tongue in front of the upper opening of the larynx, which it protects. During respiration it stands erect, leaving the opening of the larynx free; but when the act of swallowing has to be performed, it curves backwards and downwards, and completely closes the aperture of the windpipe. The thyroid, the cricoid, and the arytenoid are joined together by membrane, which also closes any opening not occupied by cartilage; so that the larynx is in shape a triangular box, flattened behind and at the sides, whilst in front it presents a prominent vertical ridge. Externally it is covered, save in some parts of the middle line where it is sub-cutaneous, by the numerous muscles of the neck, and along its sides run the great blood-vessels and nerves of the head. Internally, the larynx is lined by mucous membrane, which is continuous above with that of the mouth, and below with that of the trachea and lungs; and presents for examination the essential part of the vocal apparatus, the vocal cords. In looking down the larynx we notice, first, that the opening is heart-shaped, narrower behind than before, and that it slopes obliquely downwards and backwards; in front there is placed the epiglottis, and behind the upper points of the arytenoid cartilages. A short distance down we observe that the mucous membrane is drawn into two folds, which run one on each side from before backwards; these are the superior or false vocal cords, so called because they resemble in appearance, and partly in structure, the true vocal cords, but have no concern in the production of the voice. A little lower down the larynx we find another pair of folds or cords taking the same direction as the first pair: these are the true vocal cords; they are attached in front to the inner surface of the sides of the thyroid cartilage, close to the angle formed by their junction. Posteriorly, each cord is connected with the anterior angle of the base of an arytenoid cartilage. Into the composition of these, as in the false vocal cords, mucous membrane largely enters, but in addition each cord contains ligamentous structure and yellow elastic tissue. The small space or chink which exists between the true vocal cords is called the glottis, or rima glottidis. This is the narrowest part of the larynx; in the male it is generally nearly an inch in breadth when dilated to its widest extent; the measurement in the female is rather less. In order to bring these mechanisms into play, a complex arrangement of muscles is provided: these consist of two sets—the first, which are extrinsic to the larynx, and have other duties to perform besides influencing the production of sound; and another set intrinsic to the larynx, which are entirely devoted to this purpose. They may also be divided into two classes, in accordance with the effects they produce: thus, first, the muscles which relax the vocal cords, and thus open the glottis; and second, the muscles which tighten or make tense the vocal cords, and so close the glottis.

The vocal cords being attached in front to the thyroid cartilage, and behind to the anterior angles of the bases of the arytenoid, it is necessary that, in order to affect them, the muscles should act either upon the thyroid or the arytenoid cartilages. So we find one group of muscles specially acting upon the thyroid; one set of them drawing it down over the cricoid cartilage, making tense the vocal cords, and so closing the glottis; another set antagonistic to the first, which elevate the thyroid, relax the cords, and open the glottis. The arytenoid has also a group running from it to the cricoid: one pair draw upon the base of the arytenoid, rotate it outwards and backwards, and so tighten the cords, and at the same time open the posterior part of the glottis; another pair close the glottis by rotating the bases inwards. A pair of muscles, running from the arytenoid to the thyroid, draw forward the arytenoid, and together relax the cords and open the glottis; while another pair, specially belonging to the last-named cartilages, draw them close together, and bring the vocal cords almost into contact. In addition to these, there are many other muscles, which play more or less important parts with reference to this function.

Having now considered the structure of the larynx, we must pass on to describe the way in which it fulfils its special duties. By numerous observations, both on the living subject and the dead body, it has been conclusively shown that the production of sound is the result of the action of a current of air upon the inferior or true vocal cords. In the ordinary condition of the larynx, the air passes and re-passes through its canal without causing any sound; but if the cords are made tense, by the action of the muscles of the larynx, sounds are immediately produced. By some observers the sounds are supposed to be the result of the vibrations caused in the cords by the impinging of the air upon them—similar, indeed, to those of a stringed instrument, as the violin; others compare the action of the vocal cords to that of the reeds of the hautboy or clarionet, or the tongue of the accordion or concertina. It is most likely that it resembles the action of both classes of instruments, as it has been proved that the cords vibrate strongly through their whole length; and that, in order to produce acute or shrill sounds, it is necessary that the cords should be approximated, and the glottis reduced to very narrow limits. It is also found that, in order to produce true vocal sounds, it is necessary that the cords, in addition to being made tense, should have their inner edges parallel. Even when the lips of the glottis are most completely closed anteriorly, the hinder portion still presents a wide gap, from which it is inferred that the front part is concerned in the vocal function, and that the posterior portion is subservient to respiration simply.

Animal sounds are divided into the cry, the song, and the voice, ordinary or acquired. The cry is the sound usually produced by the lower animals, is not modulated, and is generally sharp and disagreeable. In man, the cry is generally an instinctive act, not a voluntary one, and expresses usually agony or distress; the human infant can utter no other sound, and it is only by imitation that he learns the art of producing articulate sounds. The song is the result of a succession of sounds, each of which has a certain number of vibrations, and in which the number of vibrations of each succeeding note bear the same relative proportions as characterise the notes in the musical scale. The male and female voices differ in pitch—that is, they commence and finish at different points in the musical scale—and in "timbre" or quality. In each the compass of the trained voice is much the same, and covers usually from two to three octaves. The lowest note of the female is about an octave higher than the lowest note of the male voice, and the highest note of the female voice is also an octave higher than the highest male note. The female and male voices are subdivided, the female into soprano and contralto, the male into bass and tenor. These differ from each other in tone: the bass goes lower down the scale than the tenor, and is stronger in the low notes; the contralto stands in the same position to the soprano; the tenor extends higher than the bass, and the soprano higher than the contralto, and each is stronger in the high notes than the bass or contralto. The voices called mezzo-soprano and barytone are intermediate voices, the mezzo-soprano being midway between the soprano and the contralto, and the barytone intervening between the tenor and the bass. This difference in pitch of the male and female voices is dependent on the length of the vocal cords: in the male, the length of the cords when at rest is generally about $\frac{73}{100}$ of an inch; and when they are stretched to the greatest extent, about $\frac{93}{100}$ of an inch: in the female the length varies from $\frac{51}{100}$ to $\frac{63}{100}$ of an inch. Thus the difference between the male vocal cords when quite relaxed, and when made tense to the greatest degree, is only the $\frac{20}{100}$ or $\frac{1}{5}$ of an inch; whilst in the female it is still less, being but $\frac{12}{100}$ or a little less than $\frac{1}{8}$ of an inch. Yet this slight variation in length is enough to account for the difference between the male and female voices. And not only so, but as in producing each note or semitone in the musical voice the vocal cords are relaxed or made tense to the exact degree necessary, it follows that, as the voice covers two octaves or twenty-four semitones, the performer must have the power of dividing his vocal cords into parts no greater than the $\frac{1}{1200}$ of an inch, and this in ordinary vocalisation. In some noted singers it was calculated that this power of division was carried as far as the $\frac{1}{10000}$ of an inch. And this appears even more wonderful when we remember the complex arrangement of muscles by which it is effected, and that not one of those muscles is separately under the control of the will. The difference of timbre or quality of the notes depends on the character of the walls of the larynx; in women and children these are more flexible and smoother than in men. The male voice owes its greater roughness to the greater hardness and firmness of the cartilages of the male larynx, approaching nearly, and in old age often quite, to ossification. The larynx of boys resembles that of women; but as they approach manhood it assumes a more masculine character, and the voice begins to change, or, in common parlance, "to crack;" and until the change is completed the voice is imperfect, and unfit for singing.

From what has been said, it is evident that the height of note in the musical voice depends upon two things, the degree of tension of the vocal cords and the width of the glottis. In producing the extremely high notes, the cords are so closely approximate, that they appear actually to touch along their anterior portions. The loudness of the voice is regulated partly by the force with which the air is expelled from the lungs, and partly by the size of some parts of the larynx. In some of the animals belonging to the class Mammalia, large cavities or pouches exist, opening into the larynx, which give great resonance and loudness to the voice. These structures are met with in the ass, but more markedly in the howling apes of America, which, though but of comparatively very small size, are said to make more noise than the roaring of a lion, and to be distinctly audible for a space of two miles. The epiglottis, by being pressed down so as to cover the upper part of the larynx, helps to render the notes deeper in tone.

All singers, but more markedly men, have the power of producing two entirely different series of notes—one, the notes of the natural voice or chest notes, and the other the falsetto notes. The chest notes have a fuller sound, and produce a stronger sense of vibration than the falsetto; the lowest notes of the voice can only be produced by the chest, the highest only by the falsetto; the medium may be sung by either voice. We have seen that the natural voice notes are produced by the vibrations of the vocal cords, brought into more or less close approximation to each other: the way in which the falsetto notes are produced is much disputed. Some physiologists consider that they are not dependent on the vibrations of the vocal cords themselves, but are caused by the vibration of the air rushing through the glottis, which they believe, at this time, assumes the shape of the *embouchure* of a flute. Other observers assert that, in the production of falsetto notes, the surfaces of the vocal cords are not approximated, but simply their edges, and that this accounts for the difference between the two kinds of notes. The matter cannot, however, be considered to be satisfactorily settled at present.

The articulate voice resembles the cry so far as the absence of any sustained musical tone, but differs from it both in quality, and in its being always modified by the will. Man is not the only animal that has the power of uttering articulate sounds; but he is the only one that is able to attach meanings to the words he utters, and to arrange them after a definite fashion according to the dictates of his understanding, and not from simple imitation of sound, like the parrot or other talking birds—he is the only one that can be said to have the power of speech. The special organs of articulation are the pharynx, the nasal fossæ, the mouth, and the tongue. The mechanism of the larynx is not essential to the performance of this act, as is shown by the fact that in whispering, though no laryngeal sound is produced, yet we may articulate quite distinctly. The number of sounds capable of being produced by the human voice are of almost infinite variety; some are so easily uttered as to appear to be made almost spontaneously, whilst others can only be produced by long practice. No language utilises all these sounds, but those easiest to be produced enter into the composition of almost every tongue. The various sounds used in speech are usually divided into two great classes, vowels and consonants. Of these the vowels are, for the most part, the easiest to be sounded: for their production, it is only necessary that the exit of air from the mouth should be as free as possible, and that the parts, when once put in the proper position, should retain that position till the sound is concluded; they are continuous sounds, modified by the form of the aperture of the mouth. Thus, in sounding *ah* the mouth is opened to its fullest extent, the tongue is depressed, and the hanging curtain of the palate is drawn up, so that the air escapes from the mouth without any check. In making the sound expressed in English by *oo*, the same arrangement is carried out, but the aperture of the mouth is narrowed; in the same way, if the other vowel sounds are tried, it will be found that they are varied by the form of the aperture of the mouth, and that the parts remain fixed during their production. To produce the consonants (so called because most of them cannot be sounded without the aid of a vowel), a certain degree of movement of the parts concerned in their production is necessary, and the breath, in consequence, suffers a more or less complete interruption in its passage through the mouth. These have been divided into two main classes: the first called explosives or mutes, which necessitate that the breath should be completely stopped at the moment previous to their production; the second, continuous, in which the breath only receives a partial check, and the sound, like the vowel, is continuous. In pronouncing the consonants contained in the first class, of which *b*, *p*, *d*, *t*, *k* may be taken as examples, the posterior orifices of the nose are completely closed, and all the air is driven through the mouth; in pronouncing *b* and *p*, the air is stopped by the shutting together of the lips; in pronouncing *d* and *t*, by the contact of the tongue with the front part of the roof of the mouth: this latter arrangement is also used for pronouncing the hard *g* and *k*, the difference consisting in the degree and extent to which the tongue is brought in contact with the roof. In the other class the nose is open, and the air is allowed to pass more or less freely through it, as in *m*, *n*, etc.; but in others, as *v*, the air is not allowed to enter the nose; still, in all the consonants included in this class, the sound is capable of being prolonged to an almost indefinite extent. Such, then, are the leading principles upon which articulate sounds are produced. The other simple sounds, and their almost endless modifications, are produced in similar ways; and out of these combinations, the different nations of the human family have built up each its own particular language.

THE STEAM-ENGINE.—II.

CYLINDER—SEPARATE CONDENSER—SINGLE-ACTING ENGINE.

WE must now pass on to the consideration of the means by which the steam is made to produce a mechanical effect. An iron tube of large diameter, called the cylinder, is employed for accomplishing this. The inside of this is turned so as to be as true as possible, and a solid plug or piston is made to fit it so tightly as to prevent the steam passing, but at the same time with sufficient freedom to allow of its moving up and down in the tube without a wasteful expenditure of force. Both ends of the cylinder are closed by discs. Let A (Fig. 6) represent the piston, and F the cylinder in which it moves. Also let D and E be two apertures by which the steam can be admitted to the upper and lower ends of the cylinder respectively. If the piston be at the bottom, and the steam be admitted at E, while D remains open to the air, the piston will be raised to the top of the cylinder, the air above A escaping at D. Now let the steam be turned off from E, and this aperture be left open; the weight of A will then cause it to fall, driving out the steam before it. If, instead of this, the steam be made to act through D on the upper side of the piston, it will be driven down with much greater force.

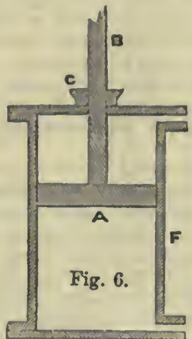


Fig. 6.

It is clear, then, that if we have some way of allowing the steam to act first on one side of the piston and then on the other, we can make it travel alternately from end to end of the cylinder with a greater degree of force.

Instead of this we may drive the piston up to the top of the cylinder by the steam, and then, closing the aperture E altogether, condense the steam which fills the cylinder by applying cold to it. A vacuum will thus be produced, and the piston will be forcibly driven down.

Fig. 7.

As yet, however, we have no mode of imparting the motion of the piston to any mechanism outside the cylinder. This, however, is not a great difficulty. A piston-rod (B) is firmly attached to the piston, so as to be at right angles to it. An aperture is then made in the upper cap of the cylinder, through which this rod may pass; and to guard against the waste of steam by escape through this aperture, a "stuffing-box," C, is placed there. This is packed with hemp, or some similar material, saturated with oil or tallow, and thus a steam-tight contact is produced.

A ring is sometimes turned in the edge of the piston, which is packed in a similar way with hemp, but what is known as a metallic packing is more commonly employed. In this the piston consists of metallic rings placed one above the other, and divided into segments, the joints in one disc being midway between those above and below. These segments are pressed outwards by spiral springs, and thus wear so as exactly to fit the cylinder. Very great perfection is now attained in the manufacture of these pistons.

We then see that there are two ways in which the piston may be moved up and down in the cylinder. We may either admit the steam at one end only, and then condense it so as to produce a vacuum, into which the pressure of the air will drive the piston, or we may admit the steam alternately at each end, and thus drive the piston in each direction. These two classes are respectively distinguished as *single-acting* and *double-acting* engines.

The former were first employed—the engines consisting of a cylinder and piston, and an arrangement by which steam could be admitted below the piston. When this was driven to the top, the steam was shut off and the cylinder cooled by the application of cold water to its external surface. This condensed the steam, and thus created a vacuum, and the pressure of the air on the upper side of the piston forced it down. These engines were, however, very imperfect, as it took some little time to condense the steam, and at the same time there was a great waste of heat. The cylinder had each time to be cooled below the boiling-point, or otherwise much of the steam remained uncondensed, so that the piston could not reach the bottom.

One day, in repairing an engine of this class, the piston was observed to descend much more rapidly than usual, and on inquiry it was found that, owing to a leak, cold water was allowed to enter the cylinder, instead of being merely applied externally. This answered so much better, that arrangements were at once made for injecting cold water below the piston, in order to condense the steam, and suitable valves were provided for the escape of the water and the air which always accompanied it in small portions. There was still, however, a great loss by the cooling of the cylinder at every stroke. At length, however, just about a hundred years ago, James Watt, the celebrated engineer, directed his attention to the subject, and endeavoured to find some mode of preventing this waste of heat. At length the idea occurred to him, that if he opened a communication between the cylinder and another vessel quite void of air or vapour, the steam would immediately diffuse itself through the two; and if this second vessel were kept at a low temperature, it might all be fully condensed without lowering the temperature of the cylinder.

Experiment soon convinced him of the benefits of this idea, and the introduction in this way of a separate condenser was one of the greatest improvements ever effected in the steam-engine. This was patented by Watt, and from it he received a large income for some time. Many other improvements, which added in no small degree to the efficiency of the engine, were likewise effected by him. To some of these we shall have occasion to refer.

We shall now be able to understand the construction of the single-acting engine, a view of which we give in Fig. 7. For most purposes this form has now been superseded, but it is still frequently employed for pumping the water from mines.

P is the piston, which works in the cylinder A, and T is the steam-pipe by which communication is made with the boiler. A suitable valve is provided in this, so that the steam may be shut off at pleasure when the engine is to be stopped. B B is the beam which oscillates on bearings fixed in the masonry; at its ends are large wooden arcs with chains fixed to them, the object of which is to allow the piston-rod to work vertically. Were it jointed directly to the end of the beam it would be swayed from side to side, and the packing of the piston and stuffing-box would be destroyed. To the further end of the beam a counterpoise, Q, is placed; this is sufficiently heavy to draw the piston to the upper end of the cylinder after it has been forced down by the pressure of the steam on its upper surface. The pump-rods are attached below Q.

N is the separate condenser into which cold water is injected from the cistern around, the amount being regulated by the cock moved by the handle seen above it. This water and the air it contains would, however, soon accumulate and stop the action of the condenser; a valve is therefore placed at the bottom opening outwards, and a pump, moved by the rod E, removes the water through this at each stroke. This water is, of course, warmed by the condensed steam, and is therefore usually employed to feed the boiler.

Another rod, F, on the end of the beam carries on it two small tappets, *a* and *b*; these give motion to the valves which regulate the steam. There are three of these *m*, *n*, and *o*, all of which are placed on one vertical rod; *m* and *o* open upwards, while *n* opens downwards. The rod which carries them is attached to one end of the bent lever *k c d*, the other end of which terminates in an eye or fork, through which the tappet-rod marked F in our illustration moves.

To understand the action, let us suppose the steam to be turned on, the valves being in the position shown. It will then pass from the boiler through the steam-valve *m*, and thus press on the upper surface of the piston. The space under this, being in connection with the condenser through the eduction-valve *o*, is a vacuum, and there is thus no resistance offered to the downward movement of the piston. It accordingly sinks, and in so doing raises the counterpoise, Q, and the pump-rods.

The rod F falls at the same time, and just before P reaches the bottom, the tappet *b* catches the bent lever, and lowers the valve-rod; *m* and *n* are thus at once closed, so that the cylinder is shut off from the boiler and from the condenser too. The equilibrium valve *n* is, however, opened at the same time, and thus makes a communication between the upper and lower ends of the cylinder, so that the pressure on each side of the piston becomes the same. The counterpoise Q accordingly lowers its end of the beam, and thus raises the piston to the top of the cylinder.

In doing this the lower tappet raises the lever again, so that the equilibrium valve is closed. The lower end is then, as at first, in communication with the condenser, and the steam in it is condensed, while the pressure of the steam on the piston again depresses it, and in this way the motion is continued.

Another great improvement effected by Watt was that of working the steam *expansively*. An example will make this quite clear. Let the cylinder be 6 feet long, and have an area of 40 square inches, and let the steam press on it with a force of 25 lbs. per square inch. The total pressure on the piston will then manifestly be 1,000 lbs.; and to drive the piston along the cylinder with this pressure will require a given amount of steam. Now let us suppose the steam-valve closed when half the stroke has been performed. Only half the amount of steam will be used; the piston will, however, still continue to be forced down by the expansive power of the steam, but the force gradually diminishes till, when the piston reaches the bottom, the steam has expanded to twice its original bulk, and therefore exerts only half the pressure—viz., $12\frac{1}{2}$ lbs. per square inch, or 500 lbs. in all. We can easily calculate the mean pressure during the latter half of the stroke, and shall find it to be a little over 700 lbs. We have, therefore, the piston forced through a space of 3 feet with the force of 700 lbs. without any further amount of steam. The amount of work accomplished by the same expenditure of fuel is in this way increased 1·7 times. By cutting off the steam at an earlier portion of the stroke, a much greater increase of power is attained, and many engines are now made which are worked with steam at a very high pressure, the valves being closed at one-eighth or one-twelfth of the stroke. This is easily effected by a suitable arrangement of the tappets.

LESSONS IN GREEK.—LII.

MOODS.

THE moods represent the circumstances under which the subject is united with the verb, or the manner in which the affirmation of the verb is made. In simple propositions the indicative, the subjunctive, and the optative moods are employed; the imperative is a form by itself, since the imperative does not make a simple statement.

The office of the indicative mood is merely to indicate or declare a reality. In Greek the use of the indicative generally resembles its use in other languages. Some peculiarities, however, have to be set forth.

The indicative, in union with the particle αν (κε, κεν), presents a condition whose realisation depends on circumstances, to which reference is made by the conjunction. This form of speech occurs partly in the historical tenses and partly in the future.

The indicative of the historical tenses, in connection with αν, denotes that a condition takes place as often as the requisite circumstances occur, consequently neither always nor merely once; as, for example, ὁτι μαθοιμ' ἑκαστοτε, επελανθανομην αν ευθυς, *whatever on each occasion I learned, forthwith I commonly forgot it.*

The force of the idiom may be illustrated by the use of our conditional *would*, denoting repetition under certain alleged circumstances:—

"These things to hear
Would Desdemona seriously incline."

The indicative with αν also signifies that a condition has not taken place or cannot take place, since the requisite circumstances do not exist; as, τίς αν ῳηθη ταυτα γενεσθαι; *who could believe that these things happened?*

Frequently are these forms used—ειδες αν, *you would have seen;* ηγησω αν, *you would have thought;* εγνω αν τις, *one would observe.*

Sometimes for the expression of this sense you find the indicative without αν, when the condition which under certain circumstances would have taken place is represented as actually taking place; as, ηισχυνομην μεντοι, ει ὑπο πολεμιου εξηπατηθην, *I should be ashamed indeed if I were deceived by an enemy.*

So wishes which are not fulfilled and cannot be fulfilled, take the indicative without αν; as, ωφελε Κυρος ζῆν, *would Cyrus were alive.*

The indicative of the future in union with αν (in the poets κε, κεν) signifies that a future event is not absolutely certain, yet is in a high degree probable; and this construction is more frequently found in Homer: for example, εγω δε κε τοι δωσω, *I will give it thee, if I can.*

Suppositions are sometimes uttered as facts. This is done by the employment, in the indicative, of an independent sentence, instead of a foregoing hypothetical one. This form of speech is used partly when a supposition is put in a general and unconditional manner; partly when the speaker intends to take to himself an unfounded statement of another; for which we employ the preparatory words *suppose that, granted that;* as, αδικει τις ἑκων· οργη και τιμωρια κατ' αυτοῦ, *some one advisedly does wrong* (*i.e.*, we will suppose that, etc.); *there are anger and punishment for him.*

The subjunctive and the optative moods denote that the predicate is applied to the subject according to a conception; and the relation between the two is one of dependence, which may exist exclusively in the mind, or it may exist in the mind as represented by a verb or a conjunction.

Homer, and the epic poets in general, put positive as well as negative propositions sometimes in the subjunctive. By this mode of expression it is intimated that the speaker has not a certain but only a doubtful idea of the matter in question; and consequently the form serves to set forth an opinion, or an undecided notion; as, και ποτε τις ειπῃσιν, *and once, I suppose, some one said.*

The occurrence in a simple sentence of the subjunctive with ου μη and μη ου is only apparently irregular, since the expressions are elliptical, something being understood; so that in the full exhibition of the proposition the subjunctive would appear as a subordinate sentence. The words φοβος εστι (*there is a fear*), δεος εστι (*it is a duty*), are to be supplied with ου μη: for example, the sentence ου μη σε απολιπω would read in full, ου φοβος εστι μη σε απολιπω, *there is no fear that I should leave thee.*

In sentences with μη ου we must understand or supply before the μη ὁρα, *see*, or σκοπει, *consider.* The phrase, therefore, serves to express an undecided or doubtful denial; as, αλλα μη ουκ ῇ διδακτον αρετη, *but virtue can scarcely be taught.*

The optative, which represents a conception as lying to the speaker beyond the present, finds its proper application in the expression of a wish. Of the use of the optative in simple propositions there are two different forms, namely, the simple optative and the optative with αν. The optative without αν represents the expression as the free act of the mind, and without any reference to the province of reality. The optative with αν stands in a sentence subordinate to another, which is hypothetical, and which arises from the nature of the case; consequently the conception appears to ensue from certain prevailing circumstances. But the conception assumes the form of an eventual reality, since, if the required circumstances occurred, then the consequent result would take place. Instances of these usages are the following:—

1. When to a proposition which in narrative sets forth an opinion or statement the determining cause thereof is subjoined in narrative, the optative is used without αν; as, απεκριναντο αυτῷ, ὁτι αδυνατα σφισιν ειη ποιεῖν ἁ προκαλεῖται ανευ Ἀθηναιων· παιδες γαρ και γυναικες παρ' εκεινοις ειησαν, *they answered him that it was impossible for them to do what he asks for without the Athenians, for the children and women were in their hands.*

2. Hesitating views and determinations, if they intimate only an inclination in the mind of the speaker, are expressed by the optative without αν; if, however, it is intended to intimate that those views and determinations may, on a certain event taking place, prove realities, then the optative with αν is employed; for example (opt. without αν), ῥεῖα θεος γ' εθελων και τηλοθεν ανδρα σαωσαι, *easily, I think, can a god, if willing, even at a distance save a man;* (opt. with αν), ουκ αν εγω ταυτα φησαιμι, *I could not, I think, affirm these things.*

In the refined tone of Attic conversation the optative with αν was a polite form of expression, by which convictions and requests were set forth in a hesitating or qualified manner; as, ὡρα αν ειη πραττειν τα δεοντα, *this is the time, I would submit, to do one's duty;* λεγοις αν ἁ δει λεγειν, *be so good as to say what ought to be said.*

The optative without αν may denote repetition; as, ει τις Σωκρατει περι του αντιλεγοι, επι την ὑποθεσιν επανηγαγεν αν παντα τον λογον, *as often as any one opposed Socrates on any point, he would bring back the conversation to the assumed principle.*

ENLARGEMENT OF SIMPLE SENTENCES.

We have considered simple sentences viewed in their Greek construction, and now pass on to consider compound sentences. In order to do so with effect, we must attend to the enlargement of simple propositions.

The external enlargement of the subject consists in this, that the affirmation made in the predicate is equally referred to several different objects, so that there are several subjects belonging to one predicate. Now several subjects to which one predicate is assigned may be viewed as a series of connected individual persons or things, or they may be viewed as forming a whole. If these subjects form a series, they are united together copulatively by και, τε—και, τε—τε, και—και, or disjunctively by η. In English the copulative and the disjunctive are ordinarily placed only before the last noun of the series; in Greek they are placed between every two of the series. If the series is viewed as a whole, the one is added to the other by means of συν, μετα, ἁμα.

We have seen that the subject must agree with the predicate. This general rule may be expanded.

The predicate may agree with the several nouns in the plural or dual number, on the ground that in sense the several nouns are comprehended in the affirmation made in the predicate; or the predicate may grammatically agree with one of the nouns, with which in sense it is more intimately connected than with any other or all the others; that intimate connection may arise from proximity. In the former case the predicate will be in the plural, in the latter case it will be either in the singular or the plural according to the number of the noun with which it is immediately connected. When the predicate agrees with only one noun, it may be understood to apply to the others through that one noun or subject.

In reference to several subjects which signify things without life or conditions of things, the Greeks commonly put the adjective predicate in the neuter plural. In reference to masculine and feminine subjects, the common adjective predicate or attribute is usually in the masculine gender.

In the union of several grammatically different subjects, the verb either agrees with the nearest or is in the plural; if one of the subjects is in the first person, the verb is in the first person.

Subjects connected disjunctively, as well as conjunctively, take a plural verb in Greek. This usage is contrary to what is common in English. Also a noun singular having a plural united with it by a preposition, and so forming a compound subject, takes the verb in the plural in the Greek.

The internal enlargement of the subject consists in this, that an attribute is associated with it. By an attribute is meant any addition made to a substantive, which serves to individualise the substantive—that is, to describe its essence and nature, and to distinguish it from other of the same species. The attribute appears as blended with the subject by means of an adjective, as καλη γυνη (*a fair woman*), or by means of a genitive, or a preposition with its case, as οἶκος πατρος, *father's house;* οἶκος εν τη πολει, *house in the city.*

The attribute may also be set forth as something subjoined in the way of explanation; as οἶκος, ἡ των ανθρωπων μονη, *house, the dwelling-place of men.* This application of the attribute is specifically called *apposition.*

Attributes may be assigned to nouns not merely as subjects, but also as objects.

In Greek frequently nouns may perform the office of attributives. Thus we may employ these uncoalescing combinations —ανηρ πρεσβυτης, *an old man;* ανηρ νεανιας, *a young man* (literally, *a youth-man*).

Adverbs and adverbial phrases may also be connected with a noun as its attribute when the noun has the article; as, ἡ ανω πολις, *the upper* (lying inland) *city;* αἱ πελας κῶμαι, *the neighbouring towns;* ὁ μεταξυ χρονος, *the interval, the meanwhile.*

The attributive adjective agrees with the subject to which it belongs, in the same way as the predicate agrees with its subject, following the subject in gender, number, and case; as, σοφος ανηρ, *a wise man;* γυνη καλη, *a fair woman;* τα ὑψηλα ορη, *the lofty mountains;* τη εμη θυγατρι, *to my daughter.*

If several adjective attributes are joined with a noun they are either connected together by means of και, τε—και, etc., or they stand without a copula. Adjectives expressive of quality are generally united by και, etc.; as, νεα και ἁπαλη σαρξ, *young and tender flesh;* αγαθῶν και παλαιων νομεθετῶν εὑρηματα, *the discoveries of good and ancient lawgivers.*

The copula may be omitted, however, if one of the adjectives blends with the noun so as to form with it a compound idea; as εσχατη κακη τυχη (*the extreme of bad luck*), where κακη τυχη go together as if they were one word; so μεγα πλοῖον σιταγωγον, *a large corn-vessel.* The copulative και is sometimes omitted also for the sake of oratorical effect.

If a preposition is employed with the chief word, it is commonly not repeated with the subordinate one.

Special notice must be given to apposition with possessive pronouns, and adjectives which indicate that something belongs to an object. In these instances the appended words are in the genitive, the case being taken from the genitive force of the word which represents possession; for example, διαρπαζουσι τε εμα του κακοδαιμονος (*they plunder my goods, wretched man that I am*), where the genitive του κακοδαιμονος is borrowed from the genitive involved in εμα, and the phrase is equivalent to διαρπαζουσι τα του κακοδαιμονος εμου πραγματα, *they plunder the goods of me, a wretched man.* In rendering the idiom into English, some latitude must be taken, in order to make the sense clear.

Another kind of apposition is that in which the parts of a whole are appended to the whole in the same case as the whole itself has; for example, λῦπαι αἱ μεν χρησται εισιν, αἱ δε κακαι, (*of*) *griefs some are useful, others bad.*

In English the whole is put in the objective, but in Greek the whole stands in the same case as the parts. We have a somewhat similar construction in English; for example, THE PILGRIMS *returned* EACH *to his own home.*

To this, which is called the *partitive apposition,* belongs the σχῆμα καθ' ὁλον και μερος—that is, the construction which puts the part and the whole in the same case—a construction which strictly is peculiar to the poets; thus Homer says, τον μεν αρα Γλαῦκος στηθος μεσον ουτασε δουρι, HIM *Glaucus,* (*in*) THE CENTRE OF HIS BOSOM, *wounded with a spear;* where στηθος μεσον, the part, is in apposition with τον, the whole; στηθος μεσον thus defines the exact place in which the man was wounded.

Sometimes the distributive apposition is connected with this partitive apposition; as, Τρῶας δε τρομος αινος ὑπηλυθε γυῖα ἑκαστον, *dreadful fear seized the Trojans in each one's knees.*

The infinitive appears in apposition, chiefly after demonstrative and relative pronouns, in order to give a more exact view of the idea before generally indicated; as, *βαρος τι και τοδ' εστιν, αινεῖσθαι λιαν, this also is something unpleasant,* (namely) *to be praised excessively.*

A substantive appears in apposition to an entire sentence, in order to mark the point of view from which the fact in the sentence is to be regarded; as, Ἑλενην κτανωμεν, Μενελεῳ λυπην πικραν, *let us slay Helen, a bitter grief to Menelaus.*

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XXIII.—BRITISH INDUSTRY AND COMMERCE.

England.—There was nothing in the intercourse between the ancient nations and our own country that ever foreshadowed the supremacy we were destined to attain in the arts of industry and the pursuits of commerce. The geographical isolation of Britain had its counterpart in our social and commercial life. Our richest natural endowments, coal and iron, were, in the first period of British history, almost utterly unknown.

England was covered with dense forests; herds of wild cattle and other beasts roamed through the country; agriculture was practised only in the rudest way, and the natives lived chiefly upon fruits and the products of hunting. Tin, lying near the surface of the soil, and lead in considerable quantities, were exchanged with the Phœnicians for trinkets; and a few simple commodities were transmitted overland to Marseilles, for use in the Levantine States and Greece. Roman occupation increased the mineral produce, but cattle-rearing and swine-herding long employed most of the inhabitants. Hides, wool, and furs are named among the exports, and British pearls appear to have been esteemed. In the Saxon period a commercial treaty was made between the king of the Mercians and Charlemagne, and about the same time notice is taken of an Anglo-Saxon merchant trading in Marseilles. Other Anglo-Saxon merchants visited the market of St. Denis, in the reign of Dagobert, while Frisians visited England in the eighth century. Fairs existed amongst the natives, but trade was restricted by the law which forbade transactions above the value of twenty pence, except in the sight of two witnesses or of the magistrate. Little of the land was arable, and the forests were valued not for their timber, but for their *pannage* in the form of the mast of oak and beech, which furnished sustenance to herds of swine.

While the Mediterranean was crowded with an active commerce, England was merely productive and passive, waiting at home for traders from abroad, who visited it for tin, lead, wool, and hides. English wool was so esteemed that Charlemagne exempted merchants dealing in it from the peril of capture in war: wool, also, was the staple of exchange for the cloths of the Netherlands from the days of Alfred the Great to those of Edward the Confessor.

William the Conqueror sheltered a band of weavers driven from Zealand by an irruption of the sea, and the country profited by the intercourse they established with Hollend. English wool improved so much very soon, that next to money it was the commodity most eagerly sought in foreign exchange. Part of the ransom of Richard I. was paid in wool. Eventually corn and cheese began to be regular articles of export. The herring shoals found off Yarmouth gave the first impulse to our principal fishery. The herring trade was confirmed to that town by a charter of King John. An early trade in slaves brought profit to Bristol, as did the negro traffic also in later days, and enriched the exchequer to the extent of £4,000 annually from the duties levied upon this human commodity. London was the earliest in time and first in importance of the English trading cities. Tacitus mentions London as a celebrated resort of merchants. Bede relates that it was frequented by foreigners in 614 for the purposes of trade. William of Malmesbury speaks of it as a wealthy and populous city in 1041; and half a century later considerable business was transacted there.

In the Norman period agriculture and manufactures were less rude than in the time of the Saxons, but spinning and weaving were for a long time household avocations, and the coarsest cloths alone were produced at a time when the industrial arts in France had reached a high degree of excellence. During the Roman occupation of Britain the native roads were improved, and others, still remaining as great highways, were first constructed. Nevertheless, the general means of communication were wretched; the carriages were clumsy, and pack-horses along bridle paths were the chief mode of transport. On the rivers the Britons skilfully managed their light coracles made of wicker and hides. Probably they ventured in larger canoes as far as Ireland and Gaul. Alfred the Great created a navy of war-galleys, each rowed by sixty or eighty men, to cope with the Danish naval power. Under the Norman kings, further improvements were stimulated by association with France. England was occasionally unable to hold her own, but at other times was aggressive. Trading states in the Middle Ages regarded the seas as the domain of the strongest, and acts which would now be called piracy were often committed. Towns fought against each other without reference to law or king. Winchelsea, Yarmouth, and the Cinque Ports were thus often in open hostility with the maritime towns of Flanders and France. Individuals as well as towns were left to enforce on their own account the reparation for maritime wrongs, and in their desire to recover their losses they were not scrupulous, where the real offender was difficult to reach, about choosing another in his stead. English merchants for many generations had to fight for every advantage they gained. The European trading leagues having got the start, did their best to stifle in its birth every native effort at foreign trade. They even looked upon English vessels as lawful prizes, and sealed their own ports against new comers by heavy "discriminative" duties. A celebrated company of "merchant adventurers" received a charter in 1406 from Henry IV., and notwithstanding the opposition of Continental monopolists, pursued a profitable trade, smuggling the cheap coarse English woollens into the marts of Flanders, Italy, and the Levant, in exchange for rich cloths, wines, and arms.

The causes and the consequence of the backward condition of England are not far to seek. Saxons, Danes, Normans, not only plundered the prior inhabitants, but disturbed their institutions. At each conquest the nation was thrown back, and had to begin anew. The Britons under the Romans partook of the refinement of their masters. Progress, arrested when William the Norman ground the land under his iron heel and blighted Saxon freedom with the curse of villenage, was long in making a fresh start. The feudal system in England virtually rendered industry penal, for it enforced idleness on the vassals, who learned to think that war and the chase were the fitting employments for free men, and that useful work was degrading. Forest laws kept the land from cultivation, and consequently husbandry remained in a feeble condition. The caprice of the seasons led to failures of produce, both vegetable and animal, and famines were far from unfrequent. For generations England continued a country of forests and marshes—the hunting-ground of untutored Normans. Red deer and wild swine were of higher value in the eyes of such men than the lives of two millions of Saxon serfs. Trade was limited by rapine and lawlessness, and few foreign merchants would risk life and property for the profits of commercial intercourse.

The monasteries of that time seem to have been the sanctuaries of industry as well as of learning. Located in fertile vales, the clergy made labour a sacred duty, and by cultivating the rich lands around them they improved the practice of agriculture. They were lenient masters. By shielding the farm labourers from the injustice of the barons, the monks prepared the way for the overthrow of villenage. If the loss of liberty be the loss of half our virtue, we owe an indefinite debt to monachism for the restitution of this priceless boon. As freemen the lower orders acquired a right to property, which elevated their moral tone and added to the prosperity of the whole population. Manufactures no less than husbandry were fostered by the monks. The principle of every monastery was, that each community should supply as far as possible its own wants by home labour. Cloth was woven from home-grown wool; abbeys and churches were planned and built by ecclesiastical artificers, and beautiful ruins and splendid cathedrals remain as evidences of their genius. Each religious retreat was a centre of blessings greater than military glory. Conquerors and conquered were silently brought together by the teaching and example of the Church, until at length, by the operation of a chain of influences, the fusion of the two rival races of Saxon and Norman was completed. From this period England possesses a national history, and dates its growth as an industrial and commercial power. Characteristic of ignorance, however, laws were passed, even thus early, to prevent native industry from being *injured* by the influx of the necessaries and comforts of life from abroad. Henry II. incorporated the weavers of London, and gave them many privileges, condemning all foreign wool to be burnt.

Edward I. and Edward III. were warlike rulers, continually in need of pecuniary subsidies, and unscrupulous as to the means by which they obtained them. They perceived that trade was a main source of wealth, and so far, therefore, they encouraged the pursuits of industry. Edward I. opened English ports to the merchants of Germany, France, the Netherlands, Portugal, Spain, Lombardy, and Tuscany, but he confiscated the property of 16,500 industrious Jews, whom he banished from the kingdom, thereby displaying religious fervour, while bringing lucre to the well-nigh exhausted treasury, and relieving himself of enormous debts. Edward III. granted the weavers, dyers, and fullers of Flanders exclusive privileges, to induce them to settle in the kingdom, yet at the same time fettered the grant with absurd regulations to prevent their growing rich or proud. A citizen of London in the same reign was executed for using coal as fuel, after it had been forbidden. The clamour against coal may be more easily understood when we remember that chimneys and glass windows were luxuries not as yet commonly enjoyed, and that the smoke from fires had to make its escape from crevices in the buildings. The first export of coal was from Newcastle to France, in 1325. About this time, also, textile fabrics were first exported from England. Woollen cloths were manufactured at Bristol, London, and Norwich. Linen and silk-weaving began to flourish. The hardware manufacture, however, was still bound down by heavy duties, and tin vessels made in Malta, from ore raised in England, formed a portion of the imports.

How rapidly a native marine was formed may be judged by the fact that the Cinque Ports, which for special immunities granted at the Conquest were bound to furnish merchant vessels for use in war when required, supplied but five of such vessels for the use of Edward I.; while, together with London, Bristol, and Southampton, they furnished 710, manned by over 14,000 sailors, for the service of Edward III. in the siege of Calais.

This was the era of the merchant princes whose names are landmarks in English history. The family of the De la Poles, merchants of Hull, were distinguished for their great wealth, amassed in commercial pursuits in the reign of Edward III. Between that period and the reign of Henry VIII., the De la Pole family produced a Lord Chancellor, and acquired successively an earldom, a marquisate, and a dukedom; and this was not an exceptional example of commercial prosperity. The wealth of Canynge, five times mayor of Bristol in the reign of King Henry VI., is attested in the stately structure of St. Mary Redcliffe, the "Pride of the West," one of the finest examples of our ecclesiastical architecture, and also in the still active charities of that city. Still more renowned is Sir Richard Whittington, thrice Lord Mayor of London, who had "right liberal and large hands" to all poor people, and the fame of whose wealth has given rise to one of our commonest nursery stories.

Wealth arising out of industry and commerce produced great changes in national manners and customs. A powerful middle class was created, jealous of their rights, and profiting by the depression of the barons during the Wars of the Roses. These conflicts long diverted the attention of the English people from the vast natural resources with which they were favoured. Iberians, Italians, Danes, Norwegians, and Germans, who had, from their offices in London, heretofore controlled the foreign trade, now obtained for many years a new and undeserved lease of our matchless coast and harbours. At the accession of the House of Tudor, however, if the magnitude of Dutch, German, or even French trade had not been reached, there had, nevertheless, been laid by England the foundations of a commerce and an opulence destined to excel and outlast the prosperity of nations much earlier in the race.

SCOTLAND.—The trade of Scotland was of less importance than that of England. Fisheries were carried on along the coasts, and a few coarse cloths were woven in the towns. The exports were chiefly raw materials, some of which were carried in Scottish ships. The commodities comprised wool, beavers' skins, hides, oxen, horses, and sheep, and were consigned for the most part to the Low Countries.

IRELAND.—Irish commerce resembled that of Scotland and England, and in importance ranked between the two. Dublin, Waterford, Cork, and Drogheda were prosperous ports, dealing in hides, skins, wool, and fish, and to some extent in grain. Woollen and linen goods were exported to a small extent. The commercial imposts were light, which gave the country the advantage of possessing comparative freedom of trade.

CHAP. XXIV.—COMMERCIAL KINGDOMS OF NORTHERN EUROPE.

RUSSIA.—Russia was the last of the states of Europe to emerge from barbarism. In the Middle Ages a great part of the country was barely known, and many districts now belonging to the empire had not then been conquered. The shores of the Black Sea were visited by Greeks, Byzantines, Venetians, and Genoese, who successively competed for the exhaustless supplies of raw materials, such as forest products, furs, metals, and grain brought down to the maritime depôts situated in the Crimea and at the mouths of the Danube.

The rude commerce carried on by these several adventurers in one part of the Russian dominions was so restricted from various causes, that in order clearly to understand it we must learn something of the political history of the country. The name "Russians" included various tribes. The Russian monarchy was established (862) by Ruric, a daring freebooter of the Baltic. He and his brothers were chosen sovereigns over the Sclavonian Boyards and Finnish tribes, in order to appease their continual feuds. The brothers, Ineo and Truvor, soon died, and left Ruric undisputed monarch. He was a chief of Varangia, a Norse or Scandinavian kingdom founded by Ingvar the Great on the east coast of the Baltic. The Vikings or Varangians called themselves *Rusini*, from the district of Sweden whence they were originally derived, and Ruric's subjects now adopted the same name, and designated their country *Rus*. Skira, son of Ingvar, had chosen Novgorod as his capital, and until 882 it was both the residence of the Russian sovereigns and the principal mart of the kingdom. Its chief trade was with Constantinople, and its natural advantages were a fertile soil, producing grain and fibres; large forests, supporting innumerable animals; and navigable rivers flowing into the Euxine. Novgorod retained its importance after the seat of government was removed to Kiev. Its population in the fourteenth and fifteenth centuries fell not far short of half a million, of whom 30,000 boasted they were skilled in warlike horsemanship. Under Vladimir the Great, who married the daughter of the Greek emperor, Basil II., Novgorod became the emporium of a great commerce. Fairs were held, and a prodigious amount of business was transacted. These fairs afterwards fell into decay. Pleskov, on Lake Peipus, shared the trade and the decay of Novgorod, while Moscow assumed by degrees the commercial importance which had belonged to both. The great market-place of Moscow, soon known as the "Hostinoydvor" or Strangers' Court, was furnished with 5,000 counters or benches of stone. Encircled by a boundless steppe, and enjoying excellent water communication, the trade of Moscow was unimpeded throughout the year; boats or rafts formed the means of communication in summer; and in winter, sledges driven over the frozen snow. Kiev, the second capital of Russia, situated on the Dnieper, and now regarded as the sacred city of the Greek Church, traded with Constantinople and with the Italian cities to an extent perhaps greater than did either Novgorod or Moscow. Kazan was the chief entrepôt of the trade of Northern and Central Asia. It was the capital of an independent Tartar state, and, though connected with Russia by trade, it was not annexed until the year 1552, by Ivan IV. The plains of Kazan are fertile, and afford rich pastures for cattle, the rearing of which, together with fishing, are the chief native occupations. The civilising influences of commercial intercourse were slow in penetrating Russia. Novgorod and Pleskov were the only towns which possessed the privilege of a free market. All other marts were so fettered, that trade could not flourish. The Boyards, as the Russian nobles were called, kept aloof from intercourse with foreigners; and it was not till the time of Peter the Great that Russian prejudices were broken down—how, we shall see.

SWEDEN.—Sweden was in every respect the most important of the three northern kingdoms inhabited by the Scandinavian race. A more extensive country than Norway and Denmark taken together, its power, both political and commercial, in the

Middle Ages, was correspondingly larger. Before the Baltic was known to other nations as a navigable sea, and as a highway to Russia, Sweden had possessed herself of the shores of Courland and Esthonia, and planted there the germ of a line of Russian kings. In the ninth century, Lake Mälar was the site of so prosperous a trade, that Biörkö, one of its island cities, could equip an army of 14,000 burghers, ready for the field, and easily able to contribute 100 silver marks a-piece towards the war. The Dutch traded with this city, bringing linen, cloth, and wine. Biörkö was devastated by St. Olaf in 1008, but such was its extent and solidity that its ruins are still to be found. A similar history attaches to Vineta, a city in the island of Usedom, on the coast of Pomerania. Wisby, in Gothland, grew and flourished by the enterprise of merchants driven from Vineta, and for two hundred years was the chief emporium of the north. It was well placed on an island possessing good harbours, a soil productive of fruits and vegetables, a genial climate, and valuable resources for traffic in corn, lime, timber, pitch, and other forest products. Wisby was a member of the Hanseatic League, and during that connection acquired such commercial greatness, that the *Maritime Law of Wisby* was accepted by most of the commercial nations of the North. The city was built of stone, and the houses were often strengthened with iron doors and adorned with gilded windows. There were sixteen churches and five monasteries, and within the walls of the town dwelt 12,000 burgesses, while the labouring classes, contrary to modern custom, dwelt in the suburbs. Merchants took personally an active part in foreign trade, making voyages in their own vessels, in which, towards the end of the eleventh century, they had already ventured as far as Egypt and the Levant. Traders from all the Baltic provinces, and merchants from more distant parts, even from Spain and Greece, were so numerous, that special streets, with warehouses and shops, were apportioned to the representatives of the different nations. With the decline of the Hanseatic League, Wisby decayed. Though fallen in magnificence, and containing only 4,000 inhabitants, it is still the most remarkable place in the north of Europe, covering an extent of ground capable of housing 40,000 or 50,000 people. There are twelve churches remaining, the beautiful Gothic ruins of which cause them to be much visited by antiquarians. In 1368 the King of Sweden gave the citizens of Amsterdam a district in the island of Schonen (*i.e.*, the extreme south of the Swedish peninsula), in order to facilitate direct traffic between the Netherlanders and his own subjects. The Swedes received salted fish, woven fabrics, wines, Dutch salt, drugs and spices, in exchange for timber, iron, copper, tar, skins, and tallow. To note one exchange, indicative of the different resources of two neighbouring states, the Swedes gave in this traffic six quintals of iron for a barrel of herrings.

NORWAY.—The industry and commerce of Norway have always been centered in Bergen, the ancient capital, which from its convenient position for carrying on the prolific fisheries of the coast, was enlarged and regularly laid out by Olaf III. in 1070. A treaty of commerce between Bergen and England was signed in 1217, and is interesting as the first record we possess of English foreign trade. Bergen, in exchange for English goods, gave dried and salt fish, fish oils, tallow, and skins. The commerce of Bergen, however, attained no importance until the city joined the Hanseatic League, of which it formed one of the four chief emporiums. It then rose to opulence and grandeur, was adorned with thirty churches and monasteries, and many fine public buildings. Its commerce from that period belongs to the history of the Hanse Towns.

DENMARK.—The facilities enjoyed by Denmark for commerce are very great. It possesses the key to the Baltic, and is, besides, favourably situated for intercourse with all the maritime states of Europe. It was the first of the Scandinavian kingdoms to engage in foreign trade. Roeskild, on the island of Zealand, its ancient capital, founded as early as the fourth century, was in the Middle Ages already a large town, containing 100,000 inhabitants and twenty-seven churches, and for more than a thousand years it continued to be the abode of royalty. The presence of the court encouraged commerce, and till 1440, when the capital was removed to Copenhagen, scarcely another Danish town is mentioned in connection with trade. In the year 1150 a semi-religious fraternity of mercantile warriors was founded, whose duty it was to proselytise as well as to trade. The "Roeskild Warriors," as they were called, were particularly enjoined to destroy the Wends of the east coast of the Baltic, whom they hated both as heathens and as rivals in trade. The other towns of Denmark noted in the Middle Ages for their trade were Aalborg, in the north of Jutland, which traded in grain and herrings; Aarhaus, in East Jutland; and Elsineur or Elsinore, formerly the toll-gate of the Sound.

LESSONS IN GERMAN.—LXXVI.

§ 148.—RULE.

THE present participle, like an attributive adjective, agrees with its noun in gender, number, and case; and may also govern the same case as the verb whence it is derived; as, der lachende Frühling, the smiling spring; die alles belebende Sonne, the all-animating sun, *i.e.*, the sun that animates all.

OBSERVATIONS.—(1.) This participle is seldom, if ever, otherwise employed with a noun than in an attributive sense. Its predicative use is found almost altogether in those words that have so far lost character as participles as to be commonly recognised only as adjectives; as, reizend, charming; kränkend, mortifying; drückend, oppressive; fließend, flowing; etc. Such combinations, therefore, as *I am reading, we are walking*, etc., so common in English, are wholly inadmissible in German.

(2.) The present participle, in connection with the article, is often used substantively, the noun being understood; as, der Lesende, the reader (literally, the [one] reading); die Sterbende, the dying (female).

(3.) This participle, however, cannot in German, as in English, be, by means of an article, turned into an abstract verbal noun. But in order properly to render such phrases as *the reading, the writing*, into German, we must use the present of the infinitive; thus, das Lesen, das Schreiben.

(4.) The present participle, as stated in the Rule, may govern the case of its own verb; but it must be noted that the word so governed always precedes the participle; as, das uns verfolgende Geschick, the *us* pursuing fate, *i.e.*, the fate that pursues us. In some instances the words are actually united, forming compounds; as, ehrliebend, honour-loving, that is, ambitious.

(5.) The present participle is sometimes used with the power of an adverb; that is, to express some circumstance of *manner* or *condition;* thus, weinend sprach er zu mir, weeping (that is, *weepingly*) he spoke to me.

§ 149.—RULE.

The preterite participle is not only used in the formation of the compound tenses, but may also be construed with nouns, like adjectives; as, ein geliebtes Kind, a beloved child.

OBSERVATIONS.—(1.) This participle, in its character as an adjective, is far more frequently employed in German than in English. Indeed, many preterites in German, having lost all character as participles, are now used exclusively as adjectives.

(2.) The preterite, like the present participle, is sometimes used in an adverbial manner; thus, das Buch ist verloren gegangen, the book is lost (literally, *gone lost*).

(3.) This is especially the case with certain participles employed with the verb kommen; as, weinend sprach er zu mir, weeping (*i.e.*, weepingly), he spoke to me; er kömmt geritten, he comes *ridden*, that is, riding on horseback.

(4.) Kindred to this is its use, when connected with a verb, to express the *condition* or *state* of the subject; as, jetzt sterb' ich beruhigt, now I die content; in seine Tugend gehüllt, trotzt er der Verleumdung, wrapped in his virtue, he defies calumny.

(5.) The preterite participle, usually in connection with the accusative, is in some phrases employed *absolutely;* as, die Augen gen Himmel gerichtet, his eyes being directed towards heaven; der Gewinn abgerechnet, the profit being deducted.

(6.) This participle is sometimes elliptically employed for the imperative. (See § 145. 3.)

§ 150.—RULE.

The future participle is used when the subject is to be represented as a thing that *must* or *ought* to take place; as, eine zu lobende That, a deed to be (*i.e.*, that *ought* to be) praised.

OBSERVATIONS.—What is called the future participle in German is produced by placing zu before the present participle, as above. It can be formed from transitive verbs only, and is always to be taken in a passive sense. It is chiefly to be found in the case of compound verbs; thus, hochzuehrender Herr, highly-to-be-honoured, *i.e.*, honourable Sir. (See Section XLI.)

§ 151.—THE ADVERBS.

RULE.—Adverbs qualify verbs, participles, adjectives, and other adverbs; as, er hat den Gegenstand vortrefflich behandelt, he has treated the subject admirably.

OBSERVATIONS.—Almost all adjectives in the absolute form are in German employed as adverbs. (See § 102. 3.) For remarks on the position of adverbs in sentences, see the section on the arrangement of words (§ 158).

§ 152.—THE PREPOSITIONS.

RULE.—The prepositions anstatt, außerhalb, diesseits, etc. (see the List, § 109), are construed with the genitive.

OBSERVATIONS.—(1.) When the same preposition governs several nouns in the same construction, it is put before the first only; as, ich bin von meiner Heimath, meinem Vaterlande, und meinen Freunden getrennt, from my home, my country, and my friends, am I separated.

(2.) For the right use and position of some of the prepositions much attention is required. See the observations on those construed with the genitive (§ 110).

§ 153.—RULE.

The prepositions aus, außer, bei, etc. (see List, § 111), are construed with the dative. (See *Obs.*, § 112.)

§ 154.—RULE.

The prepositions durch, für, gegen, etc. (see List, § 113), are construed with the accusative. (See *Obs.*, § 114.)

§ 155.—RULE.

The prepositions an, auf, hinter, etc. (see List, § 115), govern the dative or accusative; the accusative, when motion or tendency *towards* is signified, but in the other situations the dative. (See *Obs.*, § 116.)

§ 156.—THE CONJUNCTIONS.

Conjunctions connect words and sentences in construction, and show their mutual relation and dependence; as, Johann und Wilhelm gehen zur Schule, John and William are going to school; ich sah es, daher weiß ich es, I saw it, therefore I know it; er ist älter als ich, he is older than I.

OBSERVATIONS.—(1.) Under the general name of conjunctions in this rule must be included all words performing the office of conjunctions, whether properly such or not. Of these connective words three classes are to be distinguished: 1. Those that do not affect the order of the words of a sentence in which they occur (§ 160. 8); 2. Those that always remove the copula to the end of the sentence (§ 160. 7); 3, and finally, those that do or do not remove the copula to the end, according as they stand before or after the subject (§ 160. 8).

(2.) The true force and use of the conjunctions is best learned from examples; of which see a large collection in Sect. XCIX. The following are the more common correlatives; as—

Entweder, either; oder, or.	Sowohl, as well; als, as.
Weder, neither; noch, nor.	Wie, as; so, so.
Wenn, if; so, so, or then.	So, so; so, so.
Da, when; so, then.	Nicht, not; sondern, but.
Je, the; je, the.	Nicht allein, not only; sondern, but.
Je, the; desto, the.	Nicht nur, not only; sondern auch, but also.
Sobald, as soon; als, as.	

§ 157.—THE INTERJECTIONS.

RULE.—Interjections have no dependent construction.

OBSERVATIONS.—Interjections stand generally before the nominative or the vocative; as, O! theuerster Vater! But sometimes the genitive, and sometimes the dative, is preceded by an interjection; as, O, der Freude! oh, the joy! Weh mir! woe to me!

§ 158.—COLLOCATIONS OF WORDS.

(1.) In the arrangement of words in sentences, the German differs widely from the English. Many differences of collocation, accordingly, have already been noted and explained in various other parts of this work. But as every word and member of a sentence in German takes its position according to a definite law of arrangement, and cannot, without great offence against euphony, be thrown out of its proper place, we subjoin here some general instructions on this topic.

(2.) The essential parts of every sentence, as already remarked (§ 119), are the *subject* and the *predicate*. That which is used (properly some part of the verb of existence, sein) to couple the subject and the predicate, is called the *copula*. Now, arranging these three parts in their natural order, the subject will come first, the copula next, the predicate last; thus—

SUBJECT.	COPULA.	PREDICATE.
Das Pferd	war	stark.
The horse	was	strong.

(3.) When, as in the case of simple tenses, the copula and the predicate are both contained in a single word, that word holds the place of the copula. For example:—

SUBJECT.	COPULA.	PREDICATE.
Die Blume	blüht.	—
The flower	blooms.	—

(4.) In the case of compound tenses, however, the auxiliary takes the place of the copula; which place is also held by the auxiliaries of mood (§ 74), the place of the predicate being occupied by the infinitive or participle. For example:—

SUBJECT.	COPULA.	PREDICATE.
Ich	habe	gelesen.
I	have	read.
Er	kann	schreiben.
He	can	write.

(5.) When any verb which assumes the place of the copula is employed in the compound form, the participle or infinitive belonging to it stands *after* the proper predicate; as—

SUBJECT.	COPULA.	PREDICATE.
Er	ist	thöricht gewesen.
He	has	foolish been.
Er	wird	gelesen haben.
He	will	read have.

(6.) The object of a sentence comes between the copula and the predicate; and if there be two objects, that of the person precedes that of the thing. For example:—

SUBJECT.	COPULA.	FIRST OBJECT.	SECOND OBJECT.	PREDICATE.
Er	hat	einen Brief	—	geschrieben.
Ich	habe	dem Knaben	ein Buch	gegeben.
Er	hat	den Sohn	einer Sünde	beschuldigt.

(7.) Should both objects, however, be persons, the accusative comes first; except the oblique cases of the personal pronouns (ich, du, er, sie, es, wir, ihr, sie), which always take precedence; as—

SUBJECT.	COPULA.	FIRST OBJECT.	SECOND OBJECT.	PREDICATE.
Ich	habe	deinen Sohn	meinem Freunde	empfohlen.
Er	wird	ihm	seine Tochter	geben.

(8.) When two personal pronouns form the objects of a sentence, the accusative precedes the dative and the genitive; as—

SUBJECT.	COPULA.	FIRST OBJECT.	SECOND OBJECT.	PREDICATE.
Sie	haben	es	mir	gegeben.
Wir	nehmen	uns	seiner	an.

(9.) Adverbs of degree and manner, or nouns governed by prepositions, and serving in the place of adverbs, when they refer exclusively to the verb, stand immediately after the object. For example:—

SUBJECT.	COPULA.	OBJECT.	ADVERB.	PREDICATE.
Er	hat	seinen Gegenstand	vortrefflich	behandelt.
Er	hat	das Geld	mit Freuden	ausgegeben.

(10.) Adverbs of time, and phrases used instead of adverbs of time, commonly come before the object and before adverbs of place. For example:—

SUBJECT.	COPULA.	ADVERB.	OBJECT.	PREDICATE.
Ich	habe	gestern	einen Brief	geschrieben.
Er	ist	vor drei Tagen in London	—	angekommen.

(11.) Adverbs of place, and nouns with prepositions, used as such, generally come immediately before the predicate; as—

SUBJECT.	COPULA.	OBJECT.	ADVERB.	PREDICATE.
Ich	werde	meinen Sohn	nach Paris	schicken.

(12.) Nouns and pronouns, with the prepositions appropriate to the verb employed in the sentence, generally come immediately before the predicate. For example:—

Ich habe niemals über diesen Gegenstand mit ihm gesprochen.

When, however, the preposition with its noun is merely used to denote the cause or purpose, etc., of what is expressed by the verb, it stands before the object. For example:—

Wir tranken gestern aus Mangel an Bier Wasser.
Ich konnte ihm vor Freuden keine Antwort geben.

LESSONS IN ETHNOLOGY.—VI.

THE AMERICAN RACE.

Archæologists have proved that the American continent must have been inhabited from a more remote period of antiquity than was once believed; and probably it was by the ancestors of the Red Indians, now so extensively diffused over the New World. Though called *Indians*, of course they have no clearly traceable affinity to Brahman Aryans, or even to the low caste Turanians of Hindostan. It is no misnomer to term them *red*, for that is their prevailing colour. At the same time it must be remembered that various other hues occur among them, from the white seen in some tribes occupying cold mountain regions, to the black which characterises those dwelling in the hot and arid parts of California.

The aboriginal inhabitants of the American continent resolve themselves into two divisions — the Esquimaux and the Americans proper (Fig. 7). The Esquimaux inhabit Labrador, Greenland, and other parts of North America either bordering on or actually extending within the Arctic circle. Nay, more, they are found on the Asiatic as well as the American side of Behring Strait. The name Esquimaux is said to be a native Indian one, signifying "eaters of raw fish." The people so designated are in physical appearance like the Asiatic Mongolians. They have small eyes; their noses but slightly project; their faces are broad and flat, with the cheek-bones high; their hair is long, coarse in texture, and black in colour; they have naturally scanty beards, and make them yet more so by rooting the hairs out. In language they decidedly approach the American Red men, and not the Asiatic Mongols. It is, therefore, less easy than it otherwise would be to answer the question whether the original seat of the Esquimaux was Asia or America. If bodily conformation be allowed to decide, then the response will be Asia; if, on the contrary, language be made the determining consideration, the reply will be America. This latter we think the correct answer. If the Esquimaux be mitted, then the other natives of the Transatlantic continent are of one physical type. Morton, the founder of the American school of ethnology, says, "All possess alike the long, lank, black hair, the brown or cinnamon-coloured skin, the heavy brow, the dull and sleepy eye, the full and compressed lips, and the salient but dilated nose. The forehead is lower than in any other race of men, but in some instances this is compensated by its breadth; the eyes are deeply sunk in the head; the nose, though not quite aquiline, yet so far tends to that type as to be decidedly arched."

The languages of the American Red men are of a very peculiar character. Speaking broadly, they are agglutinate; but root is so added on to root that quite a multiplicity of ideas may be expressed by one complex word. An American philologist of French descent, Du Ponceau, has applied to this structure the term now generally adopted, *polysynthetic* (from πολυ, *pol'-u*; in English, *poly*, meaning much; and συνθεσις, *sun'-the'-sis*; in English, *synthesis*, a putting together). The term *polysynthetic* means that a large number of ideas are concentrated into one word. Prichard, among other examples, gives the following one taken from Heckwelder the missionary:—"The Lenni Lenape (a branch of the Algonquin tribe of Indians) express by one word, and that not a very long one, the phrase, 'Come with the canoe, and take us across the river.' The word is *nadholineen*. The first syllable, *nad*, is derived from the word *naten*, to fetch; the second, *hol*, is put for *amochol*, a boat or canoe; *ineen* is the verbal termination meaning *us*, as in *milineen*, 'give us.' The simple ideas expressed by these fragments of words are, *fetch—in—canoe—us*; but its usual acceptation is, 'Come and fetch us across the river with a canoe."

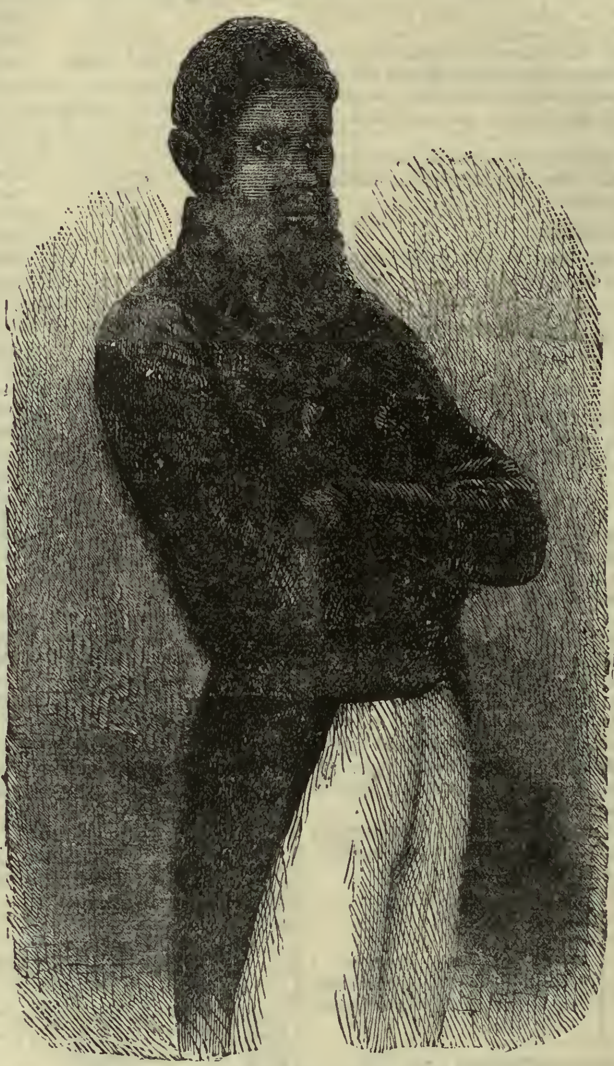


Fig. 8.—TYPE OF NEGRO OF NEW CALEDONIA.

So far as is known, all the Indian languages—that of the Esquimaux included—from Greenland to Cape Horn, are polysynthetic; so also, as we have already stated, is the Basque of the Pyrenees. Hence it is generally believed that all the American Indians, unless perhaps the Esquimaux, are of one race. Nevertheless, they now speak a great multitude of distinct languages, if we judge not by their common polysynthetic structure, but by their diversity of roots.

The popular belief as to the mental and moral characteristics of the American Red men was founded at first on the narratives of settlers, who knew no "Indians" except the Algonquins and Iroquois of the eastern parts of the United States and Canada. In reality there are great differences among them, varying from the untamable hunters of tale-writers to the comparatively civilised Mexicans and Peruvians, who when first discovered were found to be acquainted with astronomy, and to have framed for themselves a calendar which would bear favourable comparison with that of the ancient Romans.

THE NEGROES AND OTHER AFRICAN RACES.

It is convenient for ethnological purposes to suppose Africa divided into two great regions—the first comprising the Barbary States, Egypt, Nubia, and Abyssinia; and the second, the whole remaining portion of the continent. In the middle and lower part of the valley watered by the Nile, as well as in the wide expanse of territory lying between the Mediterranean and the Sahara, the physical aspect of the dominant races, and indeed of the inhabitants generally, is more or less unequivocally Caucasian, while in other parts of Africa the type of structure met with is predominantly negro.

It is difficult to classify the first-mentioned group of nations. Time was when the Coptic or Egyptian language was held to be Semitic, and placed side by side with the Arabic. The Amazirgh or Berber tongue, spoken in many parts of Barbary, was thought to have a similar affinity. Now, however, it appears that though there are many Semitic words in both Coptic and Berber, yet the great majority of the roots in these languages are un-Semitic. What, then, are they? This is a question difficult to answer. Possibly further research may show that both Coptic and Berber have certain affinities to the tongues south and west of them. Happy will it be for the negro if this should finally be established, for in this case he will be able to claim affinity with the Egyptians, to whom even the Greeks looked up with respect, and whose ancient monuments have afforded information, nowhere else obtainable, with regard to the early history of mankind. If the Egyptians were really of the race which, in the low, hot, steaming districts of tropical Africa, developed the physical peculiarities of the negro, then they must have become greatly modified for the better, both physically and intellectually, during the lapse of years. Assuming the fact to be so, then, two causes may have operated to produce the result. Resident as the Egyptians were in the immediate vicinity of the Syro-Arabian nations, they, or at least the upper classes among them, intermarrying with the superior race, would in time approach its level, just as the Turanian tribes have done in Europe. Moreover, their situation at the junction of three great continents must have tended to their civilisation; and this, again, may have acted favourably on their physical and mental organisation. The supposition that the upper classes in the valley of the Nile were more or less Caucasian, while the lower ones were somewhat akin to negroes would reconcile contradictory evidence with regard to the ethnology of ancient Egypt. Thus, on finding Herodotus describe the Egyptians very much as if they were a negro race, it would quite vindicate his accuracy were we simply to say that he referred to the mass of the people; while the Caucasian character of the mummies which have been opened, as well as that of the Egyptians represented on the monuments, would be at once accounted for by remembering that people who had been expensively embalmed, or who had been deemed worthy of being immortalised by means of painting or sculpture, would almost certainly be of aristocratic rank, and therefore pre-eminently Caucasian.

Fig. 7.—SIOUX CHIEF: TYPE OF AMERICAN RED RACE.

It should be mentioned that Bunsen considers the Egyptian language to have affinities both with the Indo-European and Semitic tongues, which he explains by supposing that the Egyptians separated from the primeval stock of mankind while the Aryans and the Semites were yet but one people.

The language of Nubia is sometimes called Barabra, or Berberine, which must not be confounded with the Berber or Amazirgh of the Barbary States. The Nubians are intermediate in physical character between the Caucasians and the negroes.

Abyssinia is a very interesting region, ethnologically viewed. There are in it undoubted Semitic tribes, and others more distinctively African. The country consists of three great tablelands rising one above another. On the second of these, that of Tigré, long stood the old city of Axum, which was the capital of a Semitic kingdom. It was in its glory in the third century of the Christian era, when a missionary, Frumentius by name, brought a considerable part of it over to the religion of the Cross. Certain professors of Judaism in Abyssinia, called Falashas, have among them a translation of the Old

Fig. 9.—NATIVES OF FOULA JALON: NEGROES OF CENTRAL AFRICA.

Testament into the now dead Ethiopic language, called Gheez. They profess to be Jews, bnt the langnage which they now speak is said to have no affinity to Hebrew. The Gheez was apparently the language of ancient Axum, and the modern dialects of the Tigré table-land, which are apparently descended from it, still retain a Semitic character. Other races exist in Abyssinia which we cannot notice in this brief sketch: we proceed, therefore, at once to the Amharic tribe, that now dominant in Abyssinia. The Amharic language is believed to be not a Semitic, but a properly African tongue. It chiefly prevails on the third or most elevated platform, the one to which our troops ascended to attack Magdala. Abyssinia is the last Caucasian or semi-Caucasian outpost in Africa; all beyond is negro; and, indeed, the outpost itself has for some considerable time back been more and more invaded by the Galla tribe, which is purely an African race.

We come now to the Negroes, or at least to the nations of Central Africa who have been so designated. Negro is properly an Italian and Spanish word, originally taken from the Latin *niger*, black. It is not the case, however, that all Central African negroes are of the same hue, as may be seen in Fig. 9. In tropical countries the climate of low-lying tracts along river-banks and that of more elevated regions greatly differs, and it is only in the former that the negro attains to that intense blackness (Fig. 8), which is often held to be a constant characteristic of his race. His uncouth featnres also are somewhat modified for the better on the more elevated table-lands; and finally, in favonred localities he reaches a certain measure of civilisation.

LESSONS IN FRENCH.—XCIV.

§ 147.—Anglo-French Homonyms and Paronyms (*continued*).

English Words.	French Equivalents.	French Words.	English Equivalents.
Solicitor,	*solliciteur;* (jur.) *avoué.*	**Solliciteur,**	*one who solicits, solicitor; canvasser.*
Son, *n.*	*fils.*	**Son,** *nm., adj.*	*sound; bran; his, her, its.*
Sort,	*sorte, genre, espèce; manière, façon; classe, condition; paire.*	**Sort,**	*fate, destiny, lot; spell, charm.*
to Sort,	*classer, distribuer; trier, assortir; appareiller* (cards).		
Sot,	*sot, imbécile, bête; ivrogne.*	**Sot,**	*fool, simpleton, idiot.*
Soul,	*âme.*	**Soûl,** *nm., adj.*	*one's fill, one's bellyful; glutted, surfeited, drunk; cloyed, satiated.*
Sour, *adj.*	*aigre, sûr, acide;* (fig.) *aigre, âpre, morose.*		
to Sour, *v.*	*aigrir; acidifier;* (fig.) *aigrir, empoisonner; s'aigrir.*	**Sourd,** *n., adj.*	*deaf; deaf man.*
Stage,	*estrade; scène, théâtre; degré, période, phase; relai; établi; tréteaux; échafaud, plancher; diligence* (coach).	**Stage,**	*probation, time of probation of a licentiate in law before he can be called to the bar; also of medical students and others before they can begin to practise; time of residence required of a new canon before enjoying the advantages attached to his prebend.*
Stationer, *n.*	*papetier.*	**Stationner,** *v.*	*to stop, to stay; to stand* (*of carriages, hackney-cabs, etc.*).
Store,	*provision, quantité, abondance; magasin, dépôt, arsenal;* (fig.) *fonds, trésor.*	**Store,** *nm.*	*window-blind; spring-roller blind.*
to Store, *v.*	*pourvoir, munir, approvisionner;* (fig.) *enrichir, orner.*		

English Words.	French Equivalents.	French Words.	English Equivalents.
Suit, *n.*	*collection; assortiment;* (cards) *couleur; sollicitation, demande; pétition, requête; recherche en mariage, cour; poursuite, procès.*	**Suite,** *nf.*	*remainder; retinue, train, attendance; sequel, consequence, result.*
to Suit, *v.*	*adapter, approprier; convenir, aller à; plaire; revêtir; s'accorder.*		
Tape, *n.*	*ruban de fil, de coton.*	**Tape,** *nf.*	*rap, slap, thump;* (nav.) *tompion.*
Taper, *n.*	*cierge; petite bougie.*	**Taper,** *v.*	*to hit, to strike, to slap; to frizzle* (*the hair*); *to sketch freely;* (nav.) *to put a tompion in a gun.*
to Taper, *v.*	*finir en pointe, effiler; se terminer en pointe, s'effiler.*		
Tar, *n.*	*goudron; matelot, loup de mer.*	**Tard,**	*late.*
to Tar, *v.*	*goudronner.*		
Tenant, *n.*	*locataire; habitant; fermier.*	**Tenant,** *nm.*	*challenger; supporter of an opinion; defender of any one; one who frequents a house and acts like the master;* (plur.) *adjacent lands, houses.*
Tenter, *n.*	*crochet; séchoir.*	**Tenter,** *v.*	*to attempt, to try, to tempt.*
to Tenter, *v.*	*ramer* (cloth), *s'étendre.*		
Test, *n.*	*épreuve; criterium; distinction; réactif;* (cupel) *test, têt;* (hist.) *test.*	**Test,** *nm.*	*test* (Engl. hist., metal.); *shell* (mol.).
to Test, *v.*	*éprouver; faire épreuve;* (metal.) *coupeller.*		
Timber, *n.*	*bois de haute futaie; bois de charpente;* (nav.) *couple, membre.*	**Timbre,**	*bell, clock-bell; ring, sound of a bell; tone of voice; stamp on paper;* (her.) *helmet;* (post-office) *mark, stamp; head, brains.*
Toil, *n.*	*peine, travail fatigant;* (net) *filet, ret.*	**Toile,** *nf.*	*linen cloth.*
to Toil, *v.*	*travailler fort; fatiguer.*		
Ton,	*tonne* (weight = 20 cwts.); (fashion) *ton.*	**Ton,** *nm., adj.*	*tone, tune, voice, accent, manner; strain, style, taste. Thy.*
Track, *n.*	*trace, voie, piste;* (of a comet) *route;* (of a ship) *sillage, eaux; sentier;* (fig.) *route, chemin, ornière.*	**Traquer,** *v.*	(hunt.) *to beat* (*for game*); *to enclose* (*a wood, game*); *to encircle, to ferret out.*
to Track, *v.*	*suivre à la piste, à la trace;* (to tow) *haler, remorquer.*		
Train,	*suite, cortège; suite, série, conséquence, enchaînement, cours; marche; traînée* (of gunpowder); (of a dress) *queue;* (artil.) *train;* (of boats) *train;* (railways) *convoi, train; artifice.*	**Train,** *nm.*	*pace, rate, attendants; noise; skeleton* (of carriages); *quarters* (*of horses*); *train* (*of boats*); (print.) *carriage; raft;* (railways) *train;* (artil.) *train.*
to Train,	*dresser, former, exercer; élever, instruire; traîner; entraîner, séduire.*		
Trainer,	*éleveur; instructeur; celui qui dresse.*	**Traîner,** *v.*	*to draw, to drag; to trail; to put off; to spin out; to drawl.*
Traitor,	*traître.*	**Traiteur,**	*eating-house; eating-house keeper.*
Translation,	*traduction;* (removal) *translation, déplacement; version.*	**Translation,**	*translation* (*of bishops*); *removal* (*of parliament, government*); *postponement* (*of a ceremony*); (jur.) *transfer.*
Travel,	*voyage.*	**Travail,**	*labour, work, toil; piece of work; employment, study; travail.*

*

English Words.	French Equivalents.	French Words.	English Equivalents.
to Travel,	*voyager.*	**Travailler,**	*to labour, to work; fermenter (of wine); to study; to overwork (a horse).*
Trespass, *n.*	*injure; violation de propriété; délit contre la personne; offense, péché, transgression.*	**Trépasser,** *v.*	*to die, to depart this life.*
to Trespass, *v.*	*violer la propriété; pécher, faillir.*		
Tromp,	*machine soufflante.*	**Trompe,**	*horn, trumpet; proboscis, trunk (of elephants, insects, etc.); overhanging* (arch.); *Fallopian tubes.*
Trouble,	*peine, inquietude, affliction, souci, chagrin, importunité, tracasserie, ennui.*	**Trouble,**	*confusion, disorder, disturbance, dispute, quarrel;* (pl.)*troubles, broils, commotions.*
Trumpery,	*éclat trompeur, faux brillant; rebut, friperie.*	**Tromperie,**	*deception, cheating, deceit, imposition.*
Tutor,	*précepteur, instituteur; professeur, maître,*	**Tuteur,**	*guardian (of minors); prop.*
Umbrella,	*parapluie.*	**Ombrelle,**	*parasol, sunshade.*
to Use,	*faire usage de; se servir de; user de, employer; user, consommer; accoutumer, habituer; en user, agir.*	**User,**	*to use, to make use, to consume, to wear out, to wear off; to spend, to waste.*
Valuable, *adj.*	*précieux.*	**Valable,** *adj.*	*valid.*
Vent, *n.*	*issue, ouverture, passage; lumière (of a gun); trou de fausset (in a cask); publication; articulation; carrière; cours, libre cours; vente.*	**Vent,** *nm.*	*wind, gale; flatulence; breath; scent*(hunt.); *vanity; emptiness;* (artil.) *windage.*
to Vent, *v.*	*donner issue, carrière à, cours à, un libre cours à, exhaler.*	**Venter,** *v.*	*to blow (of the wind).*
Venter, *n.*	*ventre, abdomen.*		
Venue, *n.*	(jur.) *voisinage.*	**Venue,** *nf.*	*coming, arrival, growth.*
Verge, *n.*	*verge;* (jur.)*ressort;* (gard.) *bord, bordure;* (brink) *bord, extrémité; (of a forest) lisière.*	**Verge,** *nf.*	*rod; shank (of an anchor); handle (of a whip);* (pl.) *rod, birch.*
to Verge, *v.*	*pencher; approcher.*		
Verger, *n.*	*huissier à verge; porte-verge.*	**Verger,** *nm.*	*orchard, fruit-garden.*
Versant, *adj.*	*familier.*	**Versant,** *nm., adj.*	*declivity, side, slope (of mountains); liable to overturn (of carriages).*
Verser, *nm.*	*versificateur.*	**Verser,** *v.*	*to shed; to spill; to pour; to be overturned (carriages); to deposit (money).*
to Vie,	*rivaliser, lutter, disputer.*	**Vie,** *nf.*	*life.*
Viol,	(mus.) *viole.*	**Viol,** *nm.*	*violation (of the person); rape.*
Voyage,	*voyage par mer; traversée.*	**Voyage,**	*travel by land; voyage by sea.*
to Voyage,	*voyager par mer; traverser, parcourir.*	**Voyager,**	*to journey by land, or by water.*

VOLTAIC ELECTRICITY.—XX.

GRAHAM BELL'S PHOTOPHONE—MOLECULAR MUSIC.

HAVING constructed an efficient cell, as described in our previous lesson, Professor Bell's next task was to devise apparatus by means of which the intensity of a beam of light can be controlled by the voice (see Fig. 93). The first forms contrived consisted of a vibrating diaphragm, D, with mouth-piece, C, attached. At the back of this diaphragm were placed two gratings, the one fixed and immovable, B, the other, A, attached to the centre of the diaphragm, so that as a person spoke or sang within the mouthpiece it was moved to and fro in response to the vibrations aroused. Now as the openings of one grating are almost superposed upon the openings in the other, it follows

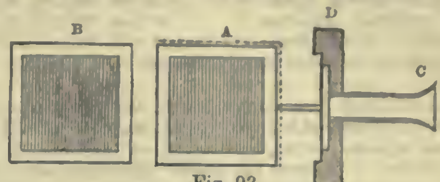


Fig. 93.

that when the movements occur which are above described, the size of the apertures through which light can be passed are constantly varied according to the vibrations of the diaphragm, so that the voice actually controls the amount of light passing through the double screen. Such light can be condensed by a lens upon a selenium cell in connection with a battery and a telephone. The results of such a combination we prefer to put in Professor Bell's own words. He says "When a person speaks into the tube, more or less light is allowed to pass through in accordance with the vibration of the plate. You then have a varying beam of light; the amount of light that reaches the distant station varies in proportion to the motion of the plate; that is, in proportion to the motion of the particles of air that actuate the plate; that is, in proportion to the vibration of the voice; the electric resistance of the selenium being affected proportionately to the intensity of the light falling upon it. Thus we have in the telephonic circuit a constantly varying current of electricity produced, the variations of which correspond to the variations of resistance in the selenium, correspond to the variations in the amount of light transmitted by the double grating, correspond to the variations of the speaker's voice, and we know the result; the articulations of a distant speaker are reproduced by the telephone at the listener's ear, although no conducting wire is found between the transmitter and the receiver. I may say that, in this form of apparatus, Mr. Tainter and I have succeeded in carrying on a conversation when the transmitter and the receiver were separated by a distance of about 280 feet."

The instrument thus made gave, however, very imperfect results. The vowels were transmitted clearly enough, but the consonants were not reproduced with any degree of fidelity, a result which was noticed in the working of the first forms of telephone. To illustrate our meaning we may quote one sentence transmitted by this form of photophone by Mr. Tainter, his colleague being the listener. The speaker said, "Put me to bed," which was translated by Professor Bell as "A good piece of bread." These faults were remedied in the perfected transmitting instrument now to be described (see Fig. 94).

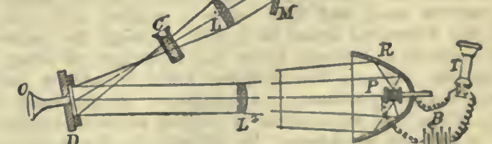


Fig. 94.

A very thin and flexible diaphragm, D, made of microscope glass, is silvered on the surface by the well-known process by which the speculum of a reflecting telescope is silvered. This flexible mirror is furnished at its back with a speaking tube, O, so that every utterance of the speaker causes the mirror to vibrate. Such vibrations will, of course, cause the surface to become alternately concave and convex, so that a ray of light reflected by the mirror is alternately condensed and spread out. The intensity of the light falling upon the selenium receiver is thus caused to vary with the variations of the speaker's voice. It is found in practice that the great heat of a ray of sunlight concentrated by a lens on such a thin diaphragm is very apt to fracture it, so that a cell, C, containing a concentrated solution

*

of alnm—which possesses the property of absorbing the heat rays, while it is transparent to light—is interposed between the lens, L, and the mirror, M. After reflection from the vibrating mirror, the rays are brought parallel by means of another lens, L^2, and carried across space to the seleninm cell, P, contained in its parabolic reflector, R. T is the telephone, and B the battery. In the first experiment with this new form of reflector sentences were clearly audible at a distance of over 800 feet.

We have noted, in a former lesson, that Professor Page, in America, had obtained from an electro-magnet an effect which he called galvanic music, by causing an intermittent current of electricity to traverse the coils. Now, Professor Bell, in his photophone experiments, was led to assnme that if an intermittent beam of light were allowed to fall npon his selenium cell, he would most surely hear a musical note in the attached telephone, such note being in pitch according to the quickness with which the light impressions followed one another. His hopes were justified by the resnlts attained. A beam of sunlight was rendered intermittent by being interrupted in its passage by a perforated wheel. As the wheel turned, the light flashed through the perforations, and in this way the selenium cell was subjected to pulsations of light, a distinct musical note being heard when the telephone at the distant station was applied to the ear.

Now comes the most cnrious part of the experiment. It became a matter of habit with the listener to occasionally cnt off the ray of light with his hand, so as to prevent it reaching the selenium cell, with the result that any one would suppose would happen—the musical note ceased. It was afterwards found convenient to substitute a sheet of hard rnbber for the hand, with the astonishing result that that opaque material did not, as was fully expected, shnt off all the sound. Something passed through the hard rnbber, and continued to affect the resistance of the selenium, but what that something was it is at present impossible to say. Still more wonderful is the fact that if the rubber is held on the other side of the revolving disc, so that no light whatever can pass through its perforations, still the mnsical note is apparent. To prove that this invisible force—if we may call it so—is not due to heat rays, Professor Bell subsequently employed two sheets of rubber, between which was a glass vessel holding a solution of alnm. The sonnds were heard all the same.

It next occnrred to the experimenters to put aside the telephone altogether, in order to ascertain whether the effect conld not be produced directly by holding the rubber to the ear while an intermittent beam of light was allowed to play npon it. To their surprise they heard clearly the mysterious note. By forming the rnbber into a thin diaphragm the effects were much intensified. After this they were led to try experiments with diaphragms of other materials, and were able to record that this curious effect of light inducing sound can be obtained from all the metals, glass, paper, indeed all kinds of substances, provided they be in the form of thin sheets or diaphragms.

After many experiments it occurred to Professor Bell that the distnrbance, whatever it was, occnrred on the surface of the material used, and that before a musical note could be heard the vibrations mnst be carried through the substance of the material to the ear; hence the advantage of nsing thin diaphragms, because the distance snch vibrations had to traverse is thereby reduced to a minimum. At the same time, granting that this snpposition is correct, more favonrable results still would be obtained by listening to the snrface upon which the light pulsations actnally fell. To do this conveniently was not easy until the experimenters hit upon the expedient of forming the material into a tnbe, and allowing the light to impinge npon its interior, the other end of the tube being applied to the ear. Using this method, they fonnd that india-rubber and all other substances responded to light impressions in a very marked degree; bnt they gave great variations with regard to intensity of sound, a circnmstance which in itself opens up a vast field for research.

It is not even necessary that the material experimented upon should be solid. It may be in the form of a liqnid, or a gas even, and exposed to the intermittent ray in a common glass test-tube. Even tobacco-smoke, placed in the tnbe, will emit its musical note; indeed, it is difficult to point to anything that refuses to take part in this strange orchestra.

LESSONS IN ALGEBRA.—XLII.

APPLICATION OF ALGEBRA TO GEOMETRY.

It is often expedient to make use of algebraical notation for expressing the relations of geometrical quantities, and to throw the several steps of a demonstration into the form of equations. By this, the natnre of the reasoning is not altered; it is only translated into a different *language*. *Signs* are substituted for *words*, but they are intended to convey the same meaning. A great part of the demonstrations in Geometry really consist of a series of equations, though they may not be presented to us under the algebraic forms. Thus the proposition, that *the sum of the three angles of a triangle is equal to two right angles*, may be demonstrated, either in common language, or by means of the signs used in algebra.

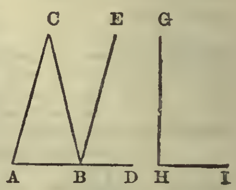


Fig. 1.

Let the side A B of the triangle A B C (Fig. 1) be produced to D; let the line B E be drawn parallel to A C; and let G H I be a right angle.

The demonstration in words is as follows:—

1. The angle E B D is *equal* to the angle B A C (Euclid I. 29).
2. The angle C B E is *equal* to the angle A C B.
3. Therefore, the angle E B D *added* to C B E—that is, the angle C B D—is *equal* to B A C *added* to A C B.
4. If to these equals we add the angle A B C, the angle C B D *added* to A B C is *equal* to B A C *added* to A C B and A B C.
5. But C B D *added* to A B C is *equal* to twice G H I—that is, to two right angles (Euclid I. 13).
6. Therefore, the angles B A C and A C B and A B C are together *equal* to twice G H I, or two right angles.

Now by substituting the sign $+$ for the word *added* or *and*, and the sign $=$ for the word *equal*, we shall have the same demonstration in the following form:—

1. By Euclid I. 29, $EBD = BAC$.
2. And $CBE = ACB$ (Euclid I. 29).
3. Add the two equations $EBD + CBE = BAC + ACB$.
4. Add ABC to both sides $CBD + ABC = BAC + ACB + ABC$.
5. But by Euclid I. 13, $CBD + ABC = 2\,GHI$.
6. Therefore $BAC + ACB + ABC = 2\,GHI$.

By comparing, one by one, the steps of these two demonstrations, it will be seen that they are precisely the same, except that they are differently expressed.

It will be observed that the notation in the example just given differs, in one respect, from that which is generally used in algebra. Each quantity is represented, not by a *single letter*, but by *several*. In common algebra, when one letter stands immediately before another, as ab, without any character between them, they are to be considered as *multiplied* together.

But in Geometry, AB is an expression for a *single line*, and not for the product of A into B. Multiplication is denoted, either by a point or by the sign $\times$. The product of A B into C D is $AB \cdot CD$, or $AB \times CD$.

There is no impropriety, however, in representing a geometrical quantity by a single letter. We may make b stand for a line or an angle, as well as for a nnmber.

If, in the example above, we pnt the angle

$$EBD = a, \qquad ACB = d, \qquad ABC = h,$$
$$BAC = b, \qquad CBD = g, \qquad GHI = l,$$
$$CBE = c,$$

the demonstration will stand thus:

1. By Euclid I. 29,	$a = b$,
2. And	$c = d$.
3. Adding the two equations,	$a + c = g = b + d$.
4. Adding h to both sides,	$g + h = b + d + h$.
5. By Euclid I. 13,	$g + h = 2l$.
6. Therefore,	$b + d + h = 2l$.

This notation is apparently more simple than the other; but it deprives us of what is of great importance in geometrical demonstrations, a continual and easy reference to the figure. To distinguish the two methods, *capitals* are generally used for that which is peculiar to Geometry; and *small letters* for that which is properly algebraic.

If a line, whose length is measured from a given point or line, be considered *positive*, a line proceeding in the *opposite* direction must be considered *negative*. If A B (Fig. 2), reckoned from D E on the *right*, is positive, A C on the *left* is negative. Hence, if in the course of a calculation the algebraical value of a line is found to be *negative*, it must be measured in a direction opposite to that which, in the same process, has been considered positive.

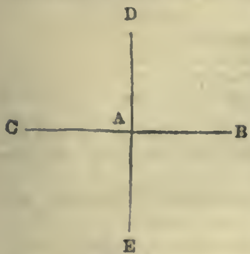


Fig. 2.

In algebraical calculations there is frequent occasion for *multiplication*, *division*, *involution*, etc. But how, it may be asked, can *geometrical* quantities be multiplied into each other? One of the factors in multiplication is always to be considered as a *number*. The operation consists in repeating the multiplicand as many times as there are *units* in the multiplier. How, then, can a *line*, a *surface*, or a *solid*, become a multiplier?

To explain this it will be necessary to observe, that whenever one geometrical quantity is multiplied into another, some *particular length* is to be considered *the unit*. It is immaterial what this length is, provided it remains the same in different parts of the same calculation. It may be an inch, a foot, a rod, or a mile. If, for instance, one of the lines be a foot long, and the other half a foot, the factors will be, one 12 inches, and the other 6, and the product will be 72 inches. Though it would be absurd to say that one line is to be repeated *as often as another is long*, yet there is no impropriety in saying that one is to be repeated as many times as there are feet or rods in the other. This the nature of a calculation often requires.

If the line which is to be the multiplier is only a *part* of the length taken for the unit, the product is a like part of the multiplicand. Thus, if one of the factors is 6 inches, and the other half an inch, the product is 3 inches.

Instead of referring to the measures in common use, as inches, feet, etc., it is often convenient to fix upon one of the lines in a figure as the unit with which to compare all the others. When there are a number of lines drawn within and about a *circle*, the *radius* is commonly taken for the unit. This is particularly the case in trigonometrical calculations.

The observations which have been made concerning lines may be applied to *surfaces* and *solids*. There may be occasion to multiply the *area* of a figure by the number of inches in some given line.

But here another difficulty presents itself. The product of two lines is often spoken of as being equal to a *surface*; and the product of a line and a surface as equal to a *solid*. But if a line has no *breadth*, how can the multiplication—that is, the *repetition*—of a line produce a surface? And if a surface has no thickness, how can a repetition of it produce a solid?

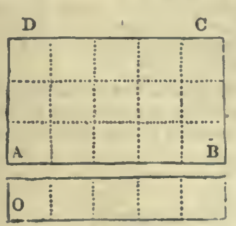


Fig. 3.

In answering these inquiries it must be admitted that measures of length do not belong to the same class of magnitudes with superficial or solid measures; and that none of the steps of a calculation can, properly speaking, transform the one into the other. But though a line cannot become a surface or a solid, yet the several measuring units in common use are so adapted to each other, that squares, cubes, etc., are bounded by lines of the same name. Thus the side of a square inch is a linear inch; that of a square rod, a linear rod, etc. The *length* of a linear inch is therefore the same as the length or breadth of a square inch.

If, then, several square inches are placed together, as from Q to R (Fig. 3), the *number* of them in the parallelogram O R is the same as the number of linear inches in the side Q R; and if we know the length of this, we have, of course, the area of the parallelogram, which is here supposed to be one inch wide.

But if the breadth is several inches, the larger parallelogram contains as many smaller ones, each an inch wide, as there are inches in the whole breadth. Thus, if the parallelogram A C (Fig. 3) is 5 inches long and 3 inches broad, it may be divided into three such parallelograms as O R. To obtain, then, the number of squares in the large parallelogram, we have only to multiply the number of squares in one of the small parallelograms into the number of such parallelograms contained in the whole figure. But the number of square inches in one of the small parallelograms is equal to the number of linear inches in the *length* A B. And the number of small parallelograms is equal to the number of linear inches in the *breadth* B C. It is therefore said concisely, that *the area of a parallelogram is equal to its length multiplied into its breadth.*

We hence obtain a convenient algebraical expression for the area of a right-angled parallelogram. If two of the sides perpendicular to each other are A B and B C, the expression for the area is A B $\times$ B C; that is, putting a for the area,

$$a = \text{A B} \times \text{B C}.$$

It must be remarked, however, that when A B stands for a *line*, it contains only *linear* measuring units; but when it enters into the expression for the *area*, it is supposed to contain *superficial* units of the same name.

The expression for the area may also be derived by another

Fig. 4.

method more simple, but less satisfactory perhaps to some. Let a (Fig. 4) represent a square inch, foot, rod, or other measuring unit, and let b and l be two of its sides; also, let A be the area of any right-angled parallelogram, B its breadth, and L its length. Then it is evident that, if the breadth of each were the same, the areas would be as the lengths; and if the length of each were the same, the areas would be as the breadths.

That is, $\text{A} : a : : \text{L} : l$, when the breadth is given;
And $\text{A} : a : : \text{B} : b$, when the length is given:
Therefore, $\text{A} : a : : \text{B} \times \text{L} : b \times l$, when both vary.

That is, the area is as the *product* of the *length* and *breadth*.

Hence, in solving problems in Geometry, the term *product* is frequently substituted for *rectangle;* and whatever is there proved concerning the equality of certain rectangles, may be applied to the product of the lines which contain the rectangles.

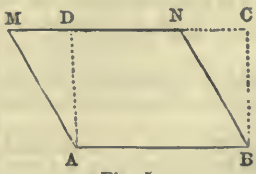


Fig. 5.

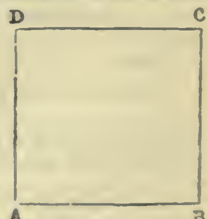


Fig. 6.

The area of an *oblique* parallelogram is also obtained by multiplying the base into the perpendicular height. Thus the expression for the area of the parallelogram A B N M (Fig. 5) is M N $\times$ A D, or A B $\times$ B C. For A B $\times$ B C is the area of the right-angled parallelogram A B C D; and by Euclid I. 36, parallelograms upon equal bases, and between the same parallels, are equal; that is, A B C D is equal to A B N M.

The area of a *square* is obtained by multiplying one of the sides *into itself*. Thus the expression for the area of the square A C (Fig. 6) is $(\text{A B})^2$; that is, $a = (\text{A B})^2$.

For the area is equal to A B $\times$ B C.
But A B = B C; therefore, A B $\times$ B C = A B $\times$ A B = $(\text{A B})^2$.

The area of a *triangle* is equal to *half* the product of the base and height. Thus the area of the triangle A B G (Fig. 7) is equal to half A B into G H, or its equal B C; that is,

$$a = \tfrac{1}{2} \text{AB} \times \text{BC}, \text{ or } \tfrac{1}{2} \text{AB} \times \text{GH}.$$

For the area of the parallelogram A B C D is AB × BC; and by Euclid I. 41, if a parallelogram and a triangle are upon the same base, and between the same parallels, the triangle is half the parallelogram.

Hence, an algebraical expression may be obtained for the area of any figure whatever which is bounded by right lines. For every such figure may be divided into triangles.

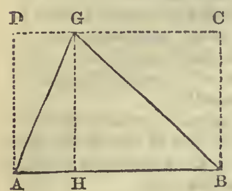


Fig. 7.

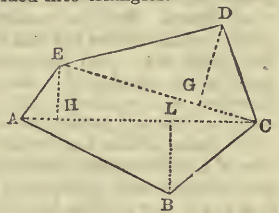


Fig. 8.

Thus the right-lined figure A B C D E (Fig. 8) is composed of the triangles A B C, A C E, and E C D.

The area of the triangle	$\text{ABC} = \frac{1}{2}\text{AC} \times \text{BL}$;
That of the triangle	$\text{ACE} = \frac{1}{2}\text{AC} \times \text{EH}$;
That of the triangle	$\text{ECD} = \frac{1}{2}\text{EC} \times \text{DG}$.

The area of the whole figure is therefore equal to

$$(\tfrac{1}{2}\text{AC} \times \text{BL}) + (\tfrac{1}{2}\text{AC} \times \text{EH}) + (\tfrac{1}{2}\text{EC} \times \text{DG}).$$

The expression for the *superficies* has here been derived from that of a *line* or *lines*. It is frequently necessary to *reverse* this order; to find a *side* of a figure, from knowing its *area*.

If the number of square inches in the parallelogram A B C D (Fig. 3), whose breadth, B C, is 3 inches, be divided by 3, the quotient will be a parallelogram, A B E F, *one* inch wide, and of the same length with the larger one. But the length of the small parallelogram is the length of its side, A B. The number of *square* inches in one is the same as the number of *linear* inches in the other. If, therefore, the area of the large parallelogram be represented by a, the side $\text{AB} = \frac{a}{\text{BC}}$; that is, *the length of a parallelogram is found by dividing the area by the breadth;* and $\text{BC} = \frac{a}{\text{AB}}$.

If a be put for the area of a *square* whose side is A B,
Then $a = (\text{AB})^2$;
And extracting both sides, $\sqrt{a} = \text{AB}$.

That is, *the side of the square is found by extracting the square root of the number of measuring units in its area.*

If A B be the base of a *triangle*, and B C its perpendicular height,

Then $a = \frac{1}{2}\text{BC} \times \text{AB}$, or $\frac{1}{2}\text{AB} \times \text{BC}$;

And dividing by $\frac{1}{2}$ B C, $\frac{a}{\frac{1}{2}\text{BC}} = \text{AB}$, and $\text{BC} = \frac{a}{\frac{1}{2}\text{AB}}$.

That is, *the base of a triangle is found by dividing the area by half the height, and the height by dividing the area by half the base.*

As a *surface* is expressed by the product of its length and breadth, the contents of a *solid* may be expressed by the product of its length, breadth, and depth. It is necessary to bear in mind, that the measuring unit of solids is a *cube;* and that the side of a cubic inch is a square inch; the side of a cubic foot, a square foot, etc.

Let A B C D (Fig. 3) represent the base of a parallelopiped, five inches long, three inches broad, and *one* inch deep. It is evident there must be as many *cubic* inches in the solid, as there are *square* inches in its base. And as the product of the lines A B and B C gives the area of this base, it gives, of course, the contents of the solid. But suppose that the depth of the parallelopiped, instead of being *one* inch, is *four* inches, its contents must be four times as great. If, then, the length be A B, the breadth B C, and the depth C O, the expression for the solid contents will be A B × B C × C O.

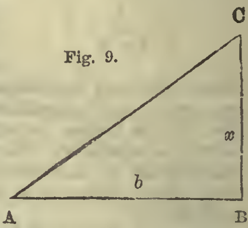
By means of algebraical notation, a geometrical demonstration may often be rendered much more simple and concise than in ordinary language. The proposition (Euclid II. 4), that when a straight line is divided into two parts, the square of the whole line is equal to the squares of the two parts, together with twice the product of the parts, is demonstrated by squaring a binomial.

Let the side of a square be represented by s;
And let it be divided into two parts, a and b.
By the supposition, $s = a + b$;
And squaring both sides, $s^2 = a^2 + 2ab + b^2$.

That is, s^2, the square of the whole line, is equal to a^2 and b^2, the squares of the two parts, together with $2ab$, twice the product of the parts.

Algebraical notation may also be applied with great advantage to the solution of geometrical *problems*. In doing this it will be necessary, in the first place, to form an algebraical equation from the geometrical relations of the quantities given and required; and then by the usual reductions, to find the value of the unknown quantity in this equation.

Fig. 9.



EXAMPLES.

1. Given b the base, and a the sum of the hypothenuse and perpendicular of the right-angled triangle A B C (Fig. 9), to find the perpendicular B C.

Let $x =$ the perpendicular B C. The sum of hypothenuse and perpendicular, $x + \text{AC} = a$. Then transposing x, $\text{AC} = a - x$.

(1.) By Euclid I. 47, $(\text{BC})^2 + (\text{AB})^2 = (\text{AC})^2$.

(2.) That is, by the notation, $x^2 + b^2 = (a - x)^2 = a^2 - 2ax + x^2$.

And $x = \dfrac{a^2 - b^2}{2a} = \text{BC}$, the side required. Hence,

In a right-angled triangle, the perpendicular is equal to the square of the sum of the hypothenuse and perpendicular, diminished by the square of the base, and divided by twice the sum of the hypothenuse and perpendicular.

It is applied to particular cases by substituting *numbers* for the letters a and b. Thus, if the base is 8 feet, and the sum of the hypothenuse and perpendicular 16, the expression $\frac{a^2 - b^2}{2a}$ becomes $\frac{16^2 - 8^2}{2 \times 16} = 6$, the perpendicular; and this subtracted from 16, the sum of the hypothenuse and perpendicular, leaves 10, the length of the hypothenuse.

2. Given the base of a right-angled triangle A B C (Fig. 10) $= b$, and the difference between the hypothenuse and perpendicular $= d$, to find the perpendicular B C. Apply this where $b = 20$ and $d = 10$.

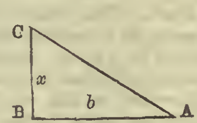


Fig. 10.

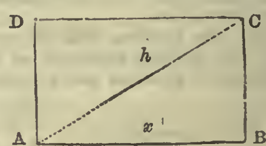


Fig. 11.

Let B C, the perpendicular, $= x$; then A C, the hypothenuse, $= x + d$. Now, by Euclid I. 47, $(\text{AC})^2 = (\text{AB})^2 + (\text{BC})^2$; and by substitution, $(x + d)^2 = b^2 + x^2$, or $x^2 + 2dx + d^2 = b^2 + x^2$.
$\therefore x = \dfrac{b^2 - d^2}{2d} = \dfrac{400 - 100}{20} = 15 = \text{BC}$.

LESSONS IN ENGLISH LITERATURE.—XXIV.

SWIFT.

It would scarcely be possible to point to a more strongly-marked contrast than that between the character and career of the great humorist of whom we spoke in our last lesson, and the still greater, whose stormy, unhappy life, and strange, powerful genius we have to consider in the present.

Jonathan Swift was of English descent; but his father having held an office in Dublin, the son was born in that city, a posthumous child, in 1667. His childhood was passed amid poverty, privation, and embarrassment. His education he received first at a grammar school at Kilkenny, and subsequently at Trinity College, Dublin. Here he not only failed to distinguish himself by his diligence or attainments, but seems to have left a very unfavourable impression of his abilities. Indeed, Swift's genius was very slow in showing itself: he was as remarkable an example of late mental development as his friend and fellow-worker, Pope, was of intellectual precocity. Swift was distantly connected by family with Sir William Temple; and not long after taking his degree, he entered the service of that statesman, then living in luxurious and lettered ease at his country seat in Surrey. Swift's employment in Temple's service was an ambiguous one, something between secretary, literary assistant, and humble hanger-on; and it may easily be conceived how acutely painful such a position must have been to Swift's proud, sensitive, and not very generous nature. There was everything, in fact, in Swift's early life and training to embitter such a disposition as his. And the facts of his history go far to explain how one capable of the depth of tenderness and affection which Swift could show, could yet have entertained that hatred and contempt for mankind which render his satire not severe merely, but positively savage and ferocious.

It was while in Temple's service that Swift first met Esther Johnson—then a very young girl, passing as the daughter of Temple's steward, though probably, in reality, a natural daughter of the old man himself. She was the Stella whose name must always remain associated with Swift's, and whose sad story is one of the most touching in the whole history of literature. An attachment seems early to have sprung up between Swift and her: on her side it ripened into an absolute and life-long devotion; on his side there was, as his Journal to Stella shows, an affection, a tenderness of the rarest kind; though with that strange, unaccountable cruelty, which was a part of his nature, he broke her heart through doubt, delay, and uncertainty, and married her only on her deathbed.

After the death of Sir William Temple, in 1699, it fell to the lot of Swift to collect and edit the works of his patron; and this appears to have been Swift's first public appearance in the paths of literature. He soon afterwards went to Ireland in the capacity, in the first instance, of chaplain to the then Lord Deputy, and was in time appointed to the living of Laracor in the county of Meath. This was now his home for some years; but his visits to London were frequent, where his great powers gradually became known, and his society proportionately cultivated among the wits and literary men of the metropolis.

His connection with Temple had naturally introduced him into political life as a Whig; but Swift's political principles were probably never very rigid, and before very long he took service under the Tory banner, and at once became the most powerful literary champion of the party of Harley and Bolingbroke.

It was during these constant visits to London that Swift's touching Journal to Stella was written, she remaining at that time near his home in Ireland. It was also during one of these visits that he became acquainted with the second victim of his affections, Esther Vanhomrigh, the daughter of a wealthy London merchant, who, under the poetical name of Vanessa given her by Swift, has become scarcely less famous than the unhappy Stella. Being left, by her father's death, with a competent independence, she also followed Swift to Ireland. Driven at last to desperation by doubt and jealousy, she sought to learn the truth about her rival, Stella (who was then, in truth, in her last illness, and whom Swift about the same time married), with a directness which excited his anger, and alienated him from her for ever. She died soon after, evidently under the influence of disappointed and wounded affection.

In 1713 Swift had been appointed to the Deanery of St. Patrick's Cathedral, Dublin; the character of his writings, and the personal enmity which his satire had in some instances excited, being an obstacle to that higher promotion to an English bishopric, which he so ardently desired and so confidently expected. During his residence in Dublin as dean, Swift showed his great powers as a satirist and party-leader in their most conspicuous light, and became almost in a moment the idol of the Irish nation. It had been determined by the Government to introduce a large quantity of a new copper coinage into Ireland; and an English manufacturer, named Wood, had obtained the contract for the production of the new coin. Wood's halfpence were from the first regarded as a wrong and a fraud. But Swift took up the quarrel, and wrote his famous series of letters known as "Drapier's Letters," from their having been published under the signature of "M. B., Drapier." The skill with which these letters were framed was consummate, and their effect extraordinary. The people of Dublin, indeed of all Ireland, were excited to frenzy; the coinage had to be withdrawn; and though Swift was well known to be the author of the letters, the Government did not dare to attack him, and proceedings which had been commenced against the printer were discreetly abandoned. Thus did Swift "his wronged country's copper chains unbind."

But Swift's heart was never in Ireland. He was never an Irishman in real sympathy, and never loved to be thought one in any sense at all. London was the place to which his thoughts and wishes really turned; there he reigned supreme. He was courted by all the leading political men on both sides, and might have sold his services to either almost at his own price. In society his bitter and brilliant speech, and the dread of his powerful and somewhat unscrupulous pen, secured him that power which probably he valued more than affection. In the literary world he could have no rivals, except Pope and Addison. And Addison and Swift, though on opposite sides in politics, always treated one another at least with respect, a respect which Swift showed for few; and with Pope Swift lived on terms of close intimacy and genuine friendship.

Swift probably not only suffered throughout much of his life, but had even been conscious of a tendency to mental disorder; a tendency which may very probably be the true key to much of what is most strange and most painful in his very painful career. He had foretold in bitterness of spirit that he would "die at top first." And so it was. Disease of the brain began to show itself in him in about 1741; and for the last four years of his life he was reduced to a state of absolute idiotcy, in which he died in 1745. He was buried in St. Patrick's Cathedral. By a strange freak of feeling, showing alike what the end he anticipated was, and how oddly that anticipation worked upon his mind, he left the bulk of his fortune to found an asylum for the insane in the city of Dublin, which still exists there under the name of Swift's Hospital.

To examine Swift's works with anything like the completeness which they deserve, would demand far more space than we can possibly give to them in these lessons. His poems are numerous, chiefly mere *jeux d'esprit*—occasional verses on the most trivial subjects. It is impossible that such a man as Swift can write anything that shall not have merit of a certain kind; but these are rather the works of a wit than of a poet.

Upon political and party questions Swift was a most powerful and not very scrupulous pamphleteer; though it must be admitted, that after he had once chosen the Tory side he remained faithful to that party. The most important of his controversial writings of this class is the celebrated pamphlet on "The Conduct of the Allies," published in 1712, a work which contributed largely to the fall of the Whig party, the abandonment of the Whig policy, and the triumph of Harley and Bolingbroke.

Others, again, of Swift's works seem to be almost purposeless, to be written in the very wantonness of satire, merely because it was a pleasure to "laugh and shake in Rabelais' easy chair," because he loved to show us the world turned upside down, to startle us with paradox, to shock our sensibilities, to bring all that is most venerable into contact with the most contemptible associations. Of this class are his "Argument against Abolishing Christianity," his "Modest Proposal to the Public," and his "Directions to Servants."

But there are three in particular of Swift's works upon which his fame with posterity mainly rests: "The Battle of the Books," "The Tale of a Tub," both published in 1704; and "Gulliver's Travels," published in 1726.

The "Battle of the Books" is one of the many valuable pieces which we owe to the great discussion then at its height—of which the celebrated Boyle and Bentley controversy was an episode—as to the relative merits of the ancients and the moderns in the field of literature. Sir William Temple had entered the arena as a champion of the ancients, and Swift, as became his humble dependent, was bound to take the same side. His work, regarded as a serious contribution to the literature of the subject, would be of small value; it is neither learned nor critical. But as a squib, as a mere piece of abuse and ridicule of antagonists, it is in Swift's best style.

The "Tale of a Tub" is one of the most extraordinary satires ever written. Its object is to ridicule extremes in religion, and exalt what in Swift's view was the happy medium of the High Church Anglican party. But few can, we think, read the "Tale of a Tub" without feeling that from the audacious levity with which the whole subject is handled, the coarse ridicule which is thrown over everything, the effect of this great work is not less hostile to religion itself than to the follies or eccentricities of any particular sect. The book tells us the adventures of three brothers, Peter, Martin, and Jack—representing the Roman Catholic, the Lutheran or moderate Protestant, and the Presbyterian bodies—left by their father with his written will to guide them, and professing, each of them, to govern their conduct by that will in every particular. That will stands for the New Testament; and the manner in which, in ordering his coat (his system of doctrine and practice) to suit his own taste and temper, each manages to find in the words or letters, or in the omissions of that will, authority for every ornament that he adds to, or every rent that he makes in the coat, is inexpressibly ludicrous. The book, too, is full of digressions, which show Swift's quaint, grotesque humour, and his infinite ingenuity of conception, in the strongest light. The "Tale of a Tub" is a masterpiece; but it is not difficult to understand that it may have stood, as it is said to have done, in the way of its author's promotion to a bishopric.

The most popular, however, and deservedly so, of Swift's works is the "Travels of Gulliver." It is one of the most comprehensive of satires. Swift, though one of the most original of thinkers, never hesitated to borrow from his predecessors, to several of whom he is largely indebted. But his chief master in satire was Rabelais, from whom he has derived not only much of his manner and style, but even many of his minutest details. "Gulliver," however, is wider on the whole in its scope than the great romance of Rabelais; it is less a satire upon particular classes, and more a satire upon human nature. The form which Swift chooses for his satire is one which had been adopted by others before, and has been since—that of imaginary travels through strange regions. Lemuel Gulliver, a doctor by trade, and a traveller by taste—of whose previous life and circumstances we are told just enough to give naturalness to the whole account—is shipwrecked, and escapes with bare life on an unknown shore, which turns out to be the kingdom of Lilliput, inhabited by a pigmy race not above six inches high. The description of Gulliver's adventures in Lilliput forms the first part of the work. With that peculiar power which Swift possessed of rendering every scene life-like by means of minute accuracy of detail, making everything which he sees in Lilliput relatively correct in size, he presents us with the most vivid picture of the world, with its kings and ministers, its courts, its politics, wars and intrigues, its pomp and splendour, all in miniature, and so all exposed in their utmost absurdity. Nothing can be more ludicrous, and at the same time more effective as satire, than the hereditary war between the Big-endians and the Smallendians—those who broke their eggs at the large end, and those who broke them at the small end; the two parties in the state, the High Heels and the Low Heels; the war with the neighbouring empire of Blefuscu, in which Gulliver himself, the Man Mountain, secures the victory by carrying off the whole of the enemy's fleet tied by pieces of packthread; the pomp, vanity, and dignity of the little emperor; his reviews of his little army, and his pride in his little palace, the work of so many generations of Lilliputians. In such ways the author shows us the absurdity of our own world, simply by letting us see it all enacted on a smaller scale. In this part, too, it is pretty clear that Swift intended perpetual reference to contemporary events. Lilliput and Blefuscu stand for England and France; the High Heels and Low Heels for Whig and Tory. Bolingbroke and Walpole are frequently introduced in a manner that at the time must have been unmistakably plain.

In the second part Gulliver, having escaped home from the Lilliputian kingdoms, again sets out on his travels, and again is accidentally left on a strange coast, which proves to be that of Brobdingnag, a land peopled by beings as much larger than Gulliver as he had been than those of Lilliput. Here Swift has fresh opportunities for satire, the principal method which he adopts in this part being to show the ordinary affairs of life, such as Gulliver relates to the Giant King, in a ludicrous light, by placing them in contrast with another system social and political, incomparably grander in scale, and far simpler and purer. Thus, after Gulliver has with great pains and no little pride given the king a minute account of the state of England, we read that, "His Majesty in another audience was at the pains to recapitulate the sum of all I had spoken; compared the questions he made with the answers I had given; then taking me into his hands, and stroking me gently, delivered himself in these words, which I shall never forget, nor the manner he spoke them in: 'My little friend, Grildrig, you have made a most admirable panegyric upon your country; you have clearly proved that ignorance, idleness, and vice are the proper ingredients for qualifying a legislator; that laws are best explained, interpreted, and applied by those whose interest and abilities lie in perverting, confounding, and eluding them. I observe among you some lines of an institution, which in its original might have been tolerable, but these half erased, and the rest wholly blurred and blotted by corruption. It does not appear, from all you have said, how any one perfection is required towards the procurement of any one station among you; much less that men are ennobled on account of their virtue; that priests are advanced for their piety or learning; soldiers, for their conduct or valour; judges, for their integrity; senators, for the love of their country; or councillors, for their wisdom. As for yourself,' continued the king, 'who have spent the greatest part of your life in travelling, I am well disposed to hope you may hitherto have escaped many vices of your country. But by what I have gathered from your own relation, and the answers I have with much pains wringed and extorted from you, I cannot but conclude the bulk of your natives to be the most pernicious race of little odious vermin that Nature ever suffered to crawl upon the surface of the earth.'" In another place, the same king having heard from Gulliver a full history of the politics and state-craft of Europe, and the many books that have been written on the art of government, is filled with astonishment. "He professed both to abominate and despise all mystery, refinement, and intrigue, either in a prince or a minister. He could not tell what I meant by secrets of state, where an enemy or some rival nation were not in the case. He confined the knowledge of governing within very narrow bounds—to common sense and reason, to justice and lenity, to the speedy determination of civil and criminal causes; with some other obvious topics which are not worth considering. And he gave it for his opinion, that whoever could make two ears of corn, or two blades of grass, to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together."

The third part of the book is chiefly taken up by Gulliver's visit to Laputa. And as the first two parts were especially directed against statesmen and politicians, this is mainly directed against philosophers and men of science. In the same part, however, he visits several other strange places, among others Luggnagg, where we meet one of the most powerful and fearful pictures that even Swift has ever drawn, in his account of the "Struldbrugs," or "Immortals," beings endowed with perpetual life, but not with perpetual youth or vigour.

But it is in the fourth part of the "Travels" that the bitter, almost savage spirit of the author, and his contempt for his kind, show themselves in their full strength. Gulliver there visits the land of the Houyhnhnms, a land in which the ruling race are horses, horses raised to a more than human standard of intelligence and cultivation, living in a state of purity, innocence, and simplicity; and having under subjection a race of men turned into brutes, termed Yahoos. In the description of these hideous creatures we can nowhere fail to recognise the human lineaments; but it is humanity with every spark of the higher nature eliminated; every base, low, and sordid passion, habit, or tendency developed without restraint; even the human form rendered repulsive and disgusting. We are shown man degraded below the level of the lowest of the brute creation, and placed in deserved subjection to brutes infinitely nobler than himself. And throughout all we cannot but see that Swift intended this not as a mere freak of the fancy, but as a picture of his fellow-creatures.

RECREATIVE NATURAL HISTORY.

FIR-TREES AND PINE-CONES (*continued*).

THE white spruce (*Pinus alba*) is an extremely handsome and picturesque tree, and from the manner of its retaining a hold on the ground—viz., without the aid of a tap-root—it is extremely well adapted for growth in situations where a very thin super-stratum of soil exists. Stretching forth its tough, rope-like rootlets in a perfect network of fibres, the white spruce gathers the elements needed for growth and support, and reaches full maturity, where trees whose roots shoot far downwards in search of nourishment would become stunted, unthrifty, and of little value to the timber-seekers; and it is on account of the readiness with which the white spruce establishes itself in apparently sterile situations, that it has been so extensively planted in this country. Its range is very extensive, being met with abundantly in Canada, Nova Scotia, and New England. The timber from this tree is made extensive use of. The resin, or pine-gum, which it abundantly furnishes, makes excellent oil of turpentine; the bark is made use of for tanning hides; and that most powerful and valuable anti-scorbutic, spruce beer, is made from its branches and loppings. So valuable is this beverage found to be on long sea-voyages, and so refreshing and wholesome is it as a drink in warm and unhealthy climates, that it is a matter for wonder that it is not more generally prepared in this country. Many districts in England abound in white spruce-trees, and lest a difficulty should at any time exist as to the identity of the tree, we have given a representation of the cone and growth of leaf in Fig. 6. Most of our readers will have heard of "spruce beer;" some few may have partaken of it; but we will venture to say that very few know how to brew it. It may not, therefore, prove uninteresting to be informed as to the method of concocting this "scurvy-killer" and agreeable thirst-quencher. A French settler, long resident in America, gives the following directions for the preparation of a cask of spruce beer:—

To make a cask of spruce beer, there ought to be a boiler large enough to hold one-fourth more than the quantity under treatment. This is to be filled with water, and as soon as it begins to boil a bundle of spruce branches, broken into pieces, is to be thrown into the boiler. The bundle should be about twenty-one inches round at the place of ligature. The water is to be kept boiling until the rind, or bark, becomes easily detachable from the branches; and whilst this process is going on, a bushel of oats is to be roasted several times over in a large iron pan, and fifteen sea-biscuits, or, instead of these, twelve or fifteen pounds of bread, cut into slices, should be well browned, and mixed all together with the liquid in the boiler. The branches of spruce are then to be taken out, and the fire extinguished. The oats and bread fall to the bottom; the leaves, etc., floating on the surface of the liquid being skimmed off. Six parts of molasses, or coarse syrup of sugar, or, in default of these, twelve or thirteen pounds of brown sugar, are to be added. This mixture should be immediately turned into a fresh port-wine cask, and if it be intended to give a colour to the beer, the dregs, and from five to six pints of the wine, may be left in the cask. Whilst the liquid remains tepid, half a pint of yeast must be added, and briskly stirred about, in order to incorporate it well with the decoction; after which the cask is to be filled up to the bung-hole, and the latter left open. The liquid will ferment, and throw off a great deal of impure matter. In proportion to the quantity which works out, the cask is to be replenished with some of the same decoction, kept apart for the purpose. If the bung-hole is stopped at the end of twenty-four hours, the spruce remains sharp, like cyder; but if it is intended to drink it softer, the bung must not be put in until the fermentation is over, taking care to replenish the cask twice a day.

Food, as well as drink, is yielded by numerous members of the cone-bearing family. The Laplanders commonly make use of the inner bark of the pine for bread-making purposes, the result of their labours being known as *bark bread*. This odd and by no means tempting article of diet is prepared in the following manner: After a selection of the tallest and least ramose trees (for the dwarfed and thickly branching ones are usually very rich in resinous juices), the dry and scaly external bark is carefully taken off, and the soft, white, fibrous, and succulent matter collected and dried. The time of the year chosen for this process is when the "alburnum" is soft, and spontaneously separates from the wood by very careful and gentle manipulation with the fingers. When the natives are about to use it, the prepared material is slowly and carefully baked or roasted on the embers, and being thus rendered crisp and brittle, it is ground readily into powder, which, when duly worked and kneaded into dough, is made into cakes, which are baked in an oven in the usual way.

The Siberian ermine-hunters also make use of the inner bark of the pine for the purpose of forming a substitute for yeast, which they use in the manufacture of *quass*. When the yeast is destroyed by cold—as it sometimes will be, in spite of every precaution—the hunters strip the inner bark from the forest pines, and boil it slowly in a cooking-pot over the camp fire for one hour; the decoction is then mixed with a quantity of rye-meal until a dough is formed. This they bury deeply under the snow, and on the expiration of twelve hours dig it up again, when it will have acquired the property of setting up fermentation in such fluids as it may be placed in.

The stone pine (*Pinus pinea*), or nut pine, is much valued on account of the vast quantity of pine-nuts furnished by it. These, nearly as large as small almonds, lie hidden behind the hard, tough scales which cover the outside of the cone, after the-manner of the plates on the shell of a turtle, or the scales of a suit of armour.

The nut pine reaches to a considerable altitude; its trunk, when growing in favourable ground, shoots up straightly. The leaves (or fir-needles, as they are called) are remarkable for their length, often reaching six inches from insertion to point. The cone is not unfrequently six inches long, and heavy in proportion. Fig. 7 represents one on a diminished scale, together with the nut or kernel, *b*, and the covering scale, *a*, after removal from the cone. Pine-nuts are sometimes to be met with in our own fruit shops, but the trappers and explorers of the north-west American territories often owe to the *pinon*, as it is termed by them, a hearty meal, when without it they would have fared but badly. Manna, too, is furnished by more than one member of the family of conifers. The larch, which we described in our last paper, produces a kind known as *Manna brigantica;* whilst the cedars of Lebanon (*Pinus cedrus*), which we shall describe as we proceed, produce a kind of their own. It must, however, be borne in mind that the manna produced by pines has nothing in common with the resins exuded by them. The manna is caused to flow by the diseased action set up in the tree from the punctures made by an insect known as *Coccus mannifarus*, whilst the turpentines or resins are merely the natural juices of the tree, inspissated and hardened by exposure to air and sun. The Canada balsam, so familiar to those who mount objects for microscopical examination, is obtained from the balsam pine, and is simply the juice of that tree. The *Auricaria imbricata*, or puzzle-monkey, as it is sometimes called, on account of the roughness and sharpness of its spines, is common now in almost all our ornamental grounds. The so-called "Aurucan region" is the land from whence it comes. The district bordering the Andes yields ample stores of excellent nuts, which are obtained from this tree. It also yields a juice, or balsam, most valuable for medicinal and art purposes. The "deodar," or *C. devadara*, now common in England, is held as sacred in India, and is esteemed as the tree of the gods. Its timber is most excellent and durable, and the torches made from splinters of devadara wood give forth a clear, powerful, and brilliant light, which serves to scare off ferocious beasts of prey, and to light the benighted traveller on his journey.

The Lebanon cedar (*P. cedrus*) is rendered so familiar to us by frequent references made to it in the Bible and the writings of ancient authors, that an unusual degree of interest is attached to it and its early history. The ancients appear to have set a high value on this tree, and to have rendered it of great commercial and social importance. Both Pliny and Vitruvius speak of the use of cedar resin in the treatment of papyrus and the embalming of Egyptian mummies. Diodorus Siculus informs us that Sesostris the Great, king of Egypt, built a vessel of cedar 280 cubits long, which was covered with gold both within and without. Mention is frequently made by ancient writers of cedars of great size, but the largest we find an account of is one which was used to construct a galley for King Demetrins. This was propelled by eleven ranks or "banks" of oars. The length of this tree was 130 feet, and its girth 18 feet. Some authors have questioned its being a true cedar, and have suggested that it might have been a green cypress, but it is scarcely probable that an error such as this could have been made concerning a tree so highly esteemed and well known

The Emperor Caligula, as most of our readers will be aware, indulged in some most extraordinary freaks of luxurious fancy. Amongst them we find that he had constructed from cedar-wood certain magnificent vessels, which he called Liburnian ships. The raised poops of these were decorated and enriched with precious stones and gold. The sails were of different rich colours, and the cabins were fitted up most luxuriously with baths; banqueting-rooms were also constructed, in which were placed the most costly pictures and specimens of wood-carving. One of the first writers of travels who gives any account of Mount Lebanon and its cedars is Belon, who visited Syria about the year 1550. He writes as follows:—"About sixteen miles from Tripoli, a city in Syria at a considerable height up the mountain, the traveller arrives at the monastery of the Virgin Mary, which is situated in a valley. Thence proceeding four miles further up the mountain, he will arrive at the cedars, the Maronites or the monks acting as guides. The cedars stand in a valley, and not at the top of the mountain, and they are supposed to be twenty-eight in number, though it is difficult to count them, they being distant from each other a few paces. These the Archbishop of Damascus has endeavoured to prove to be the same that Solomon planted with his own hands in the *quincunx* manner as they now stand. No other tree grows in the valley in which they are situated, and it is generally so covered with snow as to be only accessible in summer." It is curious to observe how, as time passes onward, the faces of lands change; vast forests pass away, and a sterile waste takes their place.

In Solomon's day Mount Lebanon must have possessed immense forests of this timber, for when he erected the temple of Jerusalem, we find that he obtained permission from Hiram, king of Tyre, to cut down the cedar and fir necessary from the forests of Mount Lebanon; and that, to perform this duty, he dispatched fourscore thousand axe-men, or hewers of wood, to fell the trees. We also read that there was a palace built by Solomon which was called the "House of the Forest of Lebanon," from the immense quantity of cedar-wood used in its construction. Solomon is said to have paid to King Hiram twenty thousand measures of pure oil annually while the work was in progress, and at its completion he ceded to him twenty villages in Galilee.

Thus writes Churchill of the pride of Lebanon:—

> "The cedar whose top motes the highest cloud,
> Whilst his old father Lebanon grows proud
> Of such a child, and his vast body, laid
> Out many a mile, enjoys the filial shade."

The Lebanon cedar is now abundant in England, and a vast number of extremely fine specimens are to be seen in the vicinity of London. There appears some doubt, however, as to the exact period at which it was first introduced into this country. Differences of opinion have also arisen as to the person to whom is due the honour of first giving the tree to England. Lord Holland has given it as his opinion that it was first introduced by his ancestor, Sir Stephen Fox; but the weight of evidence before us, collected from old records and rare MSS., is decidedly in favour of Evelyn being the first who raised young cedar plants from cone-seed in this country. In his curious and valuable work on trees, we find the following remarks:—"The cedar is a beautiful and stately tree, clad in perpetual verdure, that it grows even where the snow lies, as I am told, almost half the year; for so it does on the mountains of Lebanon, *from whence I have received cones and seed* of those few remaining trees. Why, then, should it not thrive in old England? I know not, save for want of industry and trial." It is quite clear that he succeeded in raising the seed he had sent him, as is shown by an extract from a letter written by him to the Royal Society, dated Sayes Court, Deptford, April 16, 1684. "As to exotics," writes he, referring to the unusually rigid winter which had just passed, "*my cedars are, I think, dead.*" This is no proof, however, that his fears were realised; and as no statement is afterwards made regarding the loss of these much-treasured little strangers, it is next to certain that they escaped the effects of the frosts of 1683. The celebrated Enfield cedar dates from about this time, and, without doubt, was one of Evelyn's seedlings. The cedar was not introduced into France until 1734, when Bernard de Jussieu took two young trees from England on his return journey. One of these was planted on a high mound in the Jardin des Plantes in Paris, and the other, curiously enough, was entirely lost sight of for a great number of years, when it was discovered growing in the grounds of the Château de Montigny, near Montereau, a small town about eighteen miles from Paris.

The illustration Fig. 4 in page 265 represents the cone of the Lebanon cedar, one of its scales, and the manner in which it springs from the branch. Those of our readers who are desirous of separating the seed from the cedar cone, for planting purposes, will do well to proceed as follows:—With a medium-sized gimlet bore a hole evenly through the centre of the cone, from stem attachment to crown; then fit a wooden peg tightly in the hole thus bored. Soak both cone and peg in water for twelve hours; tighten the peg, and the cone will open freely, and yield up its seed.

Handsome, picturesque, and surrounded with many historic associations, the Lebanon cedar is a veritable pigmy when placed in comparison with the mammoth trees found growing in California. These forest giants were discovered in the year 1850 by a Mr. Whitehead, in a small tract situated about ninety-seven miles from Sacramento city. Here, within a space little exceeding fifty acres, stand 103 such pines as the whole world cannot equal. Twenty of these average seventy-five feet in circumference. When, some years since, it was resolved that one of these huge vegetable productions should be felled, it was found that no axe or saw could ever complete its overthrow: so, after some deliberation, it was decided that, instead of being felled in the usual way, the "big tree" should be brought down by boring a complete zone or circle of auger holes round it, each hole penetrating to the centre. Five men were occupied for twenty-two days in completing the circle of holes. Immense wedges were then introduced, and after much driving and hammering, the vast mass was sent crushing to the earth. When stretched out on the ground, a fallen giant, this tree measured 302 feet in length, and 96 feet in girth at the base, whilst the bark was a foot in thickness. Some idea may be formed of the size of the stump's surface when we state that a party, consisting of thirty-two ladies and gentlemen, danced cotillions on it, as though in a capacious ball-room. Fig. 5 on page 265 represents, life-size, the cone and foliage of this most remarkable pine, which probably had reached full maturity long before England was first invaded by the Romans. It is somewhat remarkable that in the plant world the passing away of one description of tree should call into life, as it were, one of an entirely different species or family; and this is markedly shown in the regions where great forest fires have swept away vast tracks of pine woods, as in North America and Canada.

Poplar, hackmatac, cedar, and fir follow the true pines and spruces. Hemlock-bearing lands, when burnt out, produce alder and cedar. When woods composed of beech, maple, and birch are destroyed, the succeeding growth will consist of sumach bushes, spruce, and an abundance of wild raspberry and gooseberry bushes. Examples of this change of tree-life may be found in the bogs of Ireland, where submerged pine trunks still abound in districts where now no fir is seen to grow; and in the vast lignite deposits of Bohemia, where the buried pine forests of past ages have assumed a condition approaching that of coal.

LESSONS IN ENGLISH LITERATURE.—XXV.

POPE AND THE CONTEMPORARY POETS.

ALEXANDER POPE, the great poet of the reign of Queen Anne and her successor, was born in London in 1688. His father was a linendraper in the same city, but before his son was of an age to be influenced by the scenes around him, he had amassed a competent fortune, and, leaving London, settled in a country-house in the neighbourhood of Windsor. The religion in which he was born—for his family were Roman Catholics—would alone have excluded Pope from the educational establishments at which most of his compeers in literature received their early training; and, in addition, the extreme delicacy of his health—for his frame was small and deformed, and his constitution very weakly—prevented his being at any time sent from home for the purpose of education for very long together. He was, however, carefully taught, especially by a priest in Hampshire, under whose care he was for some time.

Pope's great abilities, and especially his poetical faculty, showed themselves at an unusually early age, even from his very childhood. "I lisped in numbers, for the numbers came," he himself tells. The ode on "Solitude" was written when its author was a boy of twelve; the "Pastorals" only two years later; and these were followed in rapid and unbroken succession by other works of greater or less importance. His poetical reputation was completely established by his "Essay on Criticism," published in 1711. The same work was also the cause of his first introduction into that atmosphere of controversy and bitter personal conflict in which it seems the life of every literary man was in those days destined to be passed. Some of the comments of Pope in his poetical essay were bitterly resented by Dennis, a poet of some pretensions and of some fame in his own day, but whose name would long have been forgotten had it not been preserved in the satires of his great antagonist. Dennis retorted upon Pope in a pamphlet full of the most violent abuse and the coarsest scurrility; and thus began a quarrel which lasted as long as they both lived, and which is still memorable as having given occasion to some of Pope's finest and keenest satire.

About this same period Pope began to be much in London, and to cultivate the society of the leading men of letters, frequenting for this purpose the coffee-houses at which the wits were wont to meet; and by the impression which his great powers thus made on those best able to estimate them, scarcely less than by his published works, he gradually attained the extraordinary and commanding position in the world of letters which he held until his death. His society was cultivated and his friendship sought by all who pretended to literary power themselves, or had judgment enough to appreciate it in another. Bolingbroke, the brilliant and versatile statesman and daring free-thinker, and Warburton, the learned and ingenious divine, were equally his friends. He was the chief and centre of a literary clique of which Swift, Atterbury, Gay, and a number of others whose names are scarcely less known, were among the members.

In 1717, his father's death having left him with a considerable inheritance, which, added to the profits of his own works, was amply sufficient to maintain him in ease and comfort, he removed to Twickenham, to the villa which his name has rendered famous. Here he was able to indulge to the full his somewhat artificial tastes in gardening and decoration, and to enjoy at will the society of his many friends.

The diligence of Pope as a writer was very great; indeed when we remember the extreme delicacy of his health (for his delicacy lasted all through life), it becomes amazing. The first part of "Windsor Forest," a descriptive poem in which Pope dwells with affectionate recollection upon the scenes amid which his childhood was passed, and the "Temple of Fame," a modernised imitation of Chaucer's "House of Fame," were undoubtedly very early works. So was, probably, the "Elegy to the Memory of an Unfortunate Lady." These productions were soon followed by the "Rape of the Lock," the second part of "Windsor Forest," and the beautiful "Epistle of Eloisa to Abelard." Immediately afterwards Pope undertook the great task of translating Homer into English verse, and at intervals from 1715 to 1720 the translation of the "Iliad" appeared. The "Odyssey," so much of it at least as is the work of Pope, very soon followed. His next important work was the "Dunciad," which in its first form appeared in 1728. For some years after this time Pope's poetical powers were devoted chiefly to a class of essays in verse, sometimes purely didactic, sometimes mainly satirical; the "Essay on Man" being of the former class, the "Moral Essays" of the latter. The last of his great poetical works, the "Dunciad," in its second and much altered form, appeared in 1742. Nor is this by any means a complete enumeration of Pope's poetical works. We have made no mention of a large number of short but by no means unimportant pieces; nor, with the exception of Homer, have we spoken of his numerous translations from the classical writers, or of his adaptations of the older English poets. And his poems are not his only works: he wrote much in prose, especially in the series of papers written by him in conjunction with Swift and Atterbury, and published under the name of Martinus Scriblerus. His correspondence was very voluminous, and has been published.

Pope died, in 1744, at the villa at Twickenham in which he had resided for so many years.

Pope, like almost every other great poet, is peculiarly the representative of the age in which he lived; and his works are the most exact, as well as the highest example of the poetical type prevailing in his day. French tastes and French influence were predominant: and whenever French influence has made itself felt in English literature its effect has always been to develop great beauty of external form in poetry; smoothness, regularity, and finish of versification; grace, accuracy, and neatness of diction. But these beauties are generally accompanied either by a pompous, artificial unreality of sentiment which arrogates to itself the title of heroic, as was the case in the tragic drama of the Restoration; or by a certain commonplaceness of thought and slightness of feeling. This latter defect is very apparent in the poetry of the period of which we are now speaking. Passion it has little or none; it neither expresses nor stimulates any strong emotion. Its thoughts are clear, correct, and appropriate; it never brings us face to face with those great riddles of nature and humanity which we meet in every page not only of Shakespeare and Webster, of Shelley and Byron, but even in the minor poets contemporary with each of these. There is little of the "thoughts that breathe and words that burn." But if Pope did not belong to the greatest school, he is nevertheless among the greatest of our poets. Every line of his is instinct with genius. His mere intellectual power was immense, and every thought and sentiment is expressed with a wealth of illustration and example which only his imagination could supply. His observation of mankind, and his appreciation of the most delicate differences in character and habit, were marvellously keen and accurate; and to this were added powers of wit and humour brilliant and unfailing. In accuracy and elegance of diction probably no English poet has ever been his equal; and his verse has a flow and rhythm, a little monotonous, perhaps, at times, but of unfailing beauty and harmony.

In examining Pope's works it will be convenient to divide them into certain strongly marked classes; and in the case of a writer whose genius was so early displayed, and his peculiar characteristics so early made apparent, and so uniformly maintained, it is of less consequence that such a division should coincide with the chronological order of the works in question.

The first class of Pope's works which we shall consider, though by no means the earliest in point of time, are his moral or didactic poems; and of these the most important is the famous "Essay on Man." The "Essay on Man," comprised in four epistles addressed to Bolingbroke, was, as its author tells us, intended as an introduction to some pieces on "Life and Manners," which he intended to write, and of which the "Moral Essays" doubtless form a part. "I thought it more satisfactory to begin with considering man in the abstract, his nature and his state: since, to prove any moral duty, or enforce any moral precept, or to examine the perfection or imperfection of any creature whatsoever, it is necessary first to know what condition and relation it is placed in, and what is the proper end and purpose of its being." Accordingly, in the four epistles which make up the essay, Pope considers first "The nature and state of man with respect to the universe;" secondly, "The nature and state of man with respect to himself as an individual;" thirdly, "The nature and state of man with respect to society;" and fourthly, "The nature and state of man with respect to happiness." Under these various heads the poet seeks to expose and reprove the error of those who complain of the condition of man in the world, and find fault with the dealings of Providence, by pointing out that we see only a portion of those dealings, and are therefore not in a position to judge of them; and by the aid of such reflections as these he seeks to promote contentment and resignation, and lay the basis of a system of moral duty. It must be admitted, however, that as a philosophical treatise the "Essay on Man" is eminently unsatisfactory. It is neither original nor profound in thought; and it is very far from disposing of the difficulties and mysteries upon which it touches. But in language and style the essay is throughout perfect; and the admirable truth of its observations of human nature, and the marvellous beauty and eloquence of its illustrations of its qualities, render it a very great poem. We take an example almost at random. It is a trite observation that ignorance of the future is one of the great sources of our happiness, and that without this ignorance the blessing of hope would be lost. But see how Pope handles this theme:—

"Heaven from all creatures hides the book of fate,
All but the page prescribed, their present state;
From brutes what men, from men what spirits know
Or who would suffer being here below?
The lamb thy riot dooms to bleed to-day,
Had he thy reason would he skip and play?
Pleased to the last, he crops the flowery food,
And licks the hand just raised to shed his blood.
Oh, blindness to the future! kindly given,
That each may fill the circle marked by Heaven;
Who sees with equal eye, as God of all,
A hero perish or a sparrow fall,
Atoms or systems into ruin hurled,
And now a bubble burst, and now a world.
Wait humbly, then; with trembling pinions soar;
Wait the great teacher, Death, and God adore.
What future bliss He gives not thee to know,
But gives that hope to be thy blessing now.
Hope springs eternal in the human breast;
Man never is, but always to be blest.
The soul uneasy and confined from home,
Rests and expatiates in a life to come.
Lo! the poor Indian, whose untutored mind,
Sees God in clouds, or hears him in the wind:
His soul proud science never taught to stray
Far as the solar walk or Milky Way;
Yet simple nature to his hope has given,
Behind the cloud-topped hill, an humbler heaven;
Some safer world in depth of wood embraced,
Some happier island in the watery waste,
Where slaves once more their native land behold,
No fiends torment, no Christians thirst for gold.
To be, contents his natural desire,
He asks no angel's wing, no seraph's fire;
But thinks, admitted to that equal sky,
His faithful dog shall bear him company."

The higher moral and religious strain which runs through this poem is well illustrated by the following lines which occur near its close:—

"See the sole bliss Heaven could on all bestow,
Which who but feels can taste, but thinks can know:
Yet poor with fortune, and with learning blind,
The bad must miss; the good, untaught, will find;
Slave to no sect, who takes no private road,
But looks through Nature up to Nature's God;
Pursues that chain, which links th' immense design,
Joins heaven and earth, and mortal and divine;
Sees that no being any bliss can know,
But touches some above and some below;
Learns from this union of the rising whole
The first, last purpose of the human soul;
And knows where faith, law, morals all began,
All end, in love of God and love of man.
For him alone, hope leads from goal to goal,
And opens still, and opens on his soul;
Till lengthened on to FAITH and unconfined,
It pours the bliss that fills up all the mind.
He sees why Nature plants in man alone
Hope of known bliss, and faith in bliss unknown:
(Nature, whose dictates to no other kind
Are given in vain, but what they seek they find)
Wise in her present; she connects in this
His greatest virtue with his greatest bliss;
At once his own bright prospect to be blest,
And strongest motive to assist the rest."

One of the most touching and beautiful of Pope's minor pieces, "The Dying Christian to his Soul," deserves to be given at length:—

"Vital spark of heavenly flame,
Quit, oh quit this mortal frame:
Trembling, hoping, lingering, flying—
Oh the pain, the bliss of dying!
Cease, fond Nature, cease thy strife,
And let me languish into life!

"Hark! they whisper: angels say,
'Sister spirit, come away!'
What is this absorbs me quite?
Steals my senses, shuts my sight,
Drowns my spirits, draws my breath?
Tell me, my soul, can this be death?

"The world recedes, it disappears!
Heaven opens on my eyes! my ears
With sounds seraphic ring:
Lend, lend your wings: I mount! I fly!
O Grave! where is thy victory?
O Death! where is thy sting?"

POLITICAL ECONOMY.—V.

BY J. E. THOROLD ROGERS, M.A.

LAND AND RENT.

IN this country it is constantly the case that one person owns the land which is employed for agricultural purposes, another person uses it in order to get agricultural produce, and a third person, or class of persons, supplies that necessary manual labour which the cultivation of the soil demands. In other words, the produce is distributed among three persons—the landlord, the farmer, and the labourer—the quantity of this produce, appropriated by each of these parties, being determined by different causes in each case. In the case of the

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labourer, the proportion subsisting between the employment which can be given and the number of persons who are in search of employment, will determine the rate of wages. In the case of the farmer, the quantity of capital accumulated, and the opportunity afforded for employing or investing it, will determine the rate of profit. The rent of the landlord will be settled by another set of circumstances, which I shall comment on in this lesson.

The existence, however, of a social order, the members of which subsist wholly on the rent of agricultural land, is almost peculiar to this country. Certain customs exist which lead to the accumulation of land in a few hands, and certain laws have given effect to this custom, and have even strengthened it. The custom applies to land only, or rather to what is called *real estate*—an expression which is a little narrower than "land:" for a person may have a lease of a thousand years at a nominal rent, or even a fictitious rent; and though, under these circumstances, his interest in the soil is practically as great as though he had the greatest ownership which the law allows, he is not supposed in law to have a *real*, but only a *personal* estate. Again, there are certain other interests in land which do not follow the custom alluded to—that, namely, of primogeniture, by which the estate of a deceased person devolves on his eldest male child, to the exclusion of all other children; but by far the largest portion of the land contained in the United Kingdom is subject to this custom. It is perfectly clear that the existence of this custom, joined to the power which persons possess by law of tying up or limiting their estates in favour of persons who are yet unborn, must, as time goes on, make the number of estates less, and their size greater, and must confer on the owners of such estates extraordinary powers of exacting high prices for the temporary use of that land, of which, in many localities, one or two persons possess a real monopoly. It would be absurd to doubt, that when an individual or a corporation possesses all the land, for example, in the vicinity of a growing town, the price which may be demanded for the occupation of such land will be much higher than it would be if the ownership were divided among fifty persons. The price of any article is as much determined by the necessity of those who sell as it is by the needs of those who buy; and if, under peculiar circumstances, the buyer is at the mercy of the seller, the price will be raised by the latter to as great a height as the former can endure.

Now it is not my object to advert to the social or political consequences of such a custom as that of primogeniture, and of such a law as that which enables a possessor of property, and especially of land, to create by any act of his own an interest in such land on behalf of unborn persons. The results of such a system may be, as some have contended, of great public benefit; or they may be, as others allege, exceedingly mischievous. But no one can doubt that they do produce two or three notable economical effects. They tend to decrease the number of landowners, and to increase the bigness of estates. They tend towards enabling the owners of these estates to exact a monopoly price for the occupation of land. They bring about a state of things in which a particular social class lives on the rent of land; and, it may be added, they induce results which are peculiarly characteristic of this country, and which give an interest to the question of rent, which is not so prominent in discussing the economical condition of other countries. There is hardly any other country in the civilised world where we can find such a person as the English or Irish farmer, that is, a person who ordinarily rents land from year to year, with a liability of being turned off his farm at the discretion of the landowner, and who employs his capital in cultivating the soil, without other assistance from the capital of his landowner than that which is contained in the use of the land which the owner has purchased. The case is a little different in Scotland, for in that kingdom the grant of a lease for eighteen years is all but universal.

In other countries, the occupier of land is generally both owner and labourer. In some cases he is owner, but not labourer, giving the labour of management only, and hiring manual labour at wages. In some localities, especially in Southern France and Italy, there is a curious partnership between the owner and the occupier. And lastly, there is, or rather was, a peculiar kind of occupancy in Ireland, in which the occupier gave his manual labour, but had only a precarious interest in the land which he cultivated. In order to expound the nature of rent, it will be necessary that I should give a short description of these different kinds of holdings, and point out some of the peculiarities of each. We shall, perhaps, then be able to discover which form of tenure produces most at least cost, and which maintains the largest number of persons in the greatest comfort. That country is not always the best off which produces most wealth at least cost, if the distribution of that which is produced is very unequal, and, consequently, if the country exhibits a growing poverty in a large number of persons side by side with the growing opulence of a few.

The English form of land tenure was the result of the feudal system, as established and confirmed in this country after the Norman conquest. In order to secure the submission of the Anglo-Saxon inhabitants, the Norman monarchs established a great militia system, the soldiers of which were all paid by the possession of land. In theory, this land was the compensation for military service; the owners, called tenants, being liable to serve with men and arms at the king's command. In fact, these tenants obtained inheritable estates, but under the condition that the chief of the family should be bound perpetually to this service. Hence arose the custom that the person liable to the obligation should be invested with the land. Such a privilege was, however, not the advantage which it is in our days, when the obligation has been for centuries no longer imposed. Owing to the wretched state of agriculture, land was the cheapest of commodities. It hardly bore a rent, for the so-called rents of the Middle Ages were rather taxes than rents, exacted from occupiers for the privilege of living on and working the soil. The most valuable property which persons possessed in that time was personal estate, as agricultural stock, manufactured goods, and money. Ordinarily, a quarter of wheat, or half-a-dozen sheep, or a fair-sized ox, would buy an acre of land fit for arable cultivation. But I cannot better illustrate the value of land at this remote period than by the fact, that on a well-stocked and well-tilled estate the stock and implements were worth three times as much as the land which the husbandman cultivated. By-and-bye we shall see how it is that this proportion has been reversed.

In all newly-settled countries, the same person is at once owner and occupier. The advantages which labour can secure to itself are so great, that everybody strives to employ what property he has in the most advantageous manner to himself. There are few lenders, for every one can employ as much capital as he can get. Labour at wages is scarce and dear, for when land is cheap and easily obtained, nobody is willing to work another's farm, if he can get one of his own. The system has its evils as well as its benefits. Labour is scattered about, the formation of an intermediate class of traders is discouraged or slowly developed, there is no leisure class, and therefore very little education and refinement. There are few manufactures, for these require a considerable capital and a stationary or abundant population.

Such a state of society characterised our own colonies and a large portion of the United States. It seemed expedient to some of those who had the good of the colonists at heart, that certain measures should be adopted in order to check this disposition of population to scatter itself over the soil. The most obvious means was to limit the facility of acquiring land; and an eminent Australian colonist, who was also a considerable economist, Mr. Gibbon Wakefield, devised a plan. He induced the local legislature to fix the price of all land which could be bought from the State at a pound per acre, and to devote the proceeds to assisting emigration. In this way it was supposed that population would be restrained from dispersing itself, while the fund which was derived from the sale of land, being devoted towards the growth of the colonial population, would supply the settler with cheap labour. The plan, however, after a short trial, broke down. The extraordinary mineral riches of the colony attracted a prodigious immigration, and thereupon the artificial supply of inhabitants was felt or believed to be no longer necessary, especially as it was seen that such persons as were introduced at the expense of the landowners would be certain to go to the mines. But the chief opposition to this scheme came from the existing population of labourers. They argued that the fund was devoted towards cheapening labour, gave strenuous opposition to the scheme, and brought about finally that it was abandoned.

The British colonists and the people of the United States have been laudably anxious to obviate the admitted evils of a system which, inviting settlers and supplying them with land at a nominal price, tends to make society little else than an aggregate of small farmers. They have endowed education munificently. Nothing which these new governments and societies have done is more generous and patriotic than the sacrifices which they have made for the establishment of schools, colleges, and universities, for the development of scientific knowledge and mental culture. With less wisdom, but very often with the best intentions, they have tried to naturalise manufactures; for they have given protection to such persons as are willing to engage in these callings, by laying import duties on foreign or British goods, and by this means confer on the colonial manufacturer the doubtful benefit of a monopoly price. The manufactures of every country do possess a certain advantage in the facts, that imported commodities are burdened with the cost of carriage, and that their sale is to be made in a market which a distant producer will be able to anticipate less fully than a home producer can; and consequently any legal protection is generally superfluous, and is quite certain to be mischievous.

But it is not only in newly-settled countries that the occupier is also the owner. Such a tenure prevails in the vast communities of India and China. It is general in Europe, where land is very much distributed. The French code, which compels the distribution of an estate, or its price, among the children of a deceased parent, only affirmed emphatically and universally a custom which was general in France before the revolution. These occupiers, called "peasant-proprietors" by English economists, are general from Sweden to Spain, from North-Western France to South-Eastern Russia. Rent, in the sense of a bargain periodically made between owner and occupier for the occupation of agricultural land, is practically unknown in these regions. The small farmer cultivates his plot of land, reaps, or gathers, or digs his produce, and having sustained himself and his family from his crops, carries the overplus to market.

In the south of France, and in the greater part of Italy, a curious kind of tenure prevails. Its origin is very ancient, for it is found as far back as the days of the Roman republic. The landowner enters into a perpetual partnership with the occupier, finding him land, seed, and sometimes stock, while the occupier gives his labour. The proceeds of the farm are then divided into moieties. Sometimes the landowner gets half the produce, occasionally more, rarely less. This kind of tenancy is called *métairie*, the tenant a *métayer*.

The Irish cottier or small farmer differs from the English farmer only in degree, and by the circumstance that he is far more helpless in the hands of his landlord than an English farmer ever is or can be. Ireland has never had, except in one locality, any manufactures. Her population is almost entirely engaged in agriculture. By a series of most injurious statutes, the trade of Ireland was at one time systematically crippled. By a series of most oppressive laws the Irish Catholic was depressed and degraded; but the people multiplied. The unfortunate facility with which the potato could be cultivated in the rich moist soil of the country, and the general adoption of this root as an article of food, stimulated the growth of population. The increasing numbers of the people drove the price of land which might be cultivated to a famine height, and the landowners took advantage of the demand to exact the utmost which the people could give. The tenure, too, was precarious, *i.e.*, from year to year. Nothing shows more clearly how absolutely the Irish peasant was dependent on the caprice or forbearance of the landowner than the fact that all improvements of the soil were done by the tenant. The cottier built his hut, such as it was, fenced his land, drained it when necessary, at his own charges. Everybody knows what the consequences were. Famine came, disaffection, agrarian outrage, rebellion; for unless there is some partnership in expense between landlord and tenant, a precarious tenure is sure to excite the deepest disaffection. At last, and not before it was needed, a remedy has been found.

As a matter of fact, and historically, the origin of rent is to be found in the power which owners of land had of levying a tax on those who were obliged to occupy it. If the whole soil of Australia and the United States had been parcelled out among a number of favoured persons, as was indeed done under many of the Crown grants made to the original settlers in America, such grantees would have been able, and were able, to levy a tax on those who wished to till the soil. Such an expedient was adopted, for example, by the representatives of Penn, of Lord Baltimore, and notably by certain persons in New York, who within a few years ago accepted a compromise, in lieu of certain vast reversionary rights which they claimed from others who held under them by lease. So again, in the empire of India, rent is a tax payable to Government, and in no sense proportionate to that value of the holding which will be determined by competition. In short, the area in which rent is determined on ordinary principles of business is a narrow one, being almost limited, in fact, to the British islands.

It is ordinarily said, that such rents as we are familiar with are payments made for using the natural powers of the soil, and that differences in rent are due to the different degrees of *fertility* which different plots of ground possess. This statement is in general correct, as applied to agricultural land, though it is not even here strictly accurate. For example: a field in the neighbourhood of a town, capable of being employed as a market-garden, will ordinarily let at the rate of twenty to thirty pounds an acre, while land of the same quality, and therefore equally capable of producing the same kind of crop, will let for not more than a tenth of this rent, if it be ten miles from a town. Here, then, unless we strain the word "fertility" to a sense which cannot be said to be natural to it, two plots of agricultural land, whose fertility is equal, vary enormously in annual value. The difference does not consist in the fact that the highly-rented land is worked at a cheaper rate of wages, for, as a rule, wages are higher in towns than they are in country places. The difference consists in two particulars: first, the price of land which is near a town can be better or more highly manured than that which is at a distance; and next, the market for produce is near, regular, and, to the cultivator, lucrative. But it is absurd to call this proximity to a market fertility, or to say that the demand of a dense population is equivalent to increased productiveness. The fact is, rent is as much derived from the exigencies of the public as it is from the powers of land.

The case is still more marked when we come to deal with the rent of building-land. In a country village this rent is at zero, the site of a house being worth no more than an equal area of the land which surrounds it. But in a town the case is far different. The site of the office in which this lesson is printed is, quantity for quantity, worth ten thousand times as much as, or even more than, the richest agricultural soil in England. But the convenience of a central locality, in which great business transactions may be most easily carried on, is very different from fertility; and this word could not, except by a very violent figure of speech, be ascribed to the qualities which confer so prodigious a value on the site of a factory in the metropolis. This value is derived from the extensive demand which exists in such localities, and the comparatively scanty supply of such convenient places. It is said that the most precious piece of ground in the world is the site of the Globe Insurance Office in Cornhill. A little reflection will show what are the circumstances which give so transcendant a value to this bit of land.

We shall now be able to arrive at a clear notion of what rent is. When competition between the owners and occupiers of land is free and unrestricted, *rent is all the difference between the value and the cost of that which is produced.* I must, however, expound this definition a little more fully.

My reader will see that the first condition of economical rent is free competition. Anything which limits the quantity which those who would rent or buy can procure, tends to disturb the price of occupation or purchase. It does not follow that it will always raise it. If a person owns an estate which he can let for grazing purposes only, when it is peculiarly fitted for becoming arable, his rent will be less than it would be if he were left free to use his own discretion. Still more, if an owner be debarred by will or settlement from letting land for building purposes, as the late Sir Thomas Wilson was, his possible rent will be materially curtailed. But, on the other hand, anything which puts the intending occupier into the power of the landowner, raises rent artificially against the former. This is seen most notably, when all the land available for building in a particular site is the property of some great landowner or great corporation. Here the proprietor may exact as great a sum as the occupier may choose to give—may, in short, do with his land what the owner of provisions may do in a time of scarcity, with this difference, that the proprietor may force his prices permanently on his customer.

Again, the competition between the owner and occupier is not free, unless the latter has a choice of callings or industries. In Great Britain it is probable that not more than an eighth of the population is engaged in cultivating the soil. If a labourer then finds that he cannot maintain himself by the wages of husbandry, he can perhaps betake himself to some other kind of work. There can be no doubt that manufactures and mining have absorbed, and do continually absorb, a large portion of the agricultural population, for wages of farm labourers are always highest in the neighbourhood of collieries and manufactories. Again, if a farmer finds that he cannot live by his farming—that he gets less by his calling than other persons engaged in business do—he may strive to extricate himself from this calling, and devote his capital to some other kind of industry. If he cannot easily do so in his own person, he will not bring his sons up to the business in which he is engaged; and so, sooner or later, other occupations being opened, the number of persons competing for farms will diminish, and rents will be proportionately reduced. But when, on the other hand, as in Ireland, half the population at least is engaged in agriculture, the transition is not so easy, and the conditions of fair competition are absent. The occupier, as the saying is, "must live;" he must, in order to live, pay the price demanded for the means of life; and as long as he gets enough to subsist on, all that is in excess of this amount may be exacted from him under the name of rent. When, under the old system in Ireland, the little farms of the cottiers were annually put up to auction, the cottiers often bid six or seven times as much rent as they could possibly pay. The rent, in short, was the extremest tax which the landlord could exact from his tenant for permission to live.

Now, however, if we suppose that the conditions of free competition are satisfied, we may be able to see what is meant by the remainder of the definition given above. We shall be best able to illustrate it by a few simple figures. Let us suppose that the rate of profit, as the word is commonly used, acquired by those who practise such callings as those of a farmer, amounts to ten per cent. on the capital which they employ, and that a farmer's capital is £3,000; he must, under these circumstances, expect to obtain £300 a year by his calling, free of all costs and charges, and on my hypothesis will accept nothing less, but will prefer to give up his farming, and take to some other kind of business instead. Let us further suppose that he occupies 300 acres of land, for which he pays a rent of £300, the question is, How is he able to pay this rent? The only answer can be as follows: He is able (after deducting all the charges to which he is liable while cultivating land, as wages to labour, wear and tear of agricultural implements, depreciation of other stock) to find his £3,000 at the end of the year not only unimpaired, but increased by £600 more. Of this sum a moiety represents his profit, the other remains as rent, and by the condition of competition remains to the landowner, who, if this farmer was unwilling to pay so much, would find some other farmer who would be content to occupy the land on such terms. Rent, then, is determined by what the land produces, what it costs to get that produce, and what that produce will sell for when it is gotten. I need scarcely add, too, that it is an average of these variable quantities, and that sometimes, as is the case with every kind of business, the farmer gets a greater, sometimes a less amount of profit.

Rent, then, increases in quantity with improvement in agricultural skill, as soon as that improvement becomes general. As long as any ability or skill is confined to one farmer or a few, such an individual, just as any other discoverer does, can secure the fruit of his own superior intelligence. I have already drawn a contrast between the state in which the art of agriculture was some centuries ago, and that in which it is now, and stated that during this time rents have prodigiously increased. They have increased, because the cost of production has diminished greatly when compared with the quantity produced, and because, owing to the growth of population, the demand has been fully up to the increased supply. If, indeed, population increases, and the supply were to temporarily diminish, the price of food would increase, and the farmer would profit. If the supply were to permanently diminish, owing to natural causes, as a series of bad harvests, or to artificial causes, as the enactment of a law which prohibited the importation of food, the profit would rest with the landowner, as it did or seemed to do during the time in which the Corn laws existed. These laws did not, indeed, prove of so much advantage to the landowner as was expected, for what he gained by the exalted price of wheat he lost by the depressed price of other articles of agricultural produce.

What applies to agricultural land applies equally, though not so plainly, to the rent of shops and houses, the natural price of the latter being occasionally disturbed by the fact alluded to above, that there is often a monopoly price for building sites, and therefore a great exaltation in their market value. The reason why the rent of a shop in a leading London thoroughfare is often treble that of another shop, placed in a locality which is either not so fashionable or not so frequented, is to be found in the fact that the overplus, after the average rate of profit is deducted, obtained from carrying on business in the former situation, is such as to enable the owner of the shop or site to exact from the competition of traders so great a rent for the premises.

Rent, then, is the result of an economical law. The landowner wrongs no one by getting his rent. If rents were extinguished to-morrow prices would not fall, for the occupier would simply add the rent to his profits, and appropriate the rent, instead of paying it to his landlord; and for the same reason rent does not enter into prices. If rents were violently extinguished, a loaf of bread or a pound of mutton would not be sold a farthing cheaper, for the price of these articles depends on the quantity which there is in existence, and on the demand which the consumers exhibit for them. It may perhaps be the case, that rent under certain circumstances enters into the price of manufactured articles, and into that of articles sold by retail. The ground-rent of a cotton-mill must, it seems, enter, though to an infinitesimal amount, into the price of cotton cloth, for it is part of the cost of producing the cloth. It would seem, too, that in a still larger degree the price of an expensive shop in a fashionable street must enter into the price of the articles sold there. At first, the rent was derived from the extraordinary profits obtained. In time, perhaps, the rent is treated as a charge, and reacts on the price; but this effect is, after all, limited. Nothing is commoner than to see "London prices," by which is meant low prices, advertised. Now, rents in London are far higher than in other towns. The cheapness is derived from the number of transactions effected.

There is one other point which I must advert to briefly in conclusion. There is a perpetual debate as to whether large or small farming is most advantageous. The general solution of this debate is to be obtained from two considerations—one economical, the other social. Some kinds of produce can doubtlessly be best produced on a large scale, as, for example, corn and fat stock. But other kinds of produce, as that of the dairy and the poultry-yard, are best obtained on a small system of farming, because they require incessant attention. So, again, the cultivation of fruits, the vine, the olive, and in our country the market-garden, is best managed by small farming. The excessive dearness of butter, poultry, eggs, fruit, in England, and the great importation of such articles from abroad, are due to the aggregation of small farms, and the growth of the large farming system. Now there is no doubt that such a dearness is an evil severely felt by the working classes, and no small hardship to those who are better off.

The social consequences of these rival systems are equally marked. Large farming may be carried to such an extent as to make a desert of a district during the greater part of the year, or at best to enrich a few farmers at the cost of reducing nearly all the labourers to poverty. A race of thrifty and intelligent husbandmen, who have a prospect of plenty before them, if not of wealth, is surely a social good. There is overwhelming testimony to the prudence, diligence, and morality of peasant farmers, while the ignorance and occasional vices of this class of men are due to exceptional and remediable causes. It is possible that such a class of persons in England has been irrecoverably lost, but it has been lost disadvantageously. At any rate, the present condition of the English agricultural labourer, who fills the place of the peasant farmer elsewhere, is not that on which statesman or philanthropist can look with satisfaction.

LESSONS IN NAVIGATION.—II.

PLANE SAILING—TRAVERSE SAILING OR COMPOUND COURSES—PARALLEL SAILING.

III. *Plane Sailing.*—The main problem of Navigation, as has been already stated, is to find the right position of the ship upon the chart, after a run of known—or rather estimated—length and direction; in other words, to track her course upon the chart from her last known position. The chief difficulty arises from the fact that, while charts are flat, the globe is round, and therefore is never represented on paper without distortion, as well as from the fact that meridians of longitude converge towards each other at an angle which varies with the latitude, making it extremely difficult to fix the longitude of the ship from mere knowledge of her course.

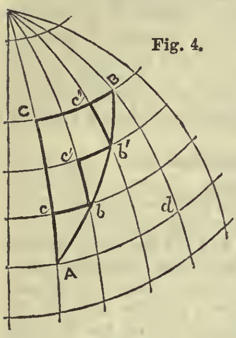


Fig. 4.

A ship may sail (first) on a meridian—*i.e.*, due north or south; (secondly) on a parallel of latitude—*i.e.*, due east or west; and (thirdly) in a course compounded of the other two. The last is naturally the commonest case. If a ship sail due north or south from a given place, for a known number of geographical miles, it is clear she can fix her position by simply taking a spot, *on the same meridian*, as many minutes north or south of her starting-point as she has sailed miles. Again, should she sail due east or west (this is called *parallel sailing*), it is clear that, by a not very difficult calculation, to be presently explained, she can fix her position east or west along the parallel on which her whole course has lain from the starting-point, the relation between miles and minutes of longitude on any given parallel of latitude being easily arrived at. But now suppose the ship to sail in a line cutting both meridians and parallels at an angle—say 40° east of north, therefore crossing the meridians at that angle. Though she cuts them all at the same angle, her course will not be a straight line (for the meridians themselves are not parallel), but a curve of some complexity, as A B in Fig. 4. This line—that is, a ship's track cutting successive meridians at the same angle (other than a right angle)—is called a *rhumb line*, and is, in fact, a spiral, which will wind an infinite number of times round the pole before reaching it. The line A C is said to represent the *difference of latitude* made while running the *distance* A B. The angle A is the *course*—*i.e.*, the angle which the ship's track makes with the meridian.

Here, then, we have some of our most important expressions, as *course* and *distance sailed*, which are usually known quantities, and *difference of latitude* between the place left and the place arrived at—usually one of the quantities sought—embodied in a right-angled triangle, which has, however, the defect of not being a plane triangle. A little consideration will show how they can be embodied instead in that useful and easily-computed figure, a right-angled plane triangle.

Let us suppose A B divided into an infinite number of parts, A b, b b', b' B, by equidistant meridians; these parts will not sensibly differ from straight lines. Then, since the angles at A, b, b' are equal, and c, c', c'' are all right angles, the triangles A c b, b c' b', b' c'' B are similar plane triangles (their infinite smallness being assumed). Whence $Ab : Ac :: bb' : bc' :: b'B : b'c''$.

$$\therefore \text{(Euc. V. 5) } Ab : Ac :: AB : Ac + bc' + b'c''.$$

But $Ac + bc' + b'c'' = AC =$ diff. of latitude (between A and B).

$$\therefore \quad Ab : Ac :: AB : \text{diff. lat.}$$

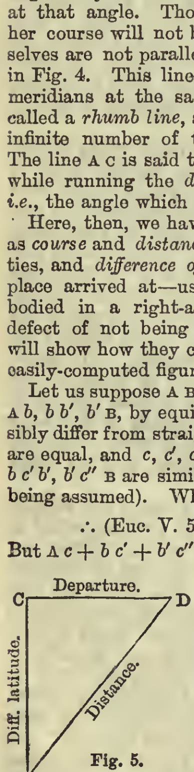


Fig. 5.

Let us now draw the plane triangle A B C (Fig. 5), making A = A in Fig. 4, C a right angle, and A B = A B in Fig. 4; then A b : A c : : A B (Fig. 5) : A C (Fig. 5). Comparing these two proportions, we see that if A (Fig. 5) represent *course* (angle of track with meridian), and A B represent *distance sailed* on that course, then A C = *difference of latitude*.

The infinitely small but infinitely numerous portions of parallels of latitude c b, c' b', c'' B, added together, make up what is called the ship's *departure*—her "departure," that is, *east or west* from the meridian on which she started. The departure, it will be noticed, is neither C B nor A d, but something between them, and is, in fact, an imaginary quantity, and not a direct measure of the ship's change of longitude, though a potent means by which it is found indirectly. It is best described as the *sum of all the minute departures* made by the ship in passing from one meridian to another, the meridians being supposed infinitely close together. And as we proved A C = diff. lat., we can prove that $cb + c'b' + c''B = CB$ in Fig. 5. Thus our plane right-angled triangle now includes, represented by the sides of an angle, *distance, diff. lat., departure*, and *course*, and any two of these being given we can find the rest.

The above is called the "Theory of Plane Sailing," and the mariner is enabled by it, his course and distance from a given point being known, to calculate his change of latitude and his "departure"—upon the latter of which he bases a further inquiry as to his longitude. The following are the practical rules (see Trigonometry) by which the unknown quantities are found from the known:—

Dep. = dist. × sin. course ... (1)
Diff. lat. = dist. × cos. course (2)
Dist. = dep. × cosec. course (3)
Dis. = diff. lat. × sec. course (4)

$$\text{Tan. course} = \frac{\text{dep.}}{\text{diff. lat.}} \quad (5)$$

The correctness of the above formulæ appears on simple inspection of Fig. 5, bearing in mind that course = angle A.

In books of mathematical tables will be found a "table of difference of latitude and departure" for all distances sailed within reasonable limits, for all courses from 1° to 89°; also for all the points and quarter-points from ¼ to 7¾, in case the mariner should prefer to estimate his course as so many points, instead of degrees, from the meridian. Look down the column headed by the given course, and opposite to the given distance will be found both diff. lat. and departure. Thus, if a ship sails 60 (nautical) miles from lat. 30° N., on a course inclined 40° from the meridian, she will have advanced 46 minutes of latitude, and will have made a departure of 38·6 miles. She will thus have reached either to 30° 46′ N. lat., or 29° 14′ N., according as she has sailed towards the north or the south; and her departure is reckoned as *east* or *west*, according to the direction taken. The use of the table of course saves the labour of calculating; but it is well to remember the formulæ by which it was constructed.

IV. *Traverse Sailing, or Compound Courses.*—It has already been stated that a ship will often make several courses of varying length and direction during the day, when the problem for the mariner becomes, How far has the ship come, *in a direct line*, from yesterday's position, and what angle does that line make with the meridian? Suppose the day's work (from noon to noon) represented on the log-board as below:—

H.	K.	F.	Courses.	Winds.	Leeway.	Remarks.
1	3	4	E.S.E.	E.N.E.	1	Current, estimated at 1 knot per hour, setting to westward. Variation, 2¼ points.
2	3					
3	3	4				
4	4		N.	E.N.E.	½	
5	4	3				
6	4					
7	4	6				
8	5	2				
9	6					
10	5	5				
11	2	4				
12	3	4				
1	6		N.	S.E.	0	
2	7					
3	7					
4	8	6	W.N.W. ½ N.		0	
5	8	2				
6	8					
7	8		N.W.		0	
8	6					
9	5		N.E.		¾	
10	4					
11	3	4				
12	3	4				

Note.—Directions of course, wind, and current are here given by *magnetic* or *compass* bearings—*i.e.*, 2¼ points to right of true bearing.

Here H stands for hour, K and F for knots and furlongs (speed). The first entry means that from noon to 1 o'clock—

i.e., during the first hour—the ship made 3 knots and 4 furlongs on a *compass* course E.S.E. (that is, her head pointed E.S.E. by compass), and that she was drifting 1 point to leeward, owing to the side pressure of the wind (the wind being on the ship's left, she makes leeway to the right, and the allowance therefore must be made to *right* of the compass course). This course lasted at varying speed for three hours, in which time 10 knots were made. A north course was then begun, and persevered in for 12 hours at varying speeds, amounting in all to 60 knots run; and so on. During the day five different courses were steered, or more correctly six, as while steering N. and making ½ point leeway (to left) the wind so shifted as to exercise less side pressure, and the vessel ceased to make leeway: this amounted to a virtual alteration of the true course by ½ point to the right. But besides these courses there was a constant current setting W.S.W.¼S. (true course) at 1 knot per hour during the whole day, carrying the ship with it. It may therefore be reckoned as a seventh course, distance 24 miles, and as such appears in the traverse table. Had the different courses been run in different currents, each must have been separately corrected for currents, but in this case it is unnecessary.

The various *true* courses and distances are now arranged one below the other in a table ruled as below, called a *traverse table*; thus—

	True Courses.	Distances.	Diff. Lat.		Departure.	
		Knots.	*N.*	*S.*	*E.*	*W.*
1	E.b.S.¼E.	10		1·5	9·9	
2	N.W.b.N.¼N.	40	34·3			20·6
3	N.N.W.¼W.	20	18·1			8·6
4	W.	25				25·0
5	W.N.W.¼W.	14	4·7			13·2
6	N.N.E.½N.	16	15·3		4·6	
7	W.S.W.¼S.	24		10·3		21·7
			72·4	11·8	14·5	89·1
			11·8			14·5
			60·6			74·6

The first course is thus found from the compass course (E.S.E):—One point *leeway* added to right gives S.E.b.E.; 2¼ points *variation to left* give E.b.S.¼E., equivalent to a course 7¼ points from the meridian. Under course 7¼ points and distance 10 miles, we find in the tables diff. lat. = 1·5 minutes, departure = 9·9 miles. Insert these results in the traverse table, remembering that, from the course run, the diff. lat. must be reckoned southwards, and departure eastwards. If the letter N. appear in the course, the diff. lat. is north; if S., it is south; if neither, there has been no change of latitude, and the ship has sailed on a parallel. If E. appear in the course, the departure is eastward; if W., then westward; if neither, then there is no departure—*i.e.*, the ship is sailing on a meridian, or due north or south. Hence in the fourth course the whole distance (25 miles) is west departure, and there is no diff. lat. By adding up the heaviest column under diff. lat. (N. in this case), and subtracting the other from it, we get 60·6 miles, the nett difference of latitude; similarly with departure.

If the ship started in lat. 30° N., we obtain her new latitude, or "latitude in," thus—

Latitude left	30°	0′	N.
Diff. lat., 60·6 miles	1	0·6	N.
Latitude in	31°	0·6′	N.

The aggregate departure due to the general course during the day is 74·6 west, and the general or direct course—which clearly lies between west and north—may be found by formula (5), either by logarithms or by a table of natural sines, tangents, etc. The latter plan is usually the least troublesome; thus—

$$\text{Tan. course} = \frac{\text{dep.}}{\text{diff. lat.}} = \frac{74 \cdot 6}{60 \cdot 6} = 1 \cdot 2475\,;$$

$$\therefore \text{ course} = 51° \text{ (approximately), or N. } 51° \text{ W.}$$

$$= \text{N.W.}\tfrac{1}{2}\text{W. (approximately).}$$

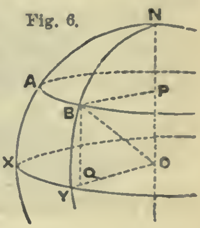
Course being known, distance may be found by (3) or (4).

It need scarcely be said that, by using formulæ (1) and (2), the "dep. and diff. lat. table" may be dispensed with, and stricter but unnecessary accuracy attained. Calculation by tables is called *inspection*, and by the formula *computation*.

Sailors have another mode of working out diff. lat., departure, etc., and the results of compound courses—viz., by *construction*, a means which, however suitable for illiterate men, is not to be compared with either of the others named. A circle is drawn, divided by a north-and-south and east-and-west line. The corrected course steered is marked by a line radiating from the centre in the appropriate direction (the circle being viewed as a skeleton compass). The number of miles run, transferred by compasses from any scale of chords, is pricked on the line, one compass point being at the centre. From the other point a perpendicular is drawn to the north-and-south line, and the part intercepted between it and the centre represents the diff. lat. in miles, while the perpendicular represents the departure. Instead of being computed, these quantities are *measured* by compasses on the same scale from which the distance run was taken. Unless this is done very carefully, with the best instruments, the error on any but a very short distance may be considerable. If the course is unknown, and other data given, the triangle is constructed by the same system of measurement; indeed, this may be called plane sailing by Geometry instead of Trigonometry. In traverse sailing the several courses are marked by radiating lines, but after the *distance run* on the first course has been marked upon it by compasses, as before, a line is drawn from the point thus reached *parallel to the radiating line representing the second course.* On this second line is marked the second distance run, and so on, until the paper contains an exact plan of the ship's actual track. A line from the centre to the last point reached gives the equivalent course, and its length shows the direct distance run. Diff. lat. and departure are then found as before.

V. *Parallel Sailing.*—It has been seen that the theory of plane sailing stops short of giving us the longitude, which the mariner needs to know as much as the latitude. For this purpose *plane sailing* must be supplemented by the rules either of *mid-latitude sailing* or *Mercator sailing.* To find the longitude is a matter of some difficulty, except in the case of *parallel sailing*, or sailing due east and west, already alluded to, and with which, as a stepping-stone to the others, we will now deal.

Fig. 6.



Suppose A B (Fig. 6) to be the track of a ship, sailing due east a known number of miles. Let the meridians of A and B cut the equator at X and Y. Then,

A B and X Y being similar arcs, A B : X Y : : radius B P : radius Y O.

But radius Y O = radius B O, and B P = O Q;

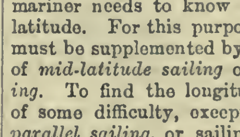
$$\therefore \quad \frac{\text{A B}}{\text{X Y}} = \frac{\text{O Q}}{\text{B O}} = \text{cos. angle O} = \text{cos. lat. of parallel A B,}$$

since either arc or angle forms a measure of the latitude of B. Now A B = distance sailed in miles, and X Y = distance sailed in minutes of longitude, *i.e.*, "difference of longitude;"

$$\therefore \quad \frac{\text{distance sailed}}{\text{difference of longitude}} = \text{cos. lat.}\,;$$

$$\therefore \quad \text{difference of longitude in minutes} = \frac{\text{distance sailed}}{\text{cos. lat.}} \;\ldots\; (6)$$

Fig. 7.



Distance sailed.

Fig. 7 shows how questions in parallel sailing may be solved by a right-angled triangle, constructed in accordance with this formula. Any two of the three things being given, the other can be found; thus,

$$\text{cos. lat.} = \frac{\text{dist.}}{\text{diff. long.}}, \text{ and dist.} = \text{cos. lat.} \times \text{diff. long.}$$

The perpendicular of the triangle has no significance.

Suppose a ship in lat. 30° N., long. 25° W., sails 200 miles due east; what is her "longitude in?"

$$\text{By (6),}\quad \text{diff. long.} = \frac{200}{\cdot 866} = 231', \text{ nearly} = 3°\ 51'\,;$$

$$\therefore \quad \text{longitude in} = 25° - 3°\ 51' \text{ W.} = 21°\ 9' \text{ W.}$$

Here we have used only the table of natural sines and cosines.

Questions in parallel sailing can be solved by the tables of "Diff. of Lat. and Departure," owing to analogy in construction of formulæ (2) and (6). Consider latitude as *course*, and distance sailed as *diff. lat.* in the tables; then in the margin, under *distance*, will be found the diff. longitude in minutes.

LESSONS IN ENGLISH.—LVI.

SYNTAX: CONJUNCTIONS.

JOINING is the office of conjunctions. The joining may take place between two words, between two clauses, and between two propositions. Properly the conjunction *and* joins two things —*this* with *that*—and is in consequence required before every second noun, adjective, verb, etc. The practice of putting *and* before only the last word of a series is of modern date. As an illustration of the merely uniting functions of the conjunction, take this example:—

1st Clause. 1 2

"Let there be no strife, I pray thee, between me *and* thee, *and*

3 *2nd Clause.*

between my herdmen *and* thy herdmen, *for* we are brethren." (Gen. xiii. 8.)

The conjunction *and*, No. 1, unites the pair of words, *me, thee;* No. 2 unites the first clause with the second; the third *and* unites "my herdmen" with "thy herdmen."

Conjunctions unite words which bear to each other the same grammatical relation.

This rule is commonly stated thus: Conjunctions connect the like tenses of verbs and the like cases of nouns. The readiest syntactical guide in the use of conjunctions is the thought. I will take two instances, one of concord, the other of dependence:—

Concord. You and I are ill. | *Dependence.* He beat you and me.

In the first proposition, we have *I* after *and*, not so much because *you* is in the nominative case, as because the statement is that I am ill. This appears by analysis—

You are ill. | I am ill.

In the second proposition, *me* occurs after *and*, because *me*, as well as *you*, is dependent on *beat;* as—

He beat *you.* | He beat *me.*

which is shortened into

He beat you and me.

Aided by these observations, you will have no difficulty in determining what form your words should assume when united by conjunctions. You will, for instance, see that of these two propositions the first is erroneous, and the second correct:—

1. He is wiser than me.
2. He is wiser than I (am).

So with

a *b* *c*
You love him better than I (me).
You love him better than me (I).

These sentences are right or wrong according to the meaning you intend. If you mean that *a* loves *b* better than *c* loves *b*, the first is correct; in full, the sentence would then stand:

You love him better than I love him;

but if you mean that *a* loves *b* better than *a* loves *c*, then the sentence is incorrect, as may appear thus:—

You love him better than you love me.

The conjunction *as* carries with it the force of a relative pronoun, that is to say, it introduces a second proposition to which it serves for the subject; as—

"But as many *as* received him." (John i. 12.)

The employment of the conjunction *that*, as in

They affirmed (*that*) he would not come,

is required as indispensable by some grammatical critics with an emphasis which may be somewhat undue. That the sense does not require its insertion, is obvious from its nature and from the sentence just given as an example. If, however, the second member of the sentence is separated from the first by several intervening words, *that* may serve as a point on which the mind may rest, until it takes up the clause to which it refers, and for which in some sort it is a substitute; as—

Your brother stated that, as he and your cousin were passing down High Street, they saw a child fall from the roof of a house.

CORRESPONDING CONJUNCTIONS.

Certain conjunctions go in pairs; that is, the precedence of the one necessitates the use of the other; for example:—

1. *Though—yet;* as, "*Though* he die, *yet* shall he live." (John xi. 25.)
2. *Whether—or;* as, "*Whether* it be greater *or* less."—*Butler.*
3. *Either—or;* as, "The indulgence of a declamatory manner is not favourable *either* to good composition *or* good delivery."—*Blair.*
4. *Neither—nor;* as, "John the Baptist came *neither* eating bread *nor* drinking wine." (Luke vii. 33.)
5. *Both—and;* as, "I am debtor *both* to the Greeks *and* to the barbarians, *both* to the wise *and* to the unwise." (Rom. i. 14.)
6. *Such—as;* as, "An assembly *such as* earth never saw."—*Cowper.*
7. *Such—that;* as, "The difference is *such that* all will perceive it."
8. *As—as;* as, "And he went out from his presence a leper *as* white *as* snow." (2 Kings v. 27.)
9. *As—so;* as, "*As* two are to four, *so* are six to twelve."
10. *So—as;* as, (1) "How can you descend to a thing *so* base *as* falsehood?" (2) "No lamb was e'er *so* mild *as* he."—*Langhorne.* (3) "We ought to read blank verse *so as* to make every line sensible to the ear."—*Blair.*
11. *So—that;* as, "No man was *so* poor *that* he could not make restitution."—*Milman.*
12. *Not only* or *not merely—but, but also, but even;* as, "In heroic times smuggling and piracy were deemed *not only* not infamous, *but even* absolutely honourable."—*Maunder's Grammar.* "These are questions *not* of prudence *merely, but* of morals *also.*"—*Dymond's Essays.*

INTERJECTIONS.

Instead of speaking *of* a person, you may speak *to* a person, or call *upon* a person; you may employ the style of direct address. For such kinds of address our nouns in English have no specific form; but exclamations or interjections supply the place of such forms, and mark the existence of a direct address or appeal. That address or appeal may have various meanings, and even various shades of meaning, corresponding with the state of the feelings at the moment; as—

"*Ah* Dennis! Gildon *ah!* what ill-starr'd rage
Divides a friendship long confirm'd by age!"—*Pope.*
"Alas! poor Yorick."—*Shakespeare.*

Sometimes interjections, for instance, *O! oh! ah! lo!* merely call attention, or indicate an appeal or an address; in such cases they are followed by the case of the subject, or that of the object; as—

Subject: "O thou unknown, almighty Cause!"—*Burns.*
Object: "Lo! the lilies of the field,
How their leaves instruction yield!"—*Heber.*

When deep feeling is intended, the case of the object is used with a pronoun of the first person; as—

Ah me! oh unhappy me! woe is me!

that is, ah! what will become of me! oh, what has befallen unhappy me! woe is to me! or, woe is on me!

"Judas said, Hail, master! and kissed him." (Matt. xxvi. 49.)
"Hail, Macbeth!"—*Shakespeare.*

That is, Hail be *to* thee, O master! Hail (health) be *to* Macbeth!

In order to distinguish the subject and the object, when used with exclamations or interjections, from the subject and the object when employed in the third person singular, the former may be called the subject of direct address, and the latter the object of direct address.

The interjection *woe to!* requires the case of the object; the object, in reality, is governed by the preposition *to*:—

"Woe *to* them that join house to house!" (Isa. v. 8.)

The exclamation *Oh for!* signifies, Oh that I possessed! as—

"Oh for that warning voice!"—*Cowper.*

but *alas for!* simply expresses grief towards; as—

"Alas for Sicily!"—*Milton.*

COMPOUND SENTENCES.

A simple sentence is a sentence which has one subject and one affirmation or predicate; and a compound sentence is a sentence that has more than one subject and more than one predicate. The component parts of a compound sentence are called its members. These members may be two or more; they may also each form a separate sentence:—

COMPOUND SENTENCES OF TWO MEMBERS.

1. He will perish	(2)	who loves unrighteousness.
The lark sang his matins		and sank into his nest.

The first sentence is equivalent to these two propositions :—

1. Some one will perish.
2. The lover of unrighteousness will perish.

The second sentence is equivalent to these two statements :—

1. The lark sang his matins.
2. The lark sank into his nest.

COMPOUND SENTENCES OF THREE MEMBERS.

1	2	3
When the Queen arrived,	the fleet had weighed anchor	and sailed.

1. The Queen arrived.
2. Before then the fleet had weighed anchor.
3. Before then the fleet had sailed.

Thus what in the compound sentence stands as three members, becomes in the analysis three individual sentences.

It is easy to see that the members may be increased almost at pleasure :—

The sick and all but dying man drinks water and revives.

Compound sentences have members of two kinds, the principal and the accessary. The principal member is that which enunciates the leading thought, the accessary member is that which enunciates the subordinate thought :—

PRINCIPAL MEMBER.		ACCESSARY MEMBER.
The man drinks	(and)	is refreshed.

The accessary member (or members) may be of two kinds, namely, interposed or appended. An accessary member is interposed when it appears in the body of a sentence, being introduced by a relative pronoun, a relative adverb, or a conjunction; for example—

	PRINCIPAL.	ACCESSARY INTERPOSED.	PRINCIPAL.
Rel. Pron.:	The man	who drinks	is refreshed.
Rel. Adv.:	The man	when he drinks	is refreshed.
Conjunc.:	The man	if he drinks	is refreshed.

Appended members are added by means of conjunctions, adverbs, and pronouns :—

	PRINCIPAL.	ACCESSARY APPENDED.
Conjunc.:	The man drinks	*and* is refreshed.
Adverb:	The man is refreshed	*when* he drinks.

The principal member may be expanded; as—

$$\left.\begin{array}{l}\text{The man drinks}\\ \text{The man eats and drinks}\end{array}\right\}\text{and is refreshed.}$$

The interposed accessary member may also be expanded; as—

$$\text{The man}\left\{\begin{array}{l}\text{who drinks}\\ \text{who eats and drinks}\end{array}\right\}\text{is refreshed.}$$

The appended member, too, may be expanded; as—

$$\text{The man drinks (and)}\left\{\begin{array}{l}\text{is refreshed.}\\ \text{is refreshed and strengthened.}\end{array}\right.$$

Sentences may be further divided into the direct and the inverted. A sentence is direct when the principal member precedes the accessary; as—

PRINCIPAL.		ACCESSARY.
The man drinks	(and)	is refreshed.

A sentence is inverted when the accessary sentence precedes the principal :—

ACCESSARY.	PRINCIPAL.
The man is refreshed	if he drinks.
	when he drinks.
	should he drink.

Relative pronouns are such pronouns as relate to some preceding noun, called the antecedent; that is, the foregoing word; for example—

	ANTECEDENT.	RELATIVE.	PREDICATE.
Subject:	The man	*who* drinks water	is wise.
Object:	The men	*whom* he met	he struck.

The relative must agree with its antecedent in person, gender, and number; as—

ANTECEDENT.	RELATIVE.	PREDICATE.
1. I	who	read.
2. He	who	reflects.

In the first of these instances, *who* is of the first person, because *I* is of the first person; *who* is of the singular number, because *I* is of the singular number. The effect of the relative on the verb is more clearly seen in the second instance, where an *s* is added to the verb, which accordingly appears as *reflects*.

As a subject for exemplifying the doctrines laid down in regard to the structure of sentences, I shall take a passage from Daniel Defoe, a writer of idiomatic English :—

COMPOUND SENTENCE.

"Oxford makes by much the best outward appearance of any city I have seen, being visible for several miles round on all sides in a most delightful plain; and adorned with the steeples of the several colleges and churches, which make a glorious show."

Here I must premise that the form "the best outward appearance of any city," etc., is incorrect, and should have been "the best outward appearance of all the cities I," etc. This compound sentence may be reduced into these simple sentences :—

1. Oxford makes a very good appearance.
2. Oxford makes an appearance better than many cities.
3. I have never seen a city with a better appearance than Oxford.
4. Oxford is visible for several miles round.
5. Oxford is visible from all sides.
6. Oxford stands in a most delightful plain.
7. Oxford is adorned with the steeples of several colleges.
8. Oxford is adorned with the steeples of several churches.
9. The architectural decorations of Oxford make a glorious show.

The resolution of this long sentence into the several distinct propositions which it contains has, by showing the meaning of the several parts, prepared the way for our exhibiting the logical relations which those parts sustain to each other; thus :—

LOGICAL RELATIONS OF THE SENTENCE.

1. *Oxford*	the subject to 2.
2. *makes*	makes together with 3 the predicate to 1.
3. *the best outward appearance*	the object to 2.
4. *of any city*	adverbial object to 2.
5. *that I have seen*	appended accessary to 2.
6. *being visible*	accessary to the subject 1.
7. *for several miles round*	adverbial object to 6.
8. *on all sides*	" "
9. *in a most delightful plain*	" "
10. *and adorned*	second accessary to 1.
11. *with the steeples*, etc.	adverbial object to 10.
12. *which make a glorious show*	appended accessary to 10.

Several of these parts may be analysed or explained; for example :—

No. 3 consists of the definite article *the*, the superlative adjective *best*, the adjective *outward* in the positive degree, and the common noun *appearance*, which is the object to the verb *makes*.

No. 6 presents a case of explanatory apposition, since *being visible* is subjoined to the subject *Oxford*, in order to state some additional facts respecting it; No. 10 stands to No. 1 in the same relation.

No. 12 presents an appended relative accessary sentence, of which these are the components; namely, *which*, a relative pronoun agreeing with its antecedent *steeples*; *make*, a verb in the indicative mood, third person, plural number, agreeing with its subject *which*; *a*, the indefinite article limiting *show*; *glorious*, an adjective qualifying *show*; *show*, a common noun dependent on, or the object to, the verb *make*. Viewed structurally, this appendage stands thus :—

SUBJECT.	PREDICATE.		
	Verb.		*Object.*
Which	make	a glorious	show.

By way of applying what you have learnt, take portions of any good prose author, mark the logical relations of the sentences after you have resolved each into the simple propositions of which it consists, and explain by grammatical analysis (that is, "parse") the several components. In other terms, convert each of these compound sentences into simple sentences. Distribute each simple sentence into subject and predicate, distinguishing the verb (the copula) and the attribute. Next, exhibit each compound sentence in its several members, showing what are principal, what accessary, and what appended, what interposed; together with the accessaries to the subjects and objects, and the adverbial objects. Finally, give the grammatical analysis of the whole.

MINERALOGY.—VI.

SILICATES (*continued*).

ANDALUSITE occurs in the older metamorphic rocks. It is usually of a grey or flesh-red colour. When crystallised it appears in the trimetric system, exhibiting a distinct lateral cleavage. Its lustre inclines to pearly, but the mineral is never fibrous. It is composed of 2 atoms of silica, and 3 of alumina.

Chiastolite is the name given to crystals of andalusite when the form of a cross is exhibited when the crystal is cut across and polished. The peculiarity is owing to impurities mixed with the andalusite, and symmetrically arranged by the powers of crystallisation. Chiastolite is found in bunches of crystals in mica slate, in the neighbourhood of granite. It is remarkably soft; sometimes it possesses only a hardness = 3.

Staurotide is dark brown or black; this is owing to the fact that some of the alumina is replaced by peroxide of iron. It always appears as a twin crystal in the shape of a cross, hence its name (Fig. 32).

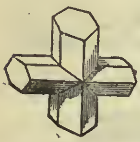


Fig. 32.

Kyanite, as its name implies, is a light-blue mineral, not unlike sapphire. It possesses the samo composition as andalusite, and appears in the same rocks as long, thin-bladed crystals penetrating the gangue, and is often accompanied by staurotide and garnet.

Topaz has also a similar composition to andalusite; but $\frac{1}{6}$ of the oxygen is replaced by fluorine—thus the mineral is a *fluosilicate of alumina*. It is trimetric, occurring in right rhombic prisms, and having a perfect basal cleavage. Its colour is yellow. The transparent varieties are used in jewellery, while the coarse, opaque forms are sometimes substituted for emery in polishing hard substances.

Oriental Topaz is a yellow variety of sapphire, while *False Topaz* is quartz tinted yellow; however, it may readily be distinguished from the gem by its want of cleavage.

Lapis-lazuli is remarkable for its rich blue colour. It is found in granite and metamorphic limestone, and is brought from China, Persia, and Siberia. It belongs to the monometric system, crystallising as dodecahedrons. Its composition is somewhat complicated, being a silicate of alumina, combined with sulphates of soda and lime; chlorine and iron are also present in small quantities. It is much valued in mosaic work, and is used in jewellery. Formerly this stone, reduced to powder, was the *ultramarine* of the painter—a very expensive colour; but now the pigment can be produced artificially.

Beryl is the head of a small family, the members of which all contain *Glucina*. It is found in six-sided prisms in granite and metamorphic rocks; it has a waxy appearance and a pale-green colour. The beryl of the Mourne mountains, in Ireland, tends towards a cerulean bluo. When beryl is transparent, and but slightly tinted with green, it is known as *Aquamarine*. The largest known specimen is in the possession of Don Pedro, and was found in Brazil; it weighs 18½ lbs. troy, and is without a flaw.

Emerald probably owes its deeper colour to the presence of a trace of oxide of chromium. The best emeralds como from Grenada, where they are found in dolomite. This gem is much prized in jewellery. All the members of the beryl family are harder than quartz.

Euclase and *Chrysoberyl* are closely allied to emerald.

Zircon is a silicate of zirconia; it occurs in dimetric prisms, and is usually found in single crystals scattered in a matrix of basaltic lava or syenite. Its colour is red, shading off into neighbouring tints, or yellow, tending towards grey. When the red specimens are transparent it is called *hyacinth*.

Jargon is a smoky variety brought from Ceylon, and is often sold as inferior diamonds.

Hyacinth, when heated in a crucible with lime, loses its red and assumes a clear yellow tinge. It is frequently substituted for straw-coloured diamonds, but the deception is readily exposed by the inferior hardness of the zirconia minerals to the diamond.

Garnet is a well-known gem; it belongs to the monometric system, usually appearing in dodecahedra. Besides the transparent variety, which is used in jewellery, there are numerous varieties which exhibit all the dark shades of green and red to black.

The typical composition of the group is 2 atoms of silica, 1 of alumina, and 3 of lime. In some garnets protoxide of iron takes the place of the last ingredient. This divides the family into two groups, the *Lime Garnets* and the *Iron Garnets*. It must be remembered, however, that many garnets contain both lime and iron, and that other elements, such as chromium manganese, occasionally take part in their composition.

The lime garnets are—

Grossular or *Gooseberry Garnet*, which is found in greenish trapezohedrons.

Cinnamon Stone or *Essonite* owes its name to its colour, which approaches that of cinnamon bark. It contains a little iron. The best specimens are from Ceylon and Sweden.

Topazolite is a variety of the last, when its colour is so light as to bear a resemblance to topaz.

Succinite and *Romanzofite* are also lime garnets.

Of the iron garnets the most noteworthy are—

Precious Garnet or *Almandine*. The deep-red colour is often so rich, that the gem has to be cut into thin plates to exhibit its beauty. The best specimens are from Ceylon and Greenland. The garnet is the carbuncle of the ancients, and the term *almandine* is probably taken from Alabanda, the place where, according to Pliny, the carbuncles were cut and polished.

Melanite, as its name implies, is black as velvet; it contains manganese.

Colophonite derives its name from its resinous lustre, *kolophonia* being the Greek for *resin*.

Garnets are found especially in mica slate, and when the rock is exposed to the action of the air the soft mica wears away, leaving the garnet prominent. In Ireland there is a rock wholly composed of garnets, without any visible cement. The stones are too small for the jeweller's use, but might probably afford a good substitute for emery.

Idocrase has been previously alluded to as offering a good example of dimorphism; it possesses the same composition as garnet, and yet belongs to the *dimetric* system, usually appearing in square prisms. It is sometimes called *Vesuvian*, having been first found in the lava of that volcano. Its colour is brown.

Tourmaline is frequently found in prisms penetrating granite, gneiss, mica slate, granular limestone, and other metamorphic rocks. Its colour passes through nearly all shades. The crystals are very brittle, and exhibit a vitreous lustre. It belongs to the hexagonal system, and its prisms, which usually exhibit numerous secondary faces, are generally terminated by a low pyramid. It becomes electrically excited when heated, and is the mineral always used to exhibit pyro-electricity. It belongs strictly to the plutonic rock, and in Cornwall is a constituent part of certain granites. The best known varieties are—

Schorl, the black variety.	*Indicolite* is blue.
Rubellite is red tourmaline.	*Achoite* is transparent.

The composition of tourmaline is very complex, but the most remarkable of its ingredients is *boracic acid*.

Axinite also contains *boracic acid*, but in other respects is related to the garnets. It becomes pyro-electric, and fuses into a green glass before the blow-pipe. Its lustre is vitreous, its colour brown, and the edges of the prisms, which are triclinic, are peculiarly sharp.

Epidote was so named by its discoverer, Hauy, from the Greek επιδιδωμι (ep'-i-di-do'-mi), *I increase*, because the base of the primary form undergoes an increase in some of the secondary forms. It belongs to the monoclinic system, generally appearing in right rhomboidal prisms, more or less modified. The most usual colour is green.

Pistacite is a bright-green variety, frequently found in hornblende rocks.

Zoisite is grey.

Maganesian Epidote, which contains 14 per cent. of manganese, is dark red. The typical composition is 3 atoms of silica, 2 of alumina, and 3 of lime.

Iolite is named from its blue colour; sometimes it is called *Dichroite*, because it exhibits two colours when looked at in two different directions. It occurs in prisms of the trimetric system. Its appearance is exactly that of blue quartz, or blue glass. It is composed of silica in combination with alumina, magnesia, and a little iron.

Chrysolite, like other members of this group, is used as a cheap gem. It is found as green crystals, like bottle-glass, disseminated through the rock. Its composition is 1 atom of silica, and 3 of magnesia; iron, manganese, and alumina all enter into the composition of different specimens. When the iron exceeds 10 per cent., the mineral is *Olivine;* and when it entirely replaces the magnesia, *Peridote* is the result.

Scapolite is a light-coloured mineral, usually pale blue, green, or light red. It occurs in dimetric prisms in granite and other crystalline rocks. It is composed of 4 atoms of silica, 2 of alumina, and 1 of lime.

There are other silicates, but they do not present sufficient interest to have a place in an elementary manual.

SULPHATES.

Gypsum is sulphate of lime. When it is found crystallised and transparent, it is termed *Selenite.* It belongs to the monoclinic system, and appears usually in tabular prisms. It possesses a very perfect cleavage, allowing very fine laminæ to be separated, which are flexible, but not elastic. It is very soft, being easily cut with a knife. When massive it is sometimes found fibrous, and then presents a very beautiful appearance, which has procured for it the name of *Satin Spar.* It is usually associated with rock-salt, and may have been the result of the evaporation of sea-water. For a notice on this the lesson on the Triassic period, in the geological lessons, must be consulted (Vol. V., page 328).

Heavy Spar is the *sulphate of baryta.* It occurs in tabular prisms belonging to the trimetric system. It is generally white or tinged with brownish yellow. As its name indicates, it is peculiarly heavy: sp. gr. = 4·8. It is found as the matrix in which galena and copper pyrites are embedded. When ground, a dead-white powder is the result, which is used to adulterate white lead, it being found to give an opacity to the colour.

Celestine is the *sulphate of strontia.* Like heavy spar it is trimetric, but its crystals are long prisms, and not tabular. It is also much lighter. It is generally white, but if coloured the tint is blue, hence its name. Its use is to make the nitrate of strontia with which the red-fire of the pyrotechnists is produced.

Alum.—There are several alums, all having a similar composition. They contain 24 parts of water, 1 of sulphate of alumina, and 1 of some other sulphate, the base of this last salt being the distinctive characteristic of the alum. Thus

In *Ammonia Alum* it is the		Sulphate of Ammonia.
,, *Soda Alum*	,,	Sulphate of Soda.
,, *Potash Alum*	,,	Sulphate of Potash.
,, *Magnesia Alum*	,,	Sulphate of Magnesia.
,, *Iron Alum*	,,	Sulphate of Iron.
,, *Manganese Alum*	,,	Sulphate of Manganese.

There is also *Feather Alum,* which is *hydrous sulphate of alumina* without the second sulphate.

All these minerals are only formed under peculiar circumstances. Sulphuric acid is never found "native," if we may use the expression, but is always produced by the oxidisation of some sulphuret—as iron pyrites. During the decomposition of the pyrites the iron and sulphur become oxidised, and thus sulphate of iron is produced; if clay be present, some of the sulphuric acid attacks the alumina, making a sulphate of that earth. This cannot proceed except moisture be present; hence the water is also ready to take part in the composition of the iron alum thus formed. Alums frequently impregnate clay slates, which are then known as *aluminous slates* or *shales.* At Whitby, in Yorkshire, alum is extracted from such slates. For the description of the process, see our "Lessons in Chemistry."

Soda Alum is found at the Solfataras, in Italy; *Magnesia Alum* at Iquique, in South America; *Ammonia Alum* at Tschermig, in Bohemia.

Alum is monometric. Beautiful crystals may be obtained by supersaturating boiling water with the salt, and hanging in the solution a bunch of thread, then allowing it to cool in a dark place. The crystals will be found to be octahedra.

Sulphate of Iron, or *green vitriol,* is usually found with iron pyrites; it is due to the decomposition and oxidisation of the pyrites. When the sulphur becomes sulphuric acid, this combining with the iron forms the mineral in question.

Sulphate of Zinc, or *white vitriol,* is produced in precisely the same way by the decomposition and oxidisation of zinc sulphuret, or *blende,* with which it is generally associated.

Sulphate of Copper, or *blue vitriol,* is similarly found with copper pyrites, and is frequently in solution in water flowing through beds of that ore.

Sulphate of Lead, or *Anglesite,* is also formed during the decomposition of *galena,* the sulphuret of lead. It appears often as slender white crystals, and sometimes massive.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XXV.—THE COMMERCE OF THE NETHERLANDS.

NORTH NETHERLANDS.

HOLLAND, or the North Netherlands, is referred to by Tacitus as the country of the Batavians, a tribe claiming to be the auxiliaries and friends, but not the subjects of the Romans. They served faithfully in Cæsar's armies, and acted also as purveyors of corn to his legions. Thus early do we trace the elements of Dutch commerce. The country was at that time a wide marsh, more or less saline—an alluvial deposit from the Rhine and the Maas, and subject to constant changes of form from the action of the sea; it is still destitute alike of minerals and of timber. Niebuhr says the prevalence of bog rendered any distinctive term for that substance unnecessary in the old dialect; as though no other soil were known. The land is now remarkable for its great fertility.

The Frisians and Zealanders mingled with the Batavians, and constituted the principal part of the population of the northern Netherlands.

Dutch history is, to speak generally, one long "wrestle for existence." Plodding, beaver-like labour, had first to enclose a country to live in, and then to found a commerce. Such industrial discipline was severe, but every step was sure. We are told that the Emperor Charlemagne chose Frisian robes, both white and of purple dye, as Easter presents to his favourites, and to the princes in alliance with him; amongst them the Caliph Haroun al Raschid. The interweaving of figures in their textures was an art in which the Frisians seem to have excelled. Their provinces in the middle of the fifth century embraced all the "sea lands" between the Weser in Germany and the Zwin in West Flanders; their name was afterwards applied only to the northern districts of Holland; but the western part of Schleswig is still Frisian. The Norse sea-kings found in them a different people to attack from the inhabitants of many other coasts. The Frisians not only repelled the rovers, but daringly pursued them on the North Sea, and even to the Baltic. Under Charlemagne, they also served on the Danube against the Avars.

In order to secure their commerce, they fixed upon Stavoren, a town conveniently situated on the Zuyder Zee, which then covered but a small part of the land now submerged, and made it their capital. Stavoren rapidly rose to commercial greatness. It was the mart at which Eastern and Western commerce met. Traditions of the opulence of its ancient burghers still linger in the epithet applied to them by the villagers, viz., "the lamented children of Stavoren." Numerous records of Frisian hardihood, both on sea and land, are met with. The Frith of Forth is called by Nennius the *Mare Frisecum,* because of its exposure to their early incursions. They reached the Orkney Islands in the year 1088, and even claim to have discovered the North-West Passage. Every year the North Sea was covered with their herring-boats. Along with other Netherlanders, they were active by sea and land during the crusades, though with but little advantage to themselves, commercially speaking.

The principal period of the growth of the towns of the Netherlands was between the ninth and the thirteenth centuries. The provinces were ruled by feudal lords, whose vassalage to the German emperor was more nominal than real, and at length was no longer acknowledged. As a means of revenue the rulers took toll at every town, and thus they hampered trade, but greater injury was inflicted upon the nascent commerce by the jealous and almost incessant strife of the provinces amongst themselves. The south and the north Netherlanders, especially, were always rivals. The mouths of the rivers being in Holland, the inhabitants were enabled to exact any tolls they pleased from the Flemish and German merchants. Such imposts led to resistance, in which the Flemings were often successful.

The trade of Holland divided itself into the trade of the south, with Venice by way of Germany, and the trade of the north, with the Osterlings or Easterlings of the Hanse Towns in the Baltic. That with Venice was conducted partly by the Germans, and partly by the Dutch, the Venetians themselves taking no active part in the carriage of the goods. Repeated interchanges took place in the German towns in the course of transit, so that the same commodities were rarely carried from one extremity to the other.

Dordrecht, now called Dort, one of the oldest Dutch cities, is situated in the estuary of the Maas, on an island torn from the mainland during a flood in 1421, about 400 years after the foundation of the city. Dort was formerly the capital of the province, and the residence of the Counts of Holland. Its natural strength was too great for its rulers to be coerced by feudal rivals. Heavily-laden vessels could come close to the quays, and the city would have been an important trading-place even without the unusual privileges which its princes conferred upon it, and by which it was enriched. English wool was one of the commodities, of which, for German dealers, it became the sole factory. Salt, wines, grain, hops and wood, were subject to pre-emptive reservations. Being the last port on the Rhine, it was the point where the huge rafts of timber floating down from the German forests were broken up and sold. A great trade was also carried on in salt fish and fish oils, as well as in corn and flax. Manufactures of cloth, both woollen and linen, employed many hands; ship-building, sawing, and other industrial occupations, added to the importance of the town.

Zierikzee, which now has its harbour choked up with sands, was, before the thirteenth century, a rich and flourishing port; in the fifteenth it possessed the largest ships and most numerous mercantile fleet in the Netherlands, and traded with Portugal and Spain. Hoorn or Horn, on the Zuyder Zee, owed its origin to some Hamburg merchants, who established a trading station there in 1316. The trade they brought to the place was chiefly that in beer, but Hoorn also became the seat of a traffic in cattle with Denmark, and in provisions and dairy produce with the maritime countries further south. Its ship-building yards were extensive, and its inhabitants were amongst the ablest navigators of Holland. Zierikzee and Hoorn are of historical as well as commercial interest, for the public spirit with which they resisted the levies of money and men made by Charles the Bold. As a consequence of the wars of this prince, Dutch merchantmen became the frequent prizes of France and other kingdoms; valuable cargoes were annually sacrificed, and crews made prisoners; while at home, taxes were enforced the more rigidly as the citizens became less able to pay. Through the vengeance taken by Charles upon the foremost towns, "cloth-weaving, which had hitherto been a flourishing manufacture at Hoorn, fell into decay, owing to the numbers of weavers and fullers who were driven from their homes." Zierikzee was made to pay a fine of 30,000 guilders, and to support a garrison of foreign troops.

Haarlem, once the capital of the province of Holland, was a large but not densely peopled town noted for its varied industry. Its staple manufactures of textile fabrics, particularly woollens, were in demand in places as distant as Portugal and Spain. Damask linen from the looms of Haarlem was esteemed in every quarter of the world. Specimens of these damask fabrics were produced of such wonderful fineness and beauty, as to surpass those of the Saracens. Haarlem compounded with the Counts of Holland in 1245, by a guaranteed payment of £20 a year, for freedom from taxes for ever. It suffered pillage in 1491 by the "Bread and Cheese" insurgents, who were incited to revolt through the misrule of the House of Burgundy.

Leyden at one time sent its cloth to Bergen, Bruges, Antwerp, Calais, Deventer, Campen, Zwolle, and Zutphen, and contained 100,000 inhabitants, a great number of whom were engaged in the weaving trade. This high state of prosperity resulted from the liberality of the citizens. While the wealthier towns of the South Netherlands were exclusive in their policy, North Holland wisely welcomed all comers, and readily accorded to them the rights of citizenship. Fugitives from Brabant and Flanders settled at Leyden and other towns soon after the year 1300, bringing with them their skill in handicrafts. The city grew rich from the labour of these immigrants, and produced from its 350 looms nearly 50,000 pieces of cloth annually. When Antwerp was given up to carnage by Philip of Spain, Leyden again received an accession of strength and skill. In this way it became necessary on several occasions to enlarge the city. During the war of independence, these citizens proved by their valour that their enfranchisement had inspired them with the sympathies and loyalty of Dutchmen.

Delft, like most of the Dutch towns, possessed cloth manufactures, especially those of say or baize: brewing was likewise an important industry. Its potteries, too, were known far and wide, so that Delf or Delft became the common name for that earthenware which is now superseded, even in Holland, by the superior Wedgwood ware and china of England. A considerable trade in tobacco-pipes was also carried on.

Enkhuizen was a ship-building and fishing port. The ships built were for mercantile and fishing purposes. Herring boats to the number of 400 and 500 a year—*i.e.*, three-fourths of all the Dutch-built craft—were constructed at this port. Its inhabitants numbered 40,000, most of them dependent upon the "great fishery." The verb *einbœckel, einbœckelen*, describes a method of pickling herrings discovered later by Bœckel, and still practised in Amsterdam, Enkhuizen, Delft, Hoorn, Schiedam, Brielle, and Vlaardingen. The produce of this industry was exported all over the world.

The harbour of Deventer, on the Yssel, was used for trading purposes in the year 882. It was burnt by the Norse pirates, and when rebuilt was often subsequently besieged by contending powers in Holland and Cologne. It was a free imperial city, well defended, and for a long while a member of the Hanseatic League, a connection which opened to its fleet the trade with Bergen. Deventer also secured trading privileges with Schonen. The exports were cattle, corn, butter, cheese, beer, wool, and turf, and there was a busy trade in timber. Coarse manufactures of linen and wool also employed the inhabitants.

Kampen, another town on the Yssel, resembled Deventer in the character of its trade. It was once a considerable place, boasting a mercantile marine of 120 vessels, and pursuing an active maritime commerce with Holland and the South Netherlands, as well as with more northern states, and also a considerable inland traffic by means of the Rhine. Merchants from England, Germany, and the Baltic assembled in its markets.

Middleburg is a characteristic example of the Dutch towns, which are said to have been in the Middle Ages not parts of the state, but commonwealths in themselves. The municipal charter of Middleburg, bearing date 1213, is the oldest document of the kind extant, except that of Gertruydenberg. King William in 1253, and Floris V. in 1271, conferred further privileges upon the town. This place was so flourishing that the English made it, about 1380, a staple or market for the wool trade. Raw wool from England came in free of all customs, the citizens, under the protection of their charter, being "allowed to buy what they liked, where they liked, to live at peace with their neighbours, and to be left alone."* The wool trade of Middleburg between 1380 and 1390 drew to its mart merchants from Italy, Portugal, and Spain, and this intercourse led to a prosperous trade in wine.

Nimeguen (Nymegen), in Guelderland, in 1050 was noted, with Wyk de Duurstede, for the production of fine cloth of a bright scarlet dye, which had retained its high character 120 years after, when the chief lord of the province stipulated for a yearly tribute of three pieces to the Emperor Frederick. Nimeguen was a member of the Hanse, and was in alliance with Cologne.

Rotterdam, the capital of South Holland, on the Maas, at the confluence of the Rotte, obtained municipal privileges in 1270, extensions of which were secured in 1340 and 1361. William VI. also materially promoted the business of the town. Rotterdam has always ranked as one of the most commercial and populous cities of Holland. It had inland communication, by means of canals, with every other town in the country; and owing to the depth of its river, the largest ships could come up close to its quays. Its manufactures of woven goods, liquors, beer, leather, and many other articles, were extensive, and it carried on a large trade in wines and grain. It was also one of the principal ports for the herring fishery, and for trade with France and England.

The inhabitants of Utrecht (*Ultrajectum*) carry their annals back to the Romans; they were early renowned as good sailors and skilful weavers. They possessed the right of levying troops and coining money. Their industry and power gave them such a

* "Industrial History of the Dutch," by T. McCullagh.

stake in their city that they burnt it, rather than capitulate, when attacked by the Norsemen. Utrecht was in the tenth century the centre of a trade with the Rhine-lands, Saxony, Denmark, Norway, Sweden, and the Baltic. It had commercial relations with Cologne, and was one of the first ports to engage in the wine trade. Besides the weaving of silk, linen, and wool, the citizens were employed in dyeing and bleaching, and in the making of earthenware. Agriculture was profitably pursued in the outskirts.

Amsterdam, on the Amstel, was in the year 1300 little more than a hamlet, sheltering a few poor fishermen who obtained their scanty living from the Zuyder Zee. The neighbourhood was desolate marsh-land. Upon this unpromising site the city arose, and became in time the capital of the commercial world. This greatness was chiefly due to advantages derived from its position. The original village offered security to fugitives from Flanders, and their intelligence and skill laid the foundation of manufactures and commerce. In 1313 William III. granted to the Baltic merchants exemption from tolls at Dort—a privilege afterwards extended to Amsterdam. The city joined the Hanse League, and in 1342 it became necessary to enlarge its boundaries. In 1368 the Swedish king assigned to Amsterdam a district of the Isle of Schonen, as already noticed.

War was entered upon in 1437 with the Hanse Towns, or Osterlings. This resulted in an extension of the trade of the Northern Netherlands, and in the acquisition of new commercial advantages from Sweden, and soon after from Norway and Denmark. In 1452 Amsterdam was burnt down, and a vast quantity of merchandise destroyed. Twenty years sufficed to restore the city, and to render it independent of the Hanse protection, from which it severed itself in 1472. The trade from this date increased even more rapidly than before. In 1482 the inhabitants fortified their capital; by 1500, commercial relations had been established with Iceland and Russia. Merchants from every European country met on its Exchange, and it owned a mercantile fleet of two hnndred sail. It was the emporinm of grain and foreign produce for Central Europe.

Without any native timber, a forest was used in piles, and large fleets were built and maintained. Surrounded by a barren waste, the city was a vast granary, and a storehonse of the fruits of the earth. Fishermen, more expert than elsewhere, made great hauls of herrings, yet no native-grown hemp could be obtained for their nets, or snfficient iron for their fish-hooks. No happy accidents or natural advantages favoured the city, yet "the sea not only bathed its walls, but entered among its streets; and the fleets of its merchantmen, as seen from the ramparts, lay so crowded together, that vision was intercepted by the thick forest of masts and yards."

RECREATIVE SCIENCE.—XXIII.

IMPRESSION OF ACCIDENTAL OR COMPLEMENTARY COLOURS ON THE VISION—SUMMARY OF THESE AND KINDRED ILLUSIONS.

It has been shown in a former paper that when the eye is suddenly impressed with a very brilliant coloured light, after it is extinguished the retina remains impressed with a colour which is usually *complementary* to the one first observed.

Complementary colours mean any two colours that will, when combined together, form white light; in fact, any two colours which contain red, yellow, and blue. Thus a brilliant yellow light would leave upon the eye the impression of lavender or violet light, composed of red and blue; a green would leave a red, and, *vice versâ*, a black may impress the retina with white; and freqnently where a dissolving view on a large screen is suddenly darkened off or obscured, it leaves the dark outlines impressed for a few seconds on the retina of the eye as distinct white lines, and this effect the writer has often witnessed whilst observing the rapid dissolving away of the pictnre of a map.

The effect can be well shown by pasting some strips, say of bright-red paper, in the form of a cross, on a sheet of white cardboard. If the oxy-hydrogen light is projected from a lantern, with condenser lenses, on to the red cross, and the spectator directed to stare at it steadily, on suddenly removing the card with the red cross, and leaving another plain white card behind, it will usually be noticed that nearly all those who are watching the experiment will exclaim that they see a green cross, faint of course; but still quite sufficiently defined to enable them to be sure that it is so. If, instead of the red cross, green is used, red remains visible, and black, as already stated, becomes white.

These effects are described by Sir D. Brewster as "accidental colours," and he appears to regard them as synonymous with the term already explained, namely, complementary colours. Brewster thus explains the phenomenon: "When the eye has been for some time fixed on the red cross, the part of the retina occupied by the red image is strongly excited, or, as it were, deadened by its continned action. The sensibility to red light will therefore be diminished; and, consequently, when the eye is turned from the red cross to the white card the deadened portion of the retina will be insensible to the red rays which form part of the white light from the paper, and consequently will see the paper of that colour which arises from all the rays in the white light of the paper but the red; that is, of a *bluish-green* colour, which is, therefore, the true complementary colour of the *red* cross."

"When a *black* cross is placed on a white ground, the portion of the retina on which the black image falls, in place of being deadened, is protected, as it were, by the absence of light, while all the surrounding parts of the retina, being excited by the white light of the paper, will be deadened by its continual action. Hence, when the eye is directed to the white card, it will see a white cross corresponding to the black image on the retina, so that the *accidental* colour of black is white."

For the same reason, if a *white* cross is placed on a black ground, and viewed steadfastly for some time, the eye will always see a black cross; so that the *accidental* colour of *white* is *black*.

The same author remarks, "It is not, however, necessary that the eye should be strongly impressed previously by some coloured light, as the phenomena of accidental colours are sometimes seen without it."

Brewster states that in order to see this class of phenomena he found the following method the simplest and the best: "Having lighted two candles, hold before one of them a piece of coloured glass, suppose bright red, and remove the other candle to such a distance that the two shadows of any body formed upon a piece of white paper may be equally dark. In this case one of the shadows will be *red*, and the other *green*. With blue glass, one of them will be *blue* and the other *orange yellow*, the one being invariably the accidental, or complementary colour of the other. The very same effect may be produced in daylight by two holes in a window-shutter; the one being covered with a coloured glass, and the other transmitting the white light of the sky."

Here, however, it may be remarked, that the disturbing cause is evidently the coloured light npon which the eye is most likely to gaze intently first, and although the colonrless light is side by side, still it amounts to nothing more than moving the eye snddenly from a red wafer to another part of the paper where there is no red wafer. The eye is thus impressed with green, and therefore it cannot be said, in the cases qnoted by Brewster, that the phenomena of accidental colours are best seen when the eye has *not been impressed* with any coloured object, becanse it is impressed by the red or blne light obtained from the candle, or the rays of the sun passing through glass coloured blue or red. What the writer insists upon, is that in these cases it will always be found that there is coloured light of some sort to set up the effect of accidental colour.

In the experiments devised and described by Mr. Rose, however, in a paper on "Persistence," it is clearly shown that with no colour whatever to look upon, and only gazing on a white card whilst the stray light falling on it is gradually redneed and restored, the white glare of light passes into various gradations of coloured light.

This very interesting experiment is thus described:—"An intensely white card is held before the eye, whilst a strong light falling on it is gradually redneed and restored. As the light is reduced the *whiteness* passes into *yellow*, *orange*, *red*, and sometimes thence int *blue*. Whilst at other times colonrs intermediate between red and blue are apprehended, the gradual reduction of the light brings up the colour by successive steps and in reverse order to whiteness. All eyes, as might be expected, are not affected alike by these experiments; but all see whiteness passing into yellow, orange, and blue, and blue returning back in deep orange, yellow, and white. The restoration of the light is on the whole less satisfactory than its reduction, for when by reduction a deeply intense blue is obtained, the light cannot, to some eyes, be restored slowly enough to prevent a sudden change to deep orange. The colours that succeed each other, as the light is gradually reduced, have none of the accepted relations between any given colour and its complement. The white is not succeeded by thin blackness, the yellow by faint purple, or the orange invariably by blue; but the different hues do come up in an order that suggests the great probability that what we name colour is only *the various affection of the optic nerve by a greater or lesser quantity of light* radiating from a focal point in an imperfect reflector."

The above experiment was the result of accident. Mr. Rose had been looking upon a white surface lying near a powerful gas-light, when his arm having caught the tap and reduced the light, his attention was drawn to a sudden change from *white* to *red*.

Another experiment of great beauty and interest was also suggested to him by an accidental circumstance. He was observing the effect of flashes of light, intermittent artificial light, on a revolving disc having twelve large circular black spaces ranged equidistantly around the margin. It was broad day, and the window-shutters were closed to exclude the natural light. In the course of the experiment the shutter started open and admitted a little daylight, when the remarkable appearance was presented of twelve *blue* circular spaces lying upon a zone of bright orange. Mr. Rose regarded this at the time as simply the presentation of a complementary colour under singular conditions that kept it permanently before the eye; but as leisure afforded him opportunity to repeat the experiment, he soon began to perceive that he had taken far too limited and narrow a view. The misconception arose out of a fact connected with the painting of the discs. It was found that lampblack alone would not give the depth and intensity required in the devices, and to remedy the defect a little indigo was added. The circular spaces, to the eye, were certainly intense black and nothing more; but it was considered that they had a tendency to blueness, and that under the rotation they were reduced to a lighter blue, and drew after them trains of complementary orange, in the same way that a black fly walking across a pane of ground-glass, backed by grey light, is seen to draw a white spectrum after it.

But this idea was dismissed as soon as it was ascertained that absolute unmixed black produced the same effect, and that the nearer the artificial light approached the intensity of whiteness, the more decided and satisfactory was the result.

How, then, is this effect to be explained? Mr. Rose says, "The diffused light of the zone is continually falling upon the eye; but the intermittent flashes find the negations, or black portions, always in the same areas, and hence from these spaces no part of the flash is reflected, whilst it mingles with and adds to the diffused light in the spaces between the negations. Now the diffused light is, we assume, intense light reduced by distribution to blueness, and in this blueness the negative spaces participate; but in the rest of the zone the flash brings up the light to such quality in relation to space as is necessary for the presentation of orange. We have more light from diffusion at the outer and inner edges than in the centre of the zone or ring, and hence the light blue at the inner margin and the light blue passing into green at the outer margin. This common quality of the zone is shown in the negative spaces. But from the intervals between them there comes the diffused light variously affected by the flash, and conveying the graduated tints of orange."

This explanation of the effect, Mr. Rose thinks, will appear reasonable if the conditions of the action are thoughtfully considered. Eight circular spaces of intense and absolute blackness produce under rotation and by persistence a nebulous ring.

"If," he says, "this is to be viewed as a mixture of light and shadow, or of black and white, we cannot explain the manner of its affection by the intermittent light, which shows the apparently stationary negations as blue, and the remainder of the zone as orange. But if we regard the black spaces as utter absence of light, reducing the quantity of light for distribution over the zone, but giving it no quality by admixture, all difficulty is at an end. A quantity of light is then understood to be diffused over a certain space, whence it comes modified to blueness, and when this reduced light receives the impression of the flash it is increased in relation to surface and raised to orange."

In the "Edinburgh Journal of Science," Mr. Smith has described a very curious instance of the change of white light into complementary tints. In his directions for the performance of this experiment the operator is directed to hold a strip of white cardboard upright, about twelve inches from the eyes. The card may be six inches long and a quarter of an inch wide. If the eyes are now fixed upon some object at a distance of ten or twelve feet behind it, so that the card becomes doubled, and a lighted candle is now placed close to the right eye and shaded from the left one, the latter will see the white strip of card *green*, whilst the former will appreciate the complementary colour, or red. On changing the candle so that the light falls upon the left eye, the phenomena are reversed. Does this show that artificial light generally presents an excess of the red waves of light, and that the green is the inevitable result obtained by first exciting the eye with a reddish light?

We cannot better conclude these papers on the persistence of vision and its illusions than by giving the reader a general summary of the effects:—

1. *Persistence.*—The retention of an image by the eye, not for an absolute instant, but for an interval—an interval sufficient for an object to pass over a succession of points, in all of which it will be apprehended by the eye at the same instant.

Illustration.—A lighted stick moved rapidly in a circle presents a ring of light, because the eye retains an impression of the light at any given point until the stick has returned to the same point again.

2. *Simple Persistence* presents only illusions of the simplest character, as the commingling of the elements of white light, the composition of colour, etc.

3. *Persistence under Condition of Interrupted Vision* offers an indefinite variety of illusions depending on the fact that a disc in rapid revolution, presenting the points on its circumference only for an instant to the eye, is virtually stationary; and any object situated in those points is distinctly seen, by reason of its making no sensible advance during the exceedingly brief interval of its apparitions.

4. *Disc Action.*—The illusions of persistence are presented under various arrangements of disc action, in which discs revolving with different degrees of velocity, and bearing multiform devices, impress the eye with a number of images at virtually the same instant.

5. *Single Disc Action.*—Tolerably well known in its application to ordinary optical experiments, and as the vehicle for the illusions presented in the thaumatrope, etc. The single action has this advantage in connection with the thaumatrope and kindred devices, that it shows true form, and does not make anamorphoses or distorted figures, in one point of view confused, in another exact and regular.

6. *Double Disc Action.*—This action produces, under certain arrangements, almost an unlimited variety of illusions. The double-disc movement (as arranged by Mr. Rose) consists of two wheels, one of which receives a disc bearing the devices, and the other a black disc perforated with a number of slots or slits. The wheels revolve in contrary directions, and their relative velocities can be varied at pleasure within certain limitations. So far as the illusions of persistence aim at no higher purpose than the representation of a horse leaping a gate, etc., the double action is less valuable than the single, because the motion of the wheels being contrary, the diameter of the figures is determined by the angular motion of the slot, and thus the normal figure of the devices is altered. For example:—If the wheels move with equal velocities the diameter is reduced one-half, and a circle becomes an ellipse. The figure is further altered by any variation in the relative velocities of the two wheels; but if in these illusions we aim at something higher than a mere optical toy, the double-disc action will rise in our estimation, since it presents the most interesting illustrations of recondite optical principles, and also examples of compound motion, multiplication, involution, and combinations of the most pleasing and attractive character.

METEOROLOGY.—V.

HALOS—PARHELIA—MIRAGE—FATA MORGANA—IGNIS FATUUS—COLOURS OF CLOUDS—CONCLUSION.

THE varied phenomena of *halos*, *parhelia* or *mock suns*, and *paraselenæ* or *mock moons*, are also optical meteors, and may be accounted for in much the same way as the rainbow.

Very frequently rings of various sizes, and more or less coloured, are seen to surround the moon; this is especially the case when the sky is covered with light cirrus clouds, or when the air is charged with vapour. This appearance results from the rays being deflected as they pass the minute particles of watery vapour. When these particles are very small, the corona, or halo, as it is frequently called, is of large size; and as they increase it contracts: hence weather indications may be drawn from its appearance. When it contracts, the particles are collecting into larger drops, and will probably soon fall in the form of rain; when, on the other hand, it spreads, they are diminishing in size, clearly showing increasing dryness of the air.

When fleecy clouds intervene between the moon and the observer, the prismatic colours may sometimes be seen in the corona. These appearances are not often seen around the sun, because its superior brightness prevents our looking at it. If, however, we examine it through a coloured glass, or view its reflection in water, we shall occasionally meet with a similar phenomenon.

The term *halo* is most strictly applied to luminous rings which are at times seen surrounding the sun, as shown in Fig. 14. The form of these varies very greatly; usually several circles and segments are combined in the most remarkable manner, and at the points of intersection parhelia are frequently observed. As many as nine of these mock suns have been seen at one and the same time, the appearance thus presented being very remarkable.

In this country the instances of their occurrence are but rare, but as we travel into arctic regions they are frequently met with. They are caused by the refraction and reflection of the solar rays from minute snow crystals floating in the air, and hence are much more common in cold climates. It is recorded that in Iceland, during the severe winter of 1615, the sun was always accompanied by some of these appearances. Minute spicules of ice have sometimes been observed falling during the continuance of the halo, and the form it assumes probably depends upon the structure of these crystals. Similar appearances are sometimes seen around the moon, and are known as paraselenæ.

If we scatter a little lycopodium on a plate of glass, and look at any bright light through it, we shall see rings round it somewhat resembling the appearances we have been describing. The minute particles of the dust act upon the rays of light in much the same way as the watery particles in the air do. A similar effect is seen on looking through a piece of glass on which the breath has condensed.

There are several other optical meteors which must just be referred to, some of which may almost be distinguished as spectral illusions. The best known of these is the *mirage* of the desert. Sometimes, as the traveller is passing on over the arid wastes of sand, he sees in the distance the appearance of beautiful lakes with islands situated in them. The images of surrounding objects are seen inverted in the water with every appearance of reality; but when he hastens forward to enjoy its coolness, the landscape recedes from him, or entirely vanishes.

The cause of the illusion seems to be that the surface of the sand becomes intensely heated by the burning rays of the sun, and hence the layers of air resting on it become much warmer than those above. The rays of light are accordingly reflected, and bent out of their course. If we look at a distant object along the surface of a red-hot poker, the rays of light will be similarly acted upon, and we shall sometimes be able to see an inverted image of the object we are looking at.

Fig. 14.—HALOS SURROUNDING THE SUN, AND PARHELIA OR MOCK SUNS.

In northern latitudes inverted images of ships have been seen in the air, and even been identified; by comparing logs it has afterwards been found that their distance from one another was so great that they would have been quite hidden by the earth's curvature, had it not been for this remarkable change in the refractive power of the air. An instance is also on record in which the coast of Picardy was quite distinctly seen from Hastings, appearing to be only a few miles distant, though under ordinary circumstances it is quite invisible even with the aid of the best telescopes. Similar appearances have been seen at other places, but they are very uncommon.

The phenomenon known as the *fata morgana*, occasionally seen in the Straits of Messina, is of a somewhat similar character. The surface of the water appears to be covered with images of mountains, buildings, and various other objects; frequently, too, a second image is seen inverted under the other, and the whole scene is almost like the creation of a dream. The air above the water seems also at times to be full of these spectral objects. The most probable explanation is that, owing to some peculiar state of the air, the objects on the further shore are apparently brought nearer, and made to appear in the middle of the straits. At the same time, the images are distorted or multiplied, so that they can scarcely be identified. Sometimes, in addition to the permanent scene, there appear in the foreground sheep and cattle, or troops of men moving on in regular succession. The appearance is only seen when the sun has attained an elevation of about 45°; the tide, too, must be fully up, and the water pressed on by the current, so that its surface is elevated in mid-channel.

In mountainous regions enlarged shadows of objects are sometimes thrown on the clouds at sunrise. In the Hartz Mountains this phenomenon has frequently been seen, and the peasantry in the neighbourhood were long terrified by rumours of a gigantic spectre which was said to walk along the clouds in the early morning. Scientific observers, however, soon discovered that it was merely an enlarged shadow of the traveller projected on the clouds, every motion of his being faithfully copied. This affords another illustration of the readiness with which ordinary appearances are set down to supernatural causes, when a little inquiry or thought would explain them. When the sun is very low in the horizon similar appearances may be seen in other localities.

The *ignis fatuus*—sometimes called the Will-o'-the-Wisp—is another meteor which formerly excited much curiosity and attention. It is a pale, flickering light, sometimes seen hovering over low valleys and marshes, or over old burying-grounds. When the observer attempts to follow and examine it, it eludes his grasp, and sometimes disappears. It is but rarely seen in this country now, probably owing to the fact that much of the marshy ground has been drained and brought into cultivation. If the places where it appears are examined by day, small bubbles of gas may usually be seen issuing from the marsh, and on being examined this is found to be phosphuretted hydrogen—a gas which ignites spontaneously, and burns with a very feeble flame.

The slight wind caused by the approach of any person is sufficient to drive the flame away; but by remaining perfectly still, and shielding off the breath, a piece of paper has been lighted from it, clearly showing that it is not merely a phosphorescent light. The gas probably burns during the day as well as by night, but owing to its pale flame it is quite overpowered by the daylight.

It is produced from decomposing animal and vegetable substances; hence the localities in which it is met with. Many accounts have been given of the way in which travellers have followed this light and been led into the depths of the marsh, but most of these are probably exaggerated.

The colours of the clouds are not unfrequently used as a means of foretelling the weather. The sky itself, when free from clouds, appears to be of a fine blue colour. Overhead the tint is deepest; towards the horizon it is considerably modified by the light reflected from the mists and vapours which arise from the earth. As we pass into regions where the air is clearer, or ascend lofty mountains, the sky appears of a deeper blue. The colour is really produced by the action of the air on the rays of light which pass through it.

When the sun is near the horizon, its rays falling on the clouds give rise to the grand and beautiful sunsets so frequently observed. As the quantity and condition of the watery vapour have a great influence in producing these gorgeous hues, we can often prognosticate the weather by observing them. Hence the common proverb—

> "Evening red, and morning grey,
> Will set the traveller on his way;
> But evening grey, and morning red,
> Will bring down rain upon his head."

When light passes through a great thickness of air charged with watery vapour, it is found that the blue rays are absorbed first, and the yellow rays next; the red rays having the greatest penetrating power. This fact accounts for the prevalence of red in the sky at sunrise and sunset, for then the rays fall almost horizontally, and thus pass through the stratum of air resting on the earth's surface, which is that most charged with vapour.

If the air is dry the cumulus clouds that have formed during the day slowly sink at evening, and dissolve in the lower and warmer strata. This produces the brilliant red and golden hues referred to in the proverb. The fact of the clouds being dissolved at a time when the temperature is falling, is a proof of the dryness of the air.

A *high* red dawn also indicates fine weather, since the colour here is produced by the thickness of the vapoury layer through which the rays pass, and not by its unusual quantity. When, however, the sky is red and *lowering*, it indicates a superabundance of vapour in the act of condensation, and rain is at hand.

One of the surest indications of wet is afforded by a green or greenish-yellow tint in the sky. If at evening the golden hues of the clouds begin to merge into this, storms or rain may be looked for; but when they change to orange and red, the weather will probably remain settled.

There are many other indications of weather, but these for the most part can only be acquired by long-continued observations.

We have thus in a hasty way looked at the more important meteorological phenomena and their explanations, and can only hope that the student will be tempted to pursue the study of the science yet further, and lend his aid to the elucidation of some of the complicated questions still remaining unsettled.

LESSONS IN GERMAN.—LXXVII.

§ 159.—INVERSION.

(1.) In all the cases preceding, the natural order of the leading parts has been preserved; that is, the subject first, the copula next, and the predicate last. But for the sake of giving special emphasis to particular words, this order is often inverted. Thus the real or logical subject is made emphatic by being put *after* the copula, the pronoun es taking its place as a grammatical subject; as, es hebt die Freiheit ihre Fahne auf, *liberty* uplifts her standard. When, again, either the copula or the predicate is to be rendered emphatic, they exchange places; thus (*predicate emphatic*), sterben müssen Alle, *die* must all. The chief places in which the copula receives the stress, are—

(*a.*) In direct questions; as, schreibt der Mann?

(*b.*) In imperatives; as, sprechen Sie mit ihm.

(*c.*) In the case of mögen, when used to express a wish; as, möge es der Himmel geben!

(*d.*) In cases where surprise (generally with doch) is to be expressed; as, ist doch die Stadt wie gekehrt!

(2.) When, on any one of those words which, in the natural order, come between the copula and the predicate, we wish to lay special emphasis, it must be put either before the other words standing between the copula and the predicate, or else before the subject. In this latter case, however, the subject and the copula exchange places; thus, nur von Edlem kann Edles stammen; where the common order would be, Edles kann nur von Edlem stammen. These inversions, however, chiefly occur when principal and subordinate sentences are connected by conjunctions.

§ 160.—SENTENCES: PRINCIPAL AND SUBORDINATE.

(1.) A principal sentence is one that expresses by itself an independent proposition; thus, "It was reported;" "He deserves;" "John toils."

(2.) A subordinate sentence is one that serves as the complement to a principal sentence, and without which it conveys no complete idea. Thus, in the expressions, "It was reported, that the town was taken;" "He deserves, that we should defend him;" "John toils, although he is rich;" the first, in each case, is the principal, and the second the subordinate sentence.

(3.) In the natural order, the principal precedes the subordinate sentence. But this order is often reversed; in which case the order of the subject and the copula in the principal sentence is also reversed. Thus, in the natural order we say, ich weiß, daß er es nicht thun kann, *I know* that he cannot do it. Putting the subordinate sentence first, it will stand: daß er es nicht thun kann, weiß ich, that he cannot do it, *know I*.

(4.) When, however, the subordinate sentence comes in after the copula (that is, before a *part* only) of the principal sentence, the natural order of the latter remains unchanged; as, ich fand, als ich in London ankam, meinen Freund nicht.

(5.) In subordinate sentences, the common order of the leading parts differs from that of the principal sentences, in making the copula come *last*, that is, in making the copula and the predicate exchange places. For example:—

		COPULA.
Er,	der mir den Brief	brachte.
He,	who to me the letter	*brought.*
Der,	dessen Herz rein	ist.
Ich weiß,	wo ich ihn gesehen	habe.
Er sagt,	daß er es nicht thun	kann.
Er ist arm,	weil er sehr träge	ist.

(6.) The subordinate sentence is usually connected with the principal one by means of some conjunctive word. The conjunctive word so employed is either a relative pronoun, a relative adverb, or some conjunction proper, expressing cause, condition, purpose, limitation, or the like. See the examples under the preceding paragraph.

(7.) The conjunctions employed in connecting principal with subordinate sentences are—

Als.	Ehe.	Obschon.	Wenn gleich.
Auf daß.	Falls.	Obwohl.	Wenn schon.
Bevor.	Je.	Obzwar.	Wenn auch.
Bis.	Je nachdem.	Seitdem.	Wie.
Da.	Indem.	Ungeachtet.	Wie auch.
Dafern.	Nachdem.	Während.	Wiewohl.
Damit.	Nun.	Weil.	Wo.
Daß.	Ob.	Wenn.	Wofern.
Dieweil.	Obgleich.	Wenn nicht.	

These all remove the copula to the *end* of the sentence.

Daß is sometimes omitted; in which case the copula stands, not at the end, but just as in a principal sentence; thus, er sagt, er könne schreiben.

When wenn is left out, the subject and copula stand as in a question; thus, wenn ich es geschrieben hätte, &c., or (without wenn) hätte ich es geschrieben, so würde ich es Ihnen gesagt haben.

(8.) The following are the conjunctive adverbs, which are used to connect subordinate sentences with principal ones, after the manner of real conjunctions:—

Außerdem.	Deßgleichen.	Jedoch.	Noch.
Daher.	Desto.	Indessen (indeß).	Nur.
Dann.	Einerseits.	Ingleichen.	Sonst.
Alsdann.	Anderseits	In so fern.	Theils-theils.
Darum.	Endlich.	In so weit (so weit).	Übrigens.
Deßwegen.	Ferner.	Kaum.	Überdies.
Deßhalb.	Folglich.	Mithin.	Vielmehr.
Dennoch.	Gleichwohl.	Nicht allein.	Wohl.
Dessenungeachtet.	Indessen.	Nicht nur.	Zudem.
Nichtsdestoweniger.	Hernach.	Nicht bloß.	Zwar.
	Nachher.		

These all reverse the order of subject and copula, when they stand *before* the subject; when, however, they come after the copula, the natural order of the sentence obtains.

(9.) Allein, denn, sondern, aber, und, and oder always stand at the head of a sentence without influencing the order of the other words. Nämlich may also occupy the first place without changing the position of the other words.

(10.) Where a mood-auxiliary, or any such verb as takes the infinitive without zu, occurs together with another infinitive, the copula stands *before* the two infinitives; thus, wenn ich es hätte thun müssen, &c., not wenn ich thun müssen hätte.

§ 161.—IDIOMATIC PHRASES.

There are in German, as in other languages, numerous idiomatic phrases. Many of these cannot be rendered literally into English without a great sacrifice both of sense and sound. Still, their meaning and application must be familiar to the student. We give below, therefore, a somewhat extended list; adding to each either some equivalent phrase in our own language, or, where it will bear it, a regular translation. In every case, however, it will be highly advantageous to the student to put the phrase first in a perfectly literal dress, and then deduce from it, if possible, the thought which it is employed to convey. This is often a very pleasant as well as profitable process.

Achten Sie es nicht so gering.	Do not think so light of it.
An der Sache ist nichts auszusetzen.	There is no fault to be found with it.
Auf's Ungewisse.	Upon an uncertainty, *i.e.*, at a venture.
Bei stockfinsterer Nacht.	At the dead of the night.
Bei der Sache ist ein Aber.	There is a *but* (*i.e.*, a difficulty) in the matter.
Darauf ist es eben angelegt.	This was the very aim.
Das Schiff lag vor Anker.	The vessel rode at anchor.
Das versteht sich von selbst, or Das versteht sich.	That is a matter of course, *i.e.*, obvious.
Das Buch läßt sich lesen.	The book is readable.
Das läßt sich sehen.	That looks well; that will do.
Das hat keine Art.	That is unbecoming; unseemly.
Das läßt sich nicht blasen.	That cannot be done in a twinkling.
Das habe ich mir bald gedacht.	I thought so soon enough.
Das wird ein Ende mit Schrecken nehmen.	That will end badly.
Dem ist nicht zu helfen.	There is no remedy for it.
Den Kürzern ziehen.	To get the worse of it.
Der Name will mir nicht beifallen.	The name does not occur to me.
Die Haare standen mir zu Berge.	My hair stood on end.
Die Griechen haben eine Schlacht geliefert.	The Greeks have given battle.
Die Fenster gehen in den Garten.	The windows look into the garden.
Die Waare findet keinen Abgang.	There is no demand for the article.
Die Waare findet starken Absatz.	The article finds a ready market.
Dieses Buch ist gut abgegangen.	This book has gone off (*i.e.*, *sold*) well.
Eile mit Weile.	Slow and sure; hasten slowly.
Ein Erz-Schurke.	An arrant knave.
Ein vornehmer Mann.	A man of rank; a leading man.
Einem Pferde die Sporen geben.	To clap spurs to a horse.
Einem auf den Leib gehen.	To attack or assault one.
Einem an die Hand gehen.	To go to one's aid.
Einen herausfordern.	To challenge or call out one.
Einen zum Narren haben, or zum Besten haben.	To make a laughing-stock of one.
Einen anfahren.	To address one harshly.
Einen an seinem Geburtstage anbinden.	To make a present to one on his birthday.
Einen aufziehen.	To quiz one.
Endlich ist sie unter die Haube gekommen.	She has got married at last.
Er ist noch einmal so groß.	He is as tall again.
Er hat sein Vermögen durchgebracht.	He has run through his fortune.
Er prahlt gern, or Er schneidet gern auf.	He is fond of talking big.
Er läßt es sich sehr angelegen sein.	He makes it his business, or concern.
Er sah mich starr an.	He stared me in the face.
Er stellt sich unwissend an.	He affects ignorance.
Er hat sich losgemacht.	He has got off.
Er hält übel Haus, or Er ist ein schlechter Wirth.	He is a poor manager.
Er mußte schwören.	He was put to his oath.
Er weiß weder aus noch ein.	He is sadly put to it.
Er riecht den Braten.	He smells the rat.
Er hat sich davon gemacht.	He ran away.
Er läßt viel darauf gehen.	He spends a great deal of money.
Er hat mir viel Abbruch gethan.	He has done me much damage.
Er hat sich mit seinen Gläubigern abgefunden.	He has come to terms with his creditors.
Er hat es so in der Art.	It is his way.
Er hat endlich seine Waare an den Mann gebracht.	He has found a market at last.
Er macht es gar zu bunt.	He is too bad; he goes too far.
Er geht nur darauf aus.	He aims at nothing else.
Er findet sich immer zu rechter Zeit ein.	He is always there at the proper time.
Erinnern Sie mich daran.	Put me in mind of it.
Es wird nicht angehen.	It will not do.
Es kann nicht schaden.	It will not be amiss.
Es ist wohl verwahrt.	It is under lock and key.
Es sieht sehr darnach aus.	It looks very much like it.
Es ist Schade, daß sie nicht kommen kann.	It is a pity that she cannot come.
Es geht mir nichts ab.	I want for nothing.
Es geht bunt zu.	These are strange goings-on.
Es reißt in den Beutel.	It costs a great deal of money.
Gelb läßt nicht schön auf Grün.	Yellow does not look well upon green.
Ich achte es nicht.	I make nothing of it.

Ich halte viel auf meine Schwester.	I set a great store by my sister.
Ich kann ihn gut leiden.	I like him well.
Ich kann mich nicht darauf besinnen.	I cannot recollect it.
Ich frage nichts darnach.	I do not care for it.
Ich kann den Mann nicht ausstehen.	I cannot bear the man.
Ich thäte es selber nicht.	I would not do it.
Ich auch nicht.	Nor I either.
Ich will es mit Ihnen so genau nicht nehmen.	I won't stand upon it with you.
Ich bin dahinter gekommen.	I have found it out.
Ich lasse es gehen, wie es will.	I let things go as they will.
Ich möchte doch wissen, was er vorhat.	I should like to know what he is about.
Ihm fällt jede Kleinigkeit auf	Every little matter catches his attention.
Ihre Reden stimmen nicht überein.	Their accounts do not agree.
In Beschlag nehmen.	To seize (goods).
Ist mir's doch, als wenn ich sie schon irgendwo gesehen hätte.	I fancy, I must have seen her somewhere.
Jedermann mag ihn gut leiden	He is liked by every one.
Kehren Sie sich nicht an ihn.	Never mind him.
Kein Blatt vor den Mund nehmen.	To speak fearlessly.
Kurz angebunden sein.	To be irritable.
Langen Sie zu, meine Herren.	Help yourselves, gentlemen.
Lassen Sie mich dafür sorgen.	Let me alone for that.
Lassen Sie mich zufrieden.	Let me alone.
Lassen Sie einen Arzt holen	Send for a physician.
Lassen Sie uns nicht uneins werden.	Let there be no difference between us.
Löschen Sie das Licht aus.	Put the candle out.
Man hält es überall für wahr.	It is believed everywhere.
Man sagt, er habe sich umgebracht.	He is said to have destroyed himself.
Man behorcht uns.	We are overheard.
Mein Nachbar läßt mir sagen.	My neighbour sends me word.
Mein Verwandter handelt mit Tuch.	My relation deals in cloth.
Mir nichts, dir nichts.	Without much ado; as easy as possible.
Mit Erlaubniß.	By your leave.
Roth und weiß stechen von einander ab.	Red and white present a great contrast.
Schenken Sie die Gläser voll	Fill the glasses up to the brim.
Seine Stelle wirft jährlich nur hundert Gulden ab.	His situation is worth only one hundred florins a year.
Setzen Sie Ihren Hut auf.	Put your hat on.
Sie hat ihn darum gebracht.	She made him lose it.
Sie ergriffen das Hasenpanier, or Sie nahmen Reißaus.	They took to their heels.
Sie geben mir immer die Schuld.	You always blame me.
Sie müssen sich nicht an ihn kehren.	You must not mind him.
Sie sind vom rechten Wege abgekommen.	You have lost your way.
Sie thun der Sache zu viel.	You are carrying the thing too far.
Sie müssen sich das aus dem Sinne schlagen.	You must banish that from your mind.
Sie macht alle Moden mit	She always follows the fashion
Sie haben es getroffen.	You have hit the mark
Sie thun sehr bekannt mit einander	They act very familiarly with one another.
Vor einer halben Stunde lag es mir auf der Zunge.	Half an hour ago, I had it at my tongue's end.
Was geht das mich an?	What is that to me?
Was hilft mir's?	What am I the better for it?
Was fällt Ihnen ein?	What an idea!
Was wollte ich doch sagen?	What was I going to say?
Weit gefehlt.	You are quite out.
Wenn ich sie zu sehen bekomme.	If I get a sight of her.
Wenn's mir fehl schlägt.	If I do not succeed.
Wenn ich anders recht daran bin.	If I am not mistaken.
Wie können Sie solche Einfälle haben?	How can you think of such a thing?
Wie konnte er sich so etwas träumen lassen?	How could he harbour such a thought?
Wenn ich an Ihrer Stelle wäre, so würde ich mit der Sache nichts zu schaffen haben.	If I were in your place, I would have nothing to do with the affair.
Wir verabredeten uns, es wechselweise zu thun.	It was agreed upon between us to do it by turns.
Wie brachten Sie dort Ihre Zeit zu?	How did you spend your time there?
Was fehlt an Ihrer Uhr?	What is the matter with your watch?

LESSONS IN ENGLISH LITERATURE.—XXVI.

POPE AND THE CONTEMPORARY POETS (*continued*).

To the same class of writings in many respects as the "Essay on Man" belong those which we have next to consider—the "Moral Essays." But these are not, like the "Essay on Man," philosophical treatises attempting to solve the great enigmas of the universe. They deal with human nature in detail—the diversities and eccentricities of character. They contain the most brilliant and life-like pictures of individual character, and show Pope's powers of satire in their highest perfection. The first epistle is on the "Knowledge and Character of Men." In it, after speaking at length of the inconsistencies and seeming incomprehensibility of men's characters and conduct, he develops his favourite theory, that there is a key to be found to every character in the ruling passion; and he concludes with some most striking examples, both humorous and pathetic, of the "ruling passion strong in death." The second epistle, "On the Characters of Women," is equally brilliant. The third and fourth epistles, on the "Use of Riches," afford Pope an admirable opportunity for the use of his varied powers. Our limited space will not allow us to quote more than a single example; but the picture is one of the most wonderful ever drawn by any satirist:—

"Where London's column, pointing to the skies,
Like a tall bully, lifts its head, and lies,
There dwelt a citizen of sober fame,
A plain good man, and Balaam was his name;
Religious, punctual, frugal, and so forth,
His word would pass for more than he was worth;
One solid dish his week-day meal affords,
An added pudding solemnised the Lord's.
Constant at church and 'change, his gains were sure,
His givings rare, save farthings to the poor.
The devil was piqued such saintship to behold,
And longed to tempt him like good Job of old:
But Satan now is wiser than of yore,
And tempts by making rich, not making poor.
Roused by the Prince of Air, the whirlwinds sweep
The surge, and plunge his father in the deep;
Then full against his Cornish lands they roar,
And two rich shipwrecks bless the lucky shore.
Sir Balaam now, he lives like other folks,
He takes his chirping pint, and cracks his jokes;
'Live like yourself,' was soon my lady's word,
And, lo! two puddings smoked upon the board.
Asleep and naked as an Indian lay,
An honest factor stole a gem away:
He pledged it to the knight: the knight had wit,
So kept the diamond, and the rogue was bit.
Some scruple rose; but thus he eased his thought,
'I'll now give sixpence where I gave a groat,
Where once I went to church I'll now go twice—
And am so clear too of all other vice.'
The tempter saw his time, the work he plied:
Stocks and subscriptions pour on every side,
Till all the demon makes his full descent
In one abundant shower of cent. per cent.,
Sinks deep within him, and possesses whole,
Then dubs director and secures his soul.
Behold Sir Balaam, now a man of spirit,
Ascribes his getting to his parts and merit;
What late he called a blessing now was wit,
And God's good providence a lucky hit.
Things change their titles as our manners turn:
His counting-house employed the Sunday morn:
Seldom at church ('twas such a busy life),
But duly sent his family and wife;
There (so the devil ordained) one Christmas-tide
My good old lady catched a cold and died.
A nymph of quality admires our knight:
He marries, bows at court, and grows polite;
Leaves the dull cits, and joins (to please the fair)
The well-bred cuckolds in St. James's air.
First for his son a gay commission buys,
Who drinks, games, fights, and in a duel dies.
His daughter flaunts a viscount's tawdry wife,
And, wretched, wears a coronet for life.
In Britain's Senate he a seat obtains,
And one more pensioner St. Stephen gains.

My lady falls to play: so bad her chance,
He must repair it; takes a bribe from France;
The house impeach him; Coningsby harangues;
The court forsakes him, and Sir Balaam hangs.
Wife, son, and daughter, Satan, are thy own,
His wealth, yet dearer, forfeit to the crown.
The devil and the king divide the prize,
And sad Sir Balaam curses God and dies."

The most important work of pure satire which Pope produced is the "Dunciad," a sort of mock-heroic poem in which the glory and triumph of Dulness, the election of the King of the Dunces, and the solemnities on the occasion are related with the utmost seriousness, and with extreme humour, sometimes mixed with a good deal of coarseness both of idea and expression. The plan of the poem was, no doubt, in part suggested by Dryden's satire of "MacFlecknoe," though the two works have very little in common. The first book of the "Dunciad" opens with an excellent description of the Empire of Dulness, and then goes on to relate the election of a successor to the throne of Dulness, in place of Eusden, the city poet, lately deceased. In the first edition of the "Dunciad," Pope assigned the bad eminence to Theobald, a man who unquestionably merited the title of dull, and who had been one of the many antagonists of Pope, and his rival as an editor of Shakespeare. In the second version of the poem the whole drift of the satire is changed, and in place of Theobald we find as King of the Dunces Colley Cibber, a writer of plays very popular in their day, and who, with all his faults, certainly by no means deserved to be called dull.

In the second book, which is the most ingenious, the most humorous, and the most severe of the whole satire, the poet, in imitation of the games in which the ancient epic poets took so much pleasure, gives an inimitable description of the contests and trials of skill held in honour of the election of the monarch. In the third and fourth books we have an account of various scenes at the court of Dulness; and a wonderful picture in mock-heroic strains of the gradual extinction of Sense, Wit, and Learning, and of the power of Dulness enveloping the whole world. This satire gave Pope an opportunity of doing two things—first, of entering his genuine protest against and thoroughly exposing the bad taste, useless learning, and misapplied ingenuity which he saw around; and, secondly, of taking a signal revenge upon all those in the world of letters from whose attacks, provoked or unprovoked, he had suffered. Not one of them escapes; not one of them but is exhibited in a light equally ludicrous and contemptible.

But there are few of Pope's poems, on matters of everyday life, in which his powers of satire are not to be traced. The lines in his "Epistle to Arbuthnot"—in which he sketches, with wonderful discrimination and but pardonable exaggeration, the strength and the weakness of Addison—are well known, but not too well known to bear quotation:—

"Were there one whose fires
True genius kindles, and fair fame inspires;
Blessed with each talent, and each art to please,
And born to write, converse, and live with ease;
Should such a man, too fond to rule alone,
Bear, like the Turk, no brother near the throne,
View him with scornful, yet with jealous eyes,
And hate for arts that caused himself to rise;
Damn with faint praise, assent with civil leer,
And, without sneering, teach the rest to sneer;
Willing to wound, and yet afraid to strike,
Just hint a fault, and hesitate dislike;
Alike reserved to blame or to commend,
A timorous foe, and a suspicious friend;
Dreading e'en fools, by flatterers besieged,
And so obliging that he ne'er obliged;
Like Cato, give his little senate laws,
And sit attentive to his own applause;
While wits and Templars every sentence raise,
And wonder with a foolish face of praise:
Who but must laugh, if such a man there be?
Who would not weep, if Atticus were he?"

In its bright and sparkling humour, the most akin to the satires among Pope's poems is the delightful "Rape of the Lock;" indeed, in one sense, it might be called a satire. The occasion of the piece was the adventure of a young nobleman who presumed furtively to cut a lock of hair from the head of a fair lady. The incident led to an estrangement between the two families, and Pope is said to have written his poem with the benevolent intention of bringing about a reconciliation, an object in which he succeeded.

It has already been said that Pope, like all the poets of the same school, is, for one so great as he was, deficient in the power of depicting passion or moving our sympathies. The two most important poems, in which the interest is mainly founded upon the pathetic, are the "Elegy on the Death of an Unfortunate Lady," and the "Epistle of Eloisa to Abelard." The first of these is full of beauty and tenderness. But it reveals too little, discloses too little of the melancholy story to which it refers, and it is too studied and regular to appeal very strongly to the feelings of the reader. The "Epistle of Eloisa to Abelard" is of far higher power. It is founded in part upon the real letters of Eloisa to Abelard, written after long years of separation; and, like them, it is supposed to be written from the convent of which she has long been at the head. To express the tempest of passion in the hour of its violence would have been a task very uncongenial to the genius of Pope. A passion, not dead indeed, but subdued, chastened, controlled by long years of penitence and self-discipline, was a subject better suited to his powers; so that this is one of the finest of his poems.

It is generally true—in England, at least—that those poets who have touched most powerfully the chords of human passion have also been most sensitive to the influence of external nature, and the keenest observers of its beauties. The poets of Queen Anne's day, as they were deficient in power over the emotions, were no less wanting in genuine appreciation of external nature. They are at home only in the city, in the club, among men and women living in a highly artificial state of culture. And this characteristic is very apparent in Pope's country poems, such as the "Pastorals" and "Windsor Forest." No one can fail to admire them for the beauty of their diction and versification. Their ideas, too, are always appropriate. But they are unreal. They have nothing of the open air about them, none of the true breath of the green field and the wood.

There remains one great work of Pope which we cannot leave unnoticed—his translation of Homer. Of all the poet's works this was the one from which he derived incomparably the largest pecuniary profit; and it probably contributed more than any other to establish his fame. Nor is this remarkable. Pope translated the "Iliad" and one-half of the "Odyssey;" and his translation is, undoubtedly, a great poem. The actual sense of the original is throughout preserved with substantial accuracy; and the language and versification are faultless. And in Pope's day, while men's taste in poetry was what it then was, no one looked for anything more; a version which reproduced the old Greek bard more faithfully would not have been admired or appreciated. But, in truth, no great poet was ever so ill qualified to translate Homer as Pope, just as no generation of Englishmen were ever so ill qualified fairly to estimate a translation of Homer as the generation among whom Pope lived. The finish, the antithetical neatness of Pope's diction, the even monotony of his verse, with its uniform rhyming couplets, are the very opposite of Homer's characteristics. The result is that, as was said by a contemporary critic, though the poem is a great poem, "it is not Homer." In tone, spirit, and character it is wholly unlike the original.

Pope's prose satires need little comment. Some of his papers in the Scriblerus series are very humorous, but they are altogether inferior to his poetical satires.

John Gay was one of the most eminent of the minor poets in the society which surrounded Pope and Swift. Witty, genial, kindly, and affectionate, he was not only popular with the public, but singularly beloved by his friends. He received more than one fortune, but always lost them; made much money by his works, but never kept it; was a favourite with the great, but never received any public advancement; and "died unpensioned with a hundred friends," having for many years lived as a kind of favoured pensioner in the household of the Duke and Duchess of Queensberry. His most important works are a series of pastorals published under the name of "The Shepherd's Week;" his Fables; "Trivia," a burlesque or satire upon London life; and, above all, the "Beggar's Opera." This last was the most successful piece that had ever been acted. It became the rage in a moment, is said to have for some time driven Italian opera from the stage, and is by no means forgotten yet. An accomplished critic has truly said of Gay that in his ballads "there is a peculiar, hinted, pathetic sweetness and melody. It charms and melts you. It is indefinable, but it exists; and is the property of John Gay's and Oliver Goldsmith's best verse, as fragrance is of a violet, or freshness of a rose."

A very different career was that of Matthew Prior. He was of very humble origin, being the son of a vintner in Whitehall; and we find him in his after-days of prosperity and distinction often reproached with his ignoble birth. His first literary effort was "The Town and Country Mouse"—of which he wrote the greater part—a burlesque poem intended to ridicule Dryden's "Hind and the Panther." This brought him to the knowledge of influential men, and was the source of his advancement in life. He became secretary to the embassy at the Hague, and ultimately rose to the important post of British ambassador in Paris for King William III. and Queen Anne. Prior's poems are for the most part short lyrical pieces on occasional subjects. They are little read now; but they are light, easy, and graceful, showing much knowledge of men and much humour, though not without the taint of coarseness.

There are very few poets whose reputation has so clearly illustrated the fluctuations in popular taste from age to age as that of Edward Young. He was born in 1681 and died in 1765, thus surviving for some years most of those of whom we have to speak in this lesson. And indeed, except in the artificial character of his poems, he has not very much in common with the school of Pope. Young was a clergyman, though he seems to have taken orders rather in disappointment at his want of success in other employments than from any great devotion to the sacred calling. In the Church, too, he seems ever to have indulged hopes of success and advancement which were never realised. He became a soured, disappointed, and discontented man, unhappy in himself, and not very amiable or attractive to those about him. His great work—the only one which is now much remembered—is the "Night Thoughts," a series of nine meditations on subjects whose solemn character is suited to the Night, to which they are assigned. In these somewhat gloomy meditations we may well suppose that Young sought relief from his own vexation and bitterness.

There are but a few more among the poets of this age who ought not to pass wholly unnoticed, though we can do little more than mention their names. Thomas Parnell was another of Pope's literary friends and followers. He was an Irishman by birth and education, and held a living in that country. The work by which he is best known is his poetical tale of "The Hermit." Sir Samuel Garth was a physician of eminence. He is known by his poem, "The Dispensary." This poem is a fairly successful example of that easiest of all forms of literature, the burlesque. Sir Richard Blackmore was likewise a physician in extensive practice. His works are enormously voluminous; epic after epic flowed from his pen, few of which were read at the time, and none of them now. He is remembered chiefly by Pope's satiric attacks upon him in the "Dunciad." The same may be said of Ambrose Philips, a writer of pastorals and other shorter pieces. His reputation was great during his life. His very name would probably hardly be remembered now, had not Pope given him immortality.

In our opening lesson in English Literature (Vol. IV., p. 50) we gave brief but clear definitions of the eight great periods into which the literature of our country, or of "English-speaking nations," may be divided. Of these we have treated six, in due order and succession, bringing under the notice of our readers the most prominent writers in each, and the most noted of their various works. The termination of the sixth period—from 1689 to 1727—is the close of what has been termed the Augustan Age of English Literature, which boasted of the exquisite taste and fancy of Addison, the correct and polished style of Pope, the scathing satire of Swift, the sparkling wit of Arbuthnot, and the sound sense and facile language of Steele. These men, with one exception, as it has been justly observed, "corrected the indecency of the vicious school introduced at the Restoration," and as the pioneers of a better, healthier state of English letters and learning, laid the foundation of a new era of our literature, which, after smouldering through the seventh period, that closed at the end of the eighteenth century or thereabouts, warmed and brightened as years passed on, until it culminated in the brilliant roll of modern writers, of whom Scott and Byron, Hallam and Macaulay, Prescott and Motley, Thackeray and Dickens, Tennyson and Longfellow, and Ruskin and Carlyle, may be regarded as the "bright particular stars."

To do justice to the merits and writings of such men as these would occupy more space than could conveniently be given; and we are therefore forced to bring these lessons to a close with a very short sketch of each of the remaining periods—namely, that which is intermediate between the Augustan Age and the great revival of romantic literature at the end of the eighteenth century, and that which was the dawn of the revived romantic school.

LESSONS IN SPANISH.—XXIV.

THE CONJUNCTION.

CONJUNCTIONS are simple—that is, such as consist of a single word; or conjunctive phrases, such as consist of more than one word. They may be divided according to their meaning into the following classes:—

1. *Copulative*, which simply unite words or sentences together; as, y, *and;* tambien, *also.*
2. *Disjunctive*, which connect words or sentences at the same time that they disjoin the sense; as, ó, *or.*
3. *Adversative*, which express opposition of meaning while they connect; as, mas, *but;* pero, *but;* sin embargo, *notwithstanding.*
4. *Comparative*, which serve to compare words or prepositions; as, como, *as;* así, *so;* como si, *as if.*
5. *Conditional*, which express a condition; as, si, *if;* con tal que, *provided that.*
6. *Concessive*, which serve to express something granted; as, aunque, *even if;* dado que, *granted that.*
7. *Conclusive*, which express a conclusion or inference; as, de aqui, *hence;* por esto, *therefore.*
8. *Causal*, which express a cause or reason; as, porque, *because;* pues que, *since.*
9. *Temporal*, which serve to express a relation of time; as, ántes que, *before;* despues que, *after.*
10. *Final*, which express an end or purpose; as, para que, *that, in order that;* á fin de que, *to the end that.*

MANNER OF USING CERTAIN CONJUNCTIONS.

Sino, meaning *but*, is used after a negative, unless the verb be repeated; and *pero* or *mas*, also meaning *but*, is used when no negative precedes; as—

El reino de Dios no está en palabras, sino en vertud,	*The kingdom of God is not in word, but in power.*
Ella es hermosa, pero (or mas) no es prudente,	*She is beautiful, but she is not prudent.*

If after a negative the verb be repeated, *pero* or *mas* is to be used instead of *sinó;* as—

Ella no lo dijo á Juan, pero (or mas) lo dijo á Pedro,	*She did not tell it to John, but she told it to Peter.*

Sino, meaning *except*, is used after an interrogation or after a negative; and *ménos*, also meaning *except*, is used when no interrogative or negative precedes, both words being rendered in English by *but;* as—

¿Quién lo hizo sino el carpintero?	*Who did it but the carpenter?*
Ninguno hay bueno sino solo Dios,	*There is no one good but God alone.*
Vinieron todos ménos el juez,	*They all came but the judge.*

The conjunction *but* is used in English with such a variety of meanings that it is necessary, before rendering it into Spanish, to find what other word or words it really represents, as this latter word or phrase is generally that which is used to represent it in Spanish; thus—

I am distant from death but (*only*) one step,	*Un solo paso disto yo de la muerte.*
We have but (*no more than*) five loaves and two fishes,	*No tenemos mas de cinco panes y dos peces.*
He arrived but (*not till*) yesterday,	*No llegó hasta ayer.*
I cannot but (*do less than*) go,	*Yo no puedo ménos de ir.*

He has but (*done no more than*) gone (*i.e.*, he has but just gone),	*El no ha hecho mas que irse.*
But (*if it were not*) for me, he would perish,	*Si no fuese por mí, él pereceria.*
There is no one of them but (*who is not*) is a general,	*No hay ninguno de ellos que no sea general*
He went no day to the village but (*that not*) he returned drunk,	*Ningun dia fué al lugar que no volvió borracho.*

It will at once be perceived that the irregularity in the use of the word *but* is chargeable to the English, not the Spanish language. In the latter *but* is not used with ten different meanings as in English.

The conjunction *unless* is to be rendered in Spanish by *á ménos de que*, or by the word or words which it really represents; as—

He will do nothing unless you speak (*may speak*) to him,	*Nada hará, á ménos de que vmd. le hable,*
No one can do these miracles unless (*if not*) God be (*should be*) with him,	*Ninguno puede hacer estos milagros, si Dios no estuviere con él.*

The conjunction *except*, when it means the same as *unless*, is rendered in Spanish in the same manner; and when it means privation—as, for instance, in the sentence "I bought all his books except the histories"—it is rendered by ménos, *less*, *minus*.

The conjunction *whether* is to be rendered in Spanish by *si* or *que*, and sometimes by the subjunctive of the verb *ser*; as—

I doubt whether (*that*) thou hast any oil,	*Dudo que tengas aceite,*
I asked him whether (*if*) his mother would come,	*Le pregunté si su madre vendria.*
Whether he may have grapes or not is nothing to me,	*Que tenga uvas ó no, nada me importa.*
Whether it rains or whether it does not rain,	*Que llueva ó que no llueva.*
Whether or not we may be (*let us be or not*) worthy of such an honour,	*Seamos ó no dignos de tal honra.*

The conjunction *as* is rendered by *como* when used by way of comparison, by *así como* when followed by *so*, by *cuando* when it means *when*, and after *mismo* by *que*; as—

John is as* strong as a lion,	*Juan es tan fuerte como un leon,*
As modesty attracts, so dissoluteness repels,	*Así como la modéstia atrae, así huye la disolucion.*
He saw her as (when) he was going home,	*La vió cuando iba á casa.*
It is not the same to promise as to fulfil,	*No es lo mismo prometer que cumplir.*

The conjunction *neither*, followed by *nor*, is rendered in Spanish by *ni*, and *nor* also by the same word; as—

Swear not, neither by heaven, nor by the earth, nor any other oath,	*No jureis, ni por el cielo, ni por la tierra, ni por otro juramento alguno.*

At the end of a sentence, *neither*, and also *either*, if preceded by a negative, are rendered by *tampoco*; as—

She will not do it, nor he either (or neither),	*Ella no quiere hacerlo, ni él tampoco.*

The conjunction *either*, followed by *or*, is rendered in both cases by *ó*; as—

Either he is a knave or he is a fool,	*O' es pícaro ó es tonto.*

The conjunction *both*, followed by *and*, is rendered by *así* or *tanto*, and the *and* by *como*; as—

Both in time of peace and in time of war,	*Tanto en tiempo de paz, como en tiempo de guerra.*
Both John and James will be here,	*Así Juan como Diego estarán aquí.*

These examples might be rendered by *as well as*; thus, "in time of peace as well as in time of war," "John as well as James will be here."

The conjunction *lest*, when it means *for fear that*, is rendered by *no sea que*; when it means *in order that not*, by *para que no*; and when it means simply *that not*, by *que no*; as—

Thou wilt accompany him to his house directly, lest any accident may happen to him,	*Tú le acompañarás á su casa al instante, no sea que le suceda algun fracaso.*
Love not sleep, lest want may oppress thee,	*No ames el sueño, para que no te oprima la indigéncia.*

* The first *as* is here an adverb, qualifying the adjective *strong*.

We were careful lest you should awake,	*Cuidábamos de que no se despertase vmd.*

The conjunction *rather*, when used in the sense of *but*, is rendered by *ántes* or *ántes bien*; as—

I do not owe him anything; rather he owes me something,	*Yo no le debo nada, ántes bien él me debe algo.*

THE INTERJECTION.

The position of the interjection in a sentence is determined by no fixed rules, but is allowed to vary, as in English, according as harmony and propriety may require.

The interjection ete, *lo, behold*, is used with the first objective case of the personal pronouns only, being joined to them and forming one word; as—

¡ Eteme ! *behold me!*	¡ Etela ! *behold her!*
¡ Etele ! *behold him!*	¡ Etelos que vienen ! *lo they come!*

The interjection he, *see, behold*, is prefixed to the first objective case of personal pronouns, and precedes adverbs, such as aquí, *here*, allí, *there*; as—

¡ Hele aquí ! *here he is!*	¡ Helos allí ! *there they are!*
¡ Hela aquí ! *here she is!*	

More literally these exclamations might be rendered, "see him here!" "see her here!" "behold them there!"

When adjectives are employed as interjections, they are followed by the preposition *de*, if a noun or pronoun come after; for example:—

¡ Desgraciado de mi !	*Unlucky me!* (or *unfortunate that I am!*)

The interjection *ay* is followed by *de* when used before a noun or pronoun; as—

¡ Ay de mi !	*Alas for me!* (or *woe to me!*)

IDIOMATIC CONSTRUCTION.

In Spanish the words forming a sentence are usually arranged in the order in which they modify each other—first the subject, agent, or nominative, then the verb, then the object of the verb, and lastly the indirect object—to each being annexed the words specially modifying it. But the laws of construction not being so rigorous and invariable as in the English language, the subject frequently follows its verb, inversion not being confined to poetry or considered peculiar to the interrogative.

INVERSION.

Inversion is obligatory in the imperative; as, venga V. con Dios, *go with God;* venga V. acá, *come hither*. But this inversion is permissible chiefly in the following instances:—(1) At the beginning of a negative sentence; as, no me gusta la gran variedad de manjares, *a great variety of food does not please me.* (2) In sentences beginning with an adverb; as, aunque está V. durmiendo, *you are yet asleep;* ya esta muerto, *he is already dead.* (3) In the latter clause of a complex sentence; as, para ser pobre, es mucho lo que gasta, *for a poor man, he spends much.*

The article is omitted after a verb of motion, with the words *casa*, *misa*, *paseo*, and a few others; as, salgo de casa, *I come from home;* vamos á misa, *let us go to mass.*

Adjectives are generally placed after the substantive which they qualify; in some cases their meaning varies with their position; while the cardinal numbers, words expressing some inherent relation of the noun, and a few others, generally precede it.

An active verb governs its object with a preposition, if the object is a rational being; as, amar al projimo, *to love one's neighbour;* aborrecer á alguno, *to hate some one.* As an exception to this rule, certain verbs admit no preposition; as, tienen buenos amijos, *they are good friends;* comparo los hombres, *I compare men.* In all other instances the verb governs its object directly.

When there is no inversion, the adverb succeeds the verb it modifies. When denying or affirming, the adverb follows the verb; in compound tenses it follows the participle, but never the auxiliary verb; as, el niño ha estudiado siempre su leccion, *the boy has always learned his task.*

Some deviations from strict grammatical arrangement are allowable in Spanish, as conducive to beauty or energy of expression, which, however, may be better acquired from practice and observation than from any rules that may be laid down.

ACOUSTICS.—V.

MUSICAL PIPES—VIBRATION OF AIR IN TUBES—THE HUMAN VOICE—SYMPATHETIC FLAMES—THE MUSICAL SCALE—CHORDS AND DISCORDS—STRUCTURE OF THE EAR.

IN our last lesson we inquired into the manner in which cords and plates may be made to vibrate, and thus produce musical notes. There are, however, many musical instruments in which the sound is produced by the column of air contained in a tube being thrown into vibration; these are usually distinguished as wind instruments, and the organ-pipe may be taken as the type of the class.

We have already seen that by holding any tuning-fork to the mouth of a glass jar, of suitable length, the sound will be greatly increased by resonance. Now remove the tuning-fork, and, holding the tube to the lips, blow across its open mouth, a note will be produced which will be found to be exactly the same as that of the tuning-fork. The rush of the air across the open mouth causes a number of different pulses, of which the tube selects the one which is in most perfect accordance with itself, and increases its power. By taking different tubes, and blowing across them in this way, we shall find that in each case exactly the same note is produced as that uttered by a tuning-fork which resounds with the tube.

By blowing more violently we shall obtain a note considerably above that first heard, and by blowing with still greater force we shall obtain notes successively higher and higher. If the number of vibrations corresponding to the fundamental note be represented by 1, we shall find that these *overtones*, as they are called, are represented by the odd numbers 3, 5, 7, etc. If, for instance, the fundamental note requires 100 vibrations in a second, the next note above it that can be obtained from the same pipe is produced by 300 vibrations in the same time. We cannot make the pipe utter any intermediate note, as, for instance, one with 200 or 250 vibrations.

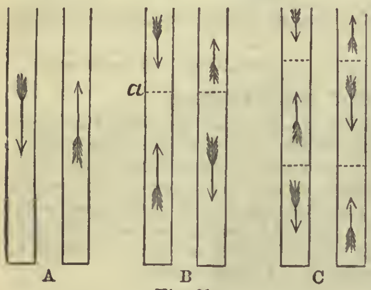


Fig. 20.

By examining the condition of the air inside the tube, we shall be able to understand the reason of this. We shall find that the bottom of the tube is always a node, while the mouth corresponds to a ventral segment.

When the fundamental note is sounded, the length of the sound-wave is just double that of the tube; the motion of the air in which is represented at A (Fig. 20), being merely a single pulse up and down.

Now, as we blow more violently, a node is formed in the tube, and since the mouth is a ventral segment and the bottom a node, the second node must clearly be one-third of the way down the tube, as shown at a. The pulses in this case will be as represented in the above figure at B. The node a may indeed be considered as a thin layer of air remaining quite motionless, while the air between it and the next node, which in the case under consideration is the bottom of the tube, pulses alternately backward and forward.

A very good proof of this statement is afforded by placing an organ-pipe on a wind-chest, and procuring a small membrane stretched over a ring of such a size as to be capable of passing up and down the tube, which, for this experiment, should have a glass side. This membrane is then suspended horizontally by strings, and lowered down the tube. It will be seen that at some parts it is thrown into rapid vibration, while in other places it will be at rest. This will be rendered more manifest by sprinkling some fine sand on it before lowering it into the tube. By watching the place at which the vibrations cease, we shall find that it is just when the membrane is at one of the nodes, thus clearly showing that there the air is at rest.

When we blow more violently across the tube, two nodes will be produced, as seen at C; and in this case it is clear that the waves produced can only be one-fifth the length of those produced when the whole pipe sounds, as at A. The number of vibrations is therefore five times as great.

Thus far we have employed pipes closed at one end. If now we take others, similar in every other respect, but open at both ends, we shall find that the notes produced are just an octave higher, that is, an open tube yields a note an octave higher than a similar closed one of the same length. The different notes produced by an open tube may be represented by the successive numbers 1, 2, 3, 4, 5, etc. In all cases the extremities are ventral segments, and the nodes are distributed evenly between them.

We have now to see the way in which pipes are employed in musical instruments. The common Pan pipe consists merely of a series of open tubes sounded by the mouth. In musical instruments, however, there is nearly always some special form given to the mouthpiece, which modulates to a greater or less extent the peculiar sound of the pipe. Fig. 21 shows the usual construction of the mouthpieces of the flageolet and of the organ-pipe. The end P of the latter is inserted in the wind-chest of the organ, whence the air issues into a cavity, i, which is frequently of larger dimensions than represented in the figure. As this issues from i, the current strikes against the upper lip b, and produces pulsations; these, by the resonance of the pipe, yield the required musical note, the pitch of which depends chiefly upon the length and size of the pipe.

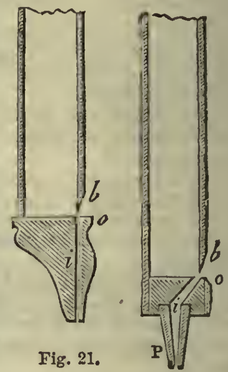


Fig. 21.

In an organ the same pipe always utters the same note, the different sounds being produced by a corresponding number of pipes. In other instruments—as, for example, the flute, trumpet, and cornet-à-piston—many notes may be produced from the same tube. This is accomplished partly by altering the position of the lips, or the intensity of the blast, and partly by altering the virtual length of the tubes by means of apertures or stops.

In the flute there are a number of openings, which are kept closed by the fingers. When any one of these is left unstopped, a ventral segment is produced in the tube at that point, and modifies the note. The vibrations in this instrument are produced by the current of air from the lips being directed over an aperture in the side of the tube.

In reed-pipes the vibrations are more or less controlled by means of a vibrating metal tongue, somewhat similar to that employed in an harmonium. A pipe of this nature, fitted with a piece of glass, so as to exhibit the reed, is shown in Fig. 22. Q is the wind-chest of the bellows, into which P is fitted. In the right-hand figure the upper part of the pipe is removed, so as to show the reed more clearly. A plate of metal, c c, has a slit cut in it, in which the tongue may just pass. When the air issues through the tube this tongue is thrown into vibration, and regulates the pulsations in the tube. By means of a curved wire, r, projecting above the top of the pipe, the play of the tongue may be controlled and the pipe tuned. The conical pipe, H, placed at the top, serves to increase the power of the sound.

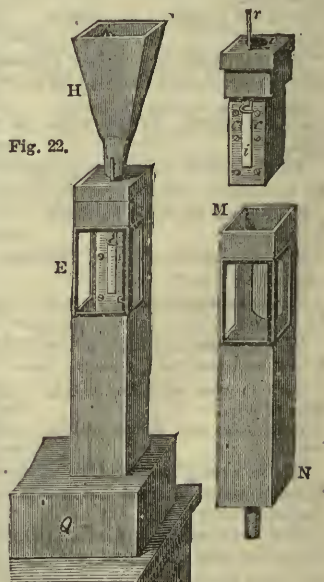


Fig. 22.

The organ of voice is, in reality, a reed instrument of the most perfect construction. It is situated at the upper end of the windpipe, which is nearly closed by certain elastic bands and membranes. When the air is forced between these they are set in vibration, and the different sounds are produced, partly by the varying tension of these vocal cords, and partly by the influence of the configuration of the mouth. The tones of different voices are apparently produced by differences in the structure of these membranes or vocal cords. By arranging an apparatus on a similar principle, various sounds of the human voice have been closely imitated.

The column of air contained in a glass tube may easily be thrown into vibration by igniting a small jet of hydrogen gas inside the tube, as shown in Fig. 23. The jet should be ignited, and several tubes of rather large diameter should be taken and held over it, moving them up or down till a clear sound is obtained. This sound is in reality caused by a series of explosions produced by the combination of the hydrogen with the air. By employing a very large metal tube, and a suitable burner, very powerful sounds may be obtained, the pitch of which varies with the length of the tube. By moving the tube up and down, it will be found that there is a certain point in it at which the jet should be, in order to produce a sound. If it be a little above or below this, the flame will burn steadily and quietly; but by sounding the note which the tube utters, or raising the pitch of the syren till it comes into unison with it, the vibration in the air will cause the tube to burst into sound. If we have a series of tubes capable of uttering different notes with the flames thus burning steadily in them, we can at once make any one sing by uttering its note, and it will usually continue to sound when it has once been started. The flame appears to be sensitive to its own note, and at once to commence to quiver when that is uttered.

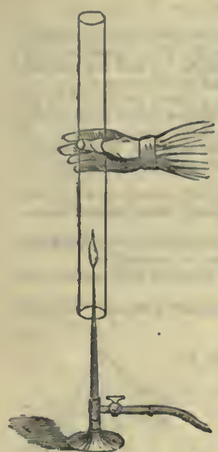


Fig. 23.

Under some conditions ordinary gas flames are found to be more or less sensitive to certain special sounds. This may occasionally be seen with an ordinary fish-tail or bat's-wing burner. The burner must be so adjusted that the flame is just on the point of roaring, and by trying a variety of sounds, some will not improbably be found which will cause the flame to alter in shape, and send forth tongue-like jets. Some burners respond to a whistle, others to the rattle of keys, while others again respond to certain musical notes.

These effects are best seen by using a small circular orifice as a jet. The flame from this may, by properly regulating the pressure, be made as much as eighteen or twenty inches high. This may be done by filling a gas-bag with hydrogen, and regulating the pressure by adjusting the weights on it. When the flame is just commencing to roar, it will be found sensitive to almost any sound. Rattling a bunch of keys at the other side of a room will cause it suddenly to shorten to about one-third of its length, bulging out laterally at the same time. It will frequently answer to every tick of a watch held near it, and by means of two concave mirrors we have made it answer in this way to a watch held at a distance of several feet.

Some burners will answer more readily to certain sounds. One which we possess will always alter in shape at the sound of an *s*, and, if a person is speaking near it, will indicate every such sound by a bow. If a musical box be played close to it, the flame will assume different shapes at almost every note. Experiments of this kind are very interesting and instructive, and can easily be tried by the student.

In musical sounds there are three distinct qualities which we have to observe; these are:—

1. The *pitch* of the note.
2. Its *intensity*.
3. Its *quality*; or, as it is technically termed, its *timbre*.

The first of these has already been explained to depend upon the number of vibrations made by the sounding body in any given time.

The intensity of the sound depends, not on the number of vibrations, but on their amplitude. The harder we strike a sounding body, or the more vigorously we pluck a string, the greater will be the extent of the vibrations produced, and therefore the greater the intensity of the sound.

The third quality of a sound—namely, its timbre—is very difficult to explain; indeed, it is as yet but imperfectly understood. If we strike any note—as, for instance, middle c—on a piano, and then sound the same note on a flute or an organ, or utter it with the voice, we shall in an instant notice a great difference between the sounds. They all utter the very same note, producing the same number of vibrations per second; perhaps all had exactly the same intensity, but yet there is a difference, which at once renders itself manifest. This is known as the timbre. The quality and shape of the sounding body, and many other points, which are only practically important to musical instrument makers, influence this greatly. Tyndall, in his admirable "Lectures on Sound," to which we are indebted for several facts, and which we recommend all our readers to study, employs the word "Clang-tint" (the equivalent of the German Klangfarbe) to represent this quality. It seems mainly to depend upon the production of various other tones, in addition to the fundamental one. These over-tones unite with and modify the vibrations produced.

If we take our monochord, and pluck the wire, first at the central division, then at a distance of one-third from one end, and again at a quarter, we shall obtain the same note each time, but a different timbre will be recognised. When the cord is struck at the centre, all over-tones which require that point as a node vanish. The cord cannot, for instance, vibrate in two segments, so as to produce the octave as well as the fundamental note, nor can it vibrate in any even number of parts, since, in any of these cases, the centre point would be a node. This may be shown by damping the cord lightly at the centre, which disturbs the fundamental note, but would not disturb the tones if they existed. If we now strike the cord at any other part, and damp the centre in the same way, the fundamental note will cease, but the octave produced by the vibrations of the two separate portions will be clearly perceived. Advantage is taken of this fact by pianoforte-makers, who make the hammer strike the wire at about one-seventh of its length from one end. Experience taught that this produced the most pleasing sound, before science discovered that, by striking at this point, those over-tones which do not form chords with the fundamental note were destroyed.

Two musical notes are said to be in unison when both produce the same number of vibrations; it is quite immaterial by what instruments they are produced. Sounds may be produced by any number of vibrations; it is found, however, that there is a series of notes arranged at certain fixed intervals which produce the most pleasing music. This series seems to depend on the natural constitution of the human ear, and is known as the Musical Scale, or Gamut.

It consists of a series of seven notes, designated in England by the letters C, D, E, F, G, A, B, and on the Continent by the names *ut* or *do*, *re*, *mi*, *fa*, *sol*, *la*, *si*. The same series is then reproduced, each note being produced by double the number of vibrations. The annexed table will show clearly the relative number of vibrations and length of string required to produce those notes. A second C is inserted to complete the octave:—

Name.	Relative Length of String.	Relative Number of Vibrations.	Actual Vibrations per Second.
C or *do.*	1	1	256
D ,, *re.*	8/9	9/8	288
E ,, *mi.*	4/5	5/4	320
F ,, *fa.*	3/4	4/3	341
G ,, *sol.*	2/3	3/2	384
A ,, *la.*	3/5	5/3	427
B ,, *si.*	8/15	15/8	480
C ,, *do.*	1/2	2	512

The first C given here is that known as middle C, and the number of vibrations for any higher or lower note can easily be found by multiplying or dividing by 2, 4, 8, etc., according to the number of octaves intervening. The length of the sound-waves, corresponding to each note, may easily be found by dividing 1,120 feet by the number of vibrations.

By comparing the fractions above given we shall find that the intervals between the notes are nearly, but not quite, uniform. There are three different intervals represented by the fractions

$\frac{9}{8}$, $\frac{10}{9}$, and $\frac{16}{15}$, and called respectively a *major tone*, a *minor tone*, and a *major semitone*. The latter is the interval between E and F, and between B and C, and is not divided, as the other intervals usually are, by the insertion of intermediate notes, known as flats and sharps.

When, instead of sounding two musical pipes which are in unison, we take two which differ very slightly in their number of vibrations—as, for example, one making 256 vibrations, while the other makes 258 or 260—we shall cease to have a uniform flow of sound. The sound-waves produced by the one alternately increase and diminish those of the other, and thus we have a series of beats which become less frequent as the notes approach more nearly to unison. These are called Tartini's beats, and may easily be noticed by sounding two adjacent notes in the bass of an organ.

By sounding different notes simultaneously, we find that some combinations produce a much more pleasing effect than others. The most pleasing result is attained when one is just an octave above the other, and consequently produces twice the number of pulsations. In this case, every other pulsation of the higher note corresponds with one of the lower, somewhat as shown at Fig. 24. This interval is called an *octave*, because in the gamut any note is the eighth above the previous one of the same name.

Next to the octave, the most pleasing chord is produced when three pulsations of the one note correspond to two of the other. This may be produced by sounding together C and G, and is known as a *fifth*. If we sound G and the C above it we shall obtain the combination known as a *fourth*, in which four vibrations of one correspond to three of the other. Both these are represented in Fig. 24.

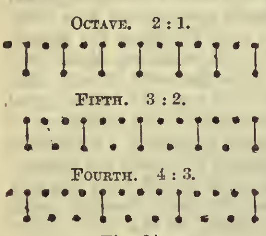


Fig. 24.

The other concords are known as the *major third*, in which the ratio is 5 : 4, and the *minor third*, in which it is 6 : 5. These may respectively be produced by striking together C and E, and E and G. When the numbers representing the ratio are high—as, for instance, 13 : 14—we get unpleasant jarring sounds or discords.

A perfect chord is produced when three notes are sounded together whose vibrations bear to one another the ratio 4 : 5 : 6. Illustrations of this may be obtained by sounding C, E, and G, or G, B, and D.

Before concluding these lessons we must just briefly notice the construction of that most wonderful and important of all acoustic instruments—the human ear.

The external ear is so shaped as to convey the pulsations of the air to a circular membrane, known as the tympanum. Behind this is a small cavity known as the drum of the ear, across which there stretches a chain of four small bones. At the further side of the drum are two apertures, also closed by membranes; through these the vibrations are conveyed to a remarkable cavity hollowed out of the bone. This cavity, which is known as the *labyrinth*, is filled with water, and the ramifications of the auditory nerve are distributed over its surface. In certain parts of it minute bristles project, and in another part we have minute crystalline particles called *otolithes*, all of which seem specially fitted to receive the faintest vibrations. A remarkable organ has further been discovered by Corti; this consists of a vast number of vibrating cords, each of which is apparently tuned to receive and render audible some special vibrations. The intimate structure of these delicate organs is, however, as yet but imperfectly understood; further investigation will doubtless serve to throw much fresh light on the whole subject; but the way in which external sensations of any kind are communicated to the brain is at present veiled in mystery.

We have purposely made the foregoing remarks on the construction of the human ear extremely short—a mere outline, in fact, of the form and disposition of the component parts of this wonderful organ—as a full description of its structure, with numerous illustrations, has already been brought under the notice of our readers in our lessons on "Animal Physiology" in Vol. I. of the POPULAR EDUCATOR.

LESSONS IN ALGEBRA.—XLIII.

WE now offer to our readers, as a useful and almost indispensable supplement to our "Lessons in Algebra," an exercise (Exercise 75) on the application of Algebra to Geometry, and two more (Exercises 76 and 77, of which the latter will be found in our next and concluding lesson) of Miscellaneous Examples for Practice.

EXERCISE 75.

1. If the hypothenuse of a right-angled triangle ABC (Fig. 10, page 350) is h feet, and the difference of the other two sides d feet, what are the lengths of AB and BC? Apply this when $d = 2$, and $h = 10$.
2. If the hypothenuse (Fig. 10, page 350) is 20 rods, and the base is to the perpendicular as 3 to 4, find their lengths.
3. Having the perimeter of a parallelogram ABCD $= 2p$, and the diagonal $= d$; to find the length (l), and the breadth (b). Apply this when $d = 15$, and $2p = 42$ (Fig. 11, page 350).

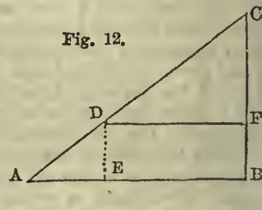


Fig. 12.

4. The area of a right-angled triangle ABC (Fig. 12) is d square feet, and the sides, DE, DF, of the inscribed parallelogram are respectively b and a feet. Find BC.
5. The perimeter of a right-angled triangle is s feet, and its area is a square feet; find the hypothenuse.
6. Having the area of a parallelogram DEFG (Fig. 14) inscribed in a given triangle ABC = c square feet, find DG.

Draw CI perpendicular to AB; by supposition DG is parallel to AB. Let CI $= a$, AB $= b$, and DG $= x$; then CH $= \frac{ax}{b}$, IH $= a - \frac{ax}{b}$, etc.

7. The three sides of a right-angled triangle ABC (Fig. 13) are as follows: AC $= 10$, BC $= 6$, and AB $= 8$; find the segments CD and DA made by a perpendicular from B on AC.

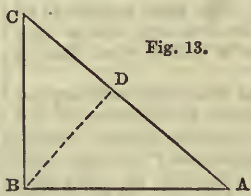


Fig. 13.

8. Through a given point (P) in the diameter AB of the circle AQBR (Fig. 15) to draw a right line so that its two parts, PR and PQ, shall have a given difference (d), if AP $= a$, and BP $= b$.
9. The height of an arch is 6 feet, and its span 20 feet; what radius was it struck with?
10. Find the side of that square whose area is $2\frac{1}{4}$ times its perimeter.
11. Find the side of that cube whose solid content and surface are expressed by the same number.
12. The area of a *right-angled* triangle is 54 square feet, and its sides are in arithmetical progression; find their lengths. Also give a general solution when the area $= a$.

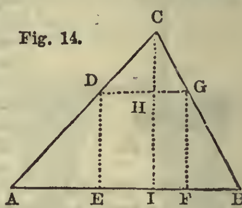


Fig. 14.

13. A rectangle contains 98 square feet, and the difference between the adjacent sides is 7 feet; find the sides.
14. The perimeter of a *right-angled isosceles* triangle is m feet; find the sides.
15. The difference between the perimeter and perpendicular of an *equilateral* triangle is m feet; find the length of one of its sides.
16. One side of a *right-angled* triangle is 15, and the excess of twice the other side above the hypothenuse is 33; find the side and hypothenuse.
17. The sides of a *right-angled* triangle are in geometrical progression—its area is m square feet; find the side which is a mean between the other two.

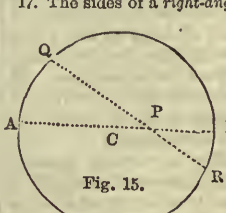


Fig. 15.

18. Given the difference between the diagonal and side of a square $= d$ feet to find its area a; apply this when $d = 9{\cdot}9411255$.
19. If a right-angled triangle has its sides in arithmetical progression, they may be found by multiplying the square root of $\frac{1}{6}$ of the area by 3, 4, and 5 respectively; required the demonstration.
20. Given the area (a) and base (b) of a triangle ABC to divide it into two equal parts by a line (FG) drawn parallel to the base (AB); find the length of FG, and its perpendicular, CE.

EXERCISE 76.—MISCELLANEOUS EXAMPLES FOR PRACTICE.

1. If $a = 8$, $b = 7$, $c = 6$, $d = 5$, and $e = 1$, prove that $(ab + ce - bd) + \left(\frac{a+b}{c-e} + \frac{3b-2c}{a-d}\right) = 3a - 2b + 4c - e$.
2. Also prove that $\sqrt{(a^2-3d)} \times \sqrt[3]{(b^3-c^3-2e)} = \left(d^2 + (a-c) - 3ce^2 + d^3\right) - \sqrt[3]{a(ab+d)}$.
3. Prove that $\frac{(a+b)-(a-b)}{2} = 1 - \left\{1 - (1 - \overline{1-b})\right\}$.
4. Prove that $\frac{(a+b)+(a-b)}{2} = -\left[-\left\{-(-a)\right\}\right]$.

5. Find the value of $\frac{a^2+b^2}{a^2-b^2} \pm \frac{a-b}{a+b}$.

6. Find the value of $\frac{2a}{a^2-b^2} + \frac{1}{a+b} - \frac{1}{a-b}$.

7. Find the value of $\frac{1}{(a-b).(c-c).(x+a)} - \frac{1}{(a-b).(b-c).(x+b)} + \frac{1}{(a-c).(b-c).(x+c)}$.

8. Find the value of $\frac{1}{4a^3(a+x)} + \frac{1}{4a^3(a-x)} + \frac{1}{2a^2(a^2+x^2)}$.

9. Divide $1+2x$ by $1-x-x^2$.

10. Simplify the following fraction : $\dfrac{\frac{a}{ab}+\frac{b}{a+b}}{\frac{a}{a-b}+\frac{b}{a+b}}$.

11. Find the value of $\frac{1-3x-2x^2}{1-4x}$.

12. Add $\frac{2}{2x+1}$, $\frac{3}{3x-2}$, and $\frac{-8}{4x+3}$ together.

13. Divide $\frac{a}{a-b}+\frac{b}{a+b}$ by $\frac{a}{a-b}-\frac{b}{a+b}$.

14. Extract the square root of $x^2+\frac{1}{x^2}+2\left(x-\frac{1}{x}\right)-1$.

15. Extract the square root of $x^2-xy+2x+\frac{1}{4}y^2-y+1$.

16. Extract the cube root of $8\frac{a^3}{b^3}+36\frac{a}{b}+54\frac{b}{a}+27\frac{b^3}{a^3}$.

17. Find the cube root of $125a^3-300a^2b+240ab^2-64b^3$.

18. Simplify $\sqrt[4]{32x}+\sqrt[4]{162x}-\sqrt[4]{512x}$.

19. Simplify $\sqrt{(a^2b-6ab+9b)}+\sqrt{9b}$.

20. Simplify $\sqrt{a^3-\sqrt{(a^6-x^6)}}\times\sqrt{a^3+\sqrt{(a^6-x^6)}}$.

21. Find the continued product of $(a+b)^{\frac{1}{m}}$, $(a-b)^{\frac{1}{n}}$, $(a+b)^{\frac{1}{n}}$, and $(a-b)^{\frac{1}{m}}$.

22. Multiply $x+2y^{\frac{1}{2}}+3z^{\frac{1}{3}}$ by $x-2y^{\frac{1}{2}}+3z^{\frac{1}{3}}$.

23. Simplify $\frac{x+\sqrt[3]{(xy^2)}-\sqrt[3]{(x^2y)}}{x+y}$.

24. Simplify the following fraction : $\sqrt{\left\{\left(\frac{a^{-3m}}{b^{-3n}}\right)^{\frac{p}{m}}\right\}^{\frac{q}{n}}}$.

25. Add together the fractions

$$\frac{\sqrt{(x^2+1)}+\sqrt{(x^2-1)}}{\sqrt{(x^2+1)}-\sqrt{(x^2-1)}} \text{ and } \frac{\sqrt{(x^2+1)}-\sqrt{(x^2-1)}}{\sqrt{(x^2+1)}+\sqrt{(x^2-1)}}.$$

26. Find the greatest common measure, and then reduce to its lowest terms $\frac{4x^2-12ax+9a^2}{8x^3-27a^3}$.

27. Reduce to its lowest terms the fractions

$$\frac{a^4+a^3b+ab^3+b^4}{a^4+3a^3b+4a^2b^2+3ab^3+b^4} \text{ and } \frac{a^4+a^3b+ab^3+b^4}{a^4-3a^3b+4a^2b^2-3ab^3+b^4}.$$

28. Prove that $\frac{1}{x(x-y)(x-z)}+\frac{1}{y(y-x)(y-z)}+\frac{1}{z(z-x).(z-y)}=\frac{1}{xyz}$.

29. Prove that $\frac{a^2+a+1}{(a-b).(a-c)}+\frac{b^2+b+1}{(b-a).(b-c)}+\frac{c^2+c+1}{(c-a).(c-b)}=1$.

30. Which is greater, n^3+1, or $n+n^2$? and which is greater, $x^{\frac{3}{2}}-1$, or $(x-1)^{\frac{3}{2}}$.

31. If $240m=(12p+q)n$, show that $£\frac{m}{n}=ps+qd$, and take the case when $m=2$, and $n=3$; $p=13$, and $q=4$.

32. Multiply $2a+3b\sqrt{-1}$ by $3a-2b\sqrt{-1}$.

33. Show that $\frac{a+b\sqrt{-1}}{a-b\sqrt{-1}}=\frac{a^2+2ab\sqrt{-1}-b^2}{a^2+b^2}$.

34. Prove that $\frac{c^2(a+b)^2+c^2(a-b)^2}{2c^2}=(a+b\sqrt{-1})\times(a-b\sqrt{1})$.

35. Find the sum and difference of $\sqrt{(x^3+2x^2y+xy^2)}$ and $\sqrt{(x^3-2x^2y+xy^2)}$.

36. Reduce a, $a^{\frac{1}{2}}$, $a^{\frac{1}{3}}$, and $a^{\frac{1}{4}}$ to equivalent quantities having the same index; also $x^{\frac{2}{3}}$, $y^{\frac{3}{4}}$, and $z^{\frac{5}{6}}$.

37. Divide $\frac{a-\sqrt{(a^2-b^2)}}{\sqrt{(a^2+b^2)}+b}$ by $\frac{\sqrt{(a^2+b^2)}-b}{a+\sqrt{(a^2-b^2)}}$, and $x^{\frac{1}{2}}-a^{\frac{1}{2}}$ by $x^{\frac{1}{6}}-a^{\frac{1}{6}}$.

38. Multiply $\sqrt{(x+2)}+1$ by $\sqrt{(x+2)}-1$.

39. Divide $4x^{\frac{8}{3}}+14x-9x^{\frac{7}{3}}-19x^{\frac{4}{3}}+4x^{\frac{1}{3}}$ by $x^{\frac{4}{3}}-2x^{\frac{2}{3}}+3x^{\frac{1}{3}}-4$.

40. Prove that $x^7-x^6-x^5+x^4-x^3+x^2+x-1=(x^4-1).(x^3-x^2-x+1)=(x^2+1).(x+1)^2.(x-1)^2$.

41. Find a fraction which, taken $\frac{a^m}{a^n}-11y^3$ times, shall produce $11y^3+z^3$.

42. What fraction multiplied by $\frac{3}{4}x^2$ will produce x^{-m}?

43. Find the product of $\frac{x^my^n}{c^2}$ by $\frac{x^ny^m}{c^3}$, and show the result in one line.

44. Find by the binomial theorem the 8th power of $1-x^{\frac{1}{2}m}$.

45. Express in a *general form* the 11th term in the mth power of the binomial $x+y$.

46. Find the 4th root of a^8b^4x, and the 5th root of $-32xy^5z^n$.

47. Find the nth root of $-\frac{x^{3n}y^{mn}}{v^{2n}z^{\frac{1}{2}n}}$ where n is an odd number.

48. Find the cube root of $x^6+9x^5+6x^4-99x^3-42x^2+441x-343$.

49. Express $-2x^3$ in the form of the 5th root, and $3x^{nm}$ in the form of the $\frac{1}{3}$th power.

50. Prove that

$$\left(a^{-\frac{m}{n}}\right)^{-\frac{p}{q}}=\sqrt[nq]{a^{mp}};\quad \left[\left(a^{\frac{1}{3}}\right)^{\frac{1}{5}}\right]^{-\frac{1}{2}}=\sqrt[30]{\frac{1}{a}};\ \text{and}\ \sqrt[4]{\left(\frac{a\sqrt{b}}{\sqrt[3]{ab}}\right)^3}=\sqrt[8]{a^4b}$$

51. Find the value of $\left(\frac{2ac}{b^3}+\frac{1}{2}bc^2d\right)^8$.

52. Find the two middle terms of $(a-b)^{17}$ by the binomial theorem.

53. Find the 9th term of $(2ab-cd)^{14}$.

54. Find the 4th term of $(a-b)^{100}$.

55. Given $\sqrt{d}-\sqrt{x}=\sqrt{dx}$, to find x.

56. Given $17x^2-21=x^2+23$, to find x.

57. Find the value of x in the following equation : $\frac{2}{7}x^{\frac{1}{2}}-7=-5$.

58. Given $\sqrt[6]{2\sqrt[3]{x^5-7}}=\sqrt{2}$, to find x.

59. Given $\sqrt[5]{7x^{\frac{1}{3}}-4}=-2$, to find x.

60. Given $2a^2(a^2+x^2)^{-\frac{1}{2}}=x+\sqrt{a^2+x^2}$, to find x.

61. Given $\sqrt[3]{x^2-2}:\sqrt[3]{x^4+x}::\sqrt[3]{x}:x$, to find x.

62. Given $2\sqrt{x}+\frac{1}{2}y-13=\sqrt{x}-\frac{1}{2}y+9$, and $9\sqrt{x}+\frac{2}{3}y-10=\frac{1}{3}\sqrt{x}+\frac{1}{3}y+72$, to find x and y.

63. Given $7\sqrt{x}-2\sqrt{y}=\sqrt{y}+15$, and $4\sqrt{x}-\sqrt{y}=\sqrt{x}+7$, to find x and y.

64. Given $\frac{1}{2}x-\frac{1}{3}y=3$, and $\frac{1}{3}x+\frac{1}{3}y=14$, to find x and y.

65. Given $(x+4).(y-2)=xy$, and $(x-3).(y+5)=xy$, to find x and y.

66. Given $\sqrt{x-2}+5\sqrt[3]{y+3}=23$, and $\frac{1}{2}\sqrt{x-2}-3\sqrt[3]{y+3}=-3\frac{1}{2}$, to find x and y.

67. Given $2x^2+3y^2=d$, and $x:y::2a:c$, to find x and y.

68. Given $xy=20$, and $x^2+y^2=41$, to find x and y.

69. Given $x+y=25{\cdot}5$, and $xy=57{\cdot}5$, to find x and y.

70. Given $x-y=2$, and $x^3-y^3=98$, to find x and y.

71. Given $x+y=18$, and $x^3+y^3=170$, to find x and y.

72. Given $x+y=34$, and $x^3+y^3=27064$, to find x and y.

73. Given $x-y=7$, and $\frac{x^2}{y}-\frac{y^2}{x}=32\frac{1}{3}\frac{3}{0}$, to find x and y.

74. Given $6x^2-17xy+12y^2=28$, and $2x-3y=4$, to find x and y. (N.B. Divide the first equation by the second.)

75. Given $x+y=7$, and $x^2-y^2=21$, to find x and y.

76. Given $x+y-z=17$, $2x-2y+z=9$, and $3x-4y-z=4$, to find x, y, and z.

77. Given $x+y+z=117$, $x-y-z=63$, and $x-y+z=105$, to find x, y, and z.

78. Given $10x-\frac{1}{2}y+\frac{1}{3}z=50$, $4x+2y-\frac{1}{2}z=22\frac{1}{2}$, and $3x-3y-3z=0$, to find x, y, and z.

79. Given $xy=40$, $xz=10$, and $yz=16$, to find x, y, and z.

80. Given $x^2y^2=144$, $x^2z^2=225$, and $y^2z^2=400$, to find x, y, and z.

81. Given $3x-2y+\frac{1}{2}z+w=3$, $x+\frac{1}{2}y+z-\frac{1}{4}w=4$, $2x-4y+\frac{1}{3}{}^{3}z+2w=5$, and $\frac{1}{2}x+\frac{2}{3}y+\frac{1}{4}z-3w=6$, to find w, x, y, and z.

82. Given $x+y-z-v+w=0$, $2x-3y-z+5v-6w=33$, $3x+7y+3z-4v+5w=62$, $\frac{1}{2}x-\frac{1}{3}y+\frac{1}{4}z-\frac{1}{5}v-\frac{1}{6}w=4$, and $4x-4y-4z+10v-8w=92$, to find v, w, x, y, and z.

83. Given $x^2+x+2y^2=24$, and $2x^2-y^2=1$, to find x and y.

84. Given $x\sqrt{5+x^2}=x^3$, to find x.

85. Given $2x^6-4x^3+3=99$, to find x.

86. Resolve 8 into two factors, whereof the sum of the 5th powers may be 1056.

87. Given $x^2+xy+y^2=52$, and $x^2-xy=-8$, to find x and y.

88. Given $x(x+z)=104$, and $3(x-z)z=45$, to find x and z.

89. Given $x^2+z^2=x^3-z^3$, and $x^2-z^2=xz$, to find x and y.

90. Given $x^4-x^2y^2+x^3y-xy^3=405$, and $x^2+xy=45$, to find x and y. (N.B. Divide the former by the latter.)

91. Given $x+y=10$, and $x^4+y^4=1552$, to find x and y.

92. Given $x+y=7$, and $x^5+y^5=3157$, to find x and y.

93. Given $x-y=4$, and $x^4-y^4=2320$, to find x and y.

94. Given $x-y=2$, and $\frac{x^4}{y}-\frac{y^4}{x}=124$, to find x and y.

95. Given $x+y=11$, and $\frac{x^4}{y}+\frac{y^4}{x}=779\frac{1}{3}\frac{7}{0}$, to find x and y.

96. Given $x-y=2$, and $\frac{x}{y}-\frac{y}{x}=1\frac{1}{15}$, to find x and y.

97. Given $x+y=5$, and $xy=6$, to find x^7+y^7 without finding x and y.

98. Given $x-y=11$, and $xy=26$, to find x^3-y^3 without finding x and y.

99. Given $x^4-2x^3+x=132$, to find x by quadratics.

100. Given $x^6-2x^4+x^2=359400$, to find x by quadratics.

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XLI.

Exercise 73.

1. $a + 2$.
2. $a + b$.
3. $a - 2b$.
4. $2a - 3b + 4h$.
5. $1 - 2b + y$.
6. $a^3 - a^2 + a$.
7. $a^2 + 2b - 2$.
8. $x^3 - 2x + 1$.
9. $x^2 - 2x + 1$.
10. $2x^2 - x + 3$.
11. $2a - 3x$.
12. $x + 1$.
13. $a - b$.

Exercise 74.

1. 3 solutions. $x = 7, 4, 1$; $y = 1, 2, 3$; $z = 1, 2, 3$.
2. 1 solution. $x = 1$, $y = 2$, $z = 3$.
3. 1 solution. $x = 3$, $y = 2$, $z = 1$, and $m = 4$.
4. 10 solutions. $x = 1, 1, 1$, etc.; $y = 1, 2, 3$, etc., to 8; $z = 24, 21, 18$, etc., to 3; $n = 37, 38, 39$, etc., to 44; $x = 4, 4$; $y = 1, 2$; $z = 5, 2$; $n = 45, 46$.
5. 1 solution. 19 at £5, 1 at £1, 80 at 1s.
6. 301.
7. 7 solutions. Retired: $1m$ to 6, $2m$ to 7, $3m$ to 8, etc. Got up: $6m$ to 1, $7m$ to 2, $8m$ to 3, etc.
8. £6 13s.
9. $x = 39$.
10. 2 solutions. 1031 and 510, 299 and 1292.
11. $\frac{4}{7}$ and $\frac{2}{11}$.
12. 10 solutions. $x = 1, 3, 4, 6, 9, 13, 19, 27, 34$ and 69; $y = 69, 34, 27, 19, 13, 9, 6, 4, 3, 1$.
13. 6, 11, and 13.
14. 780 and 4110, 2778 and 2112, 4776 and 114.
15. 2 cwts. 5 lbs., or 5 bshs. 34 lbs.
16. 255 or 65535.

THE UNIVERSITIES.—XVI.

THE VICTORIA UNIVERSITY, MANCHESTER.

Though the Victoria University, Manchester, received its royal charter so recently as the 20th of April, 1880, it offers a curriculum of study in the faculties of Arts, Science, Medicine, and Law which will compare favourably with that of any of the older universities. At present Owens College—long recognised as one of the most distinguished educational institutions in England—and University College, Liverpool, are the only colleges of the university; but in course of time there is no doubt that colleges at other large and influential centres will also be admitted. Universities, in this country at all events, possess characteristics more or less distinctive, and in this respect Victoria University forms no exception to the rule. For example, it differs from London and from Dublin Universities in *insisting upon residence in all cases*, with this important proviso, that residence means attendance upon certain prescribed courses of lectures at a "college of the university" for a definite period, and does not imply the supervision, or living altogether *in statu pupillari*, which is essential at Oxford, Cambridge, and elsewhere. The system thus briefly sketched closely resembles, it will be seen, that in vogue in the Scottish universities. The condition as to residence will grow much more elastic in the future, when the number of federate colleges shall have increased. In fact, a person resident in any town or city possessing a "College of the University" will then be able to prepare for his degree while beginning a profession or business. This possibility—the importance of which it is difficult to over-estimate, and which, moreover, must open up a path to university degrees (subject, of course, to the condition as to attendance upon lectures above noted) to many a student of the Popular Educator—accentuates still more the difference between the youngest and the older English universities. Other points of interest may be mentioned before passing on to more matter-of-fact particulars. As regards subjects, considerable latitude of choice is allowed not only to those preparing for the Honours Degree, but also to those aiming at an Ordinary Degree, so that, while a certain amount of general training is necessary, they are not, beyond reasonable limits, compelled to take up uncongenial subjects. Then, again, the question of the "lady graduate" has been met in the most successful manner. At other of our seats of learning this has proved a veritable *quæstio vexata*, but Victoria University, under the provisions of its charter, has the power to confer degrees upon all persons, "male or female," who have pursued a regular course of study in any of its colleges and have passed the examinations. It may be added, that a perusal of the university lists will show that advantage has been taken of this right.

We will now proceed to supply information respecting the principal statutes and regulations regarding degrees, examinations, and courses of study. It should, however, be borne in mind, that the latest particulars will always be found in the Calendar of the current session. The Registrar will also, no doubt, be glad to give further information upon any specific point that may be submitted to him.

DEGREES.

Victoria University grants the following degrees in the faculties of Arts, Science, Law, and Medicine, namely:—B.A. and B.Sc.; M.A. and M.Sc.; D.Lit., D.Phil., and D.Sc.; LL.B.; M.B., M.D., &c. The degree of B.A. or B.Sc. is either an *ordinary* or *pass* Degree (implying a moderate proficiency in *several* subjects in arts or in science), or a Degree with Honours (implying a much greater proficiency in *one* subject). There is no corresponding distinction in the case of the degree of LL.B. or of M.B.

MATRICULATION

consists in placing the name of a student upon the register of scholars of the university. This, then, is the first formal step to be taken by a person who contemplates graduation, but before he can matriculate he will be required to produce a certificate of his admission as a member of some college of the university (that is, at present, of Owens College, Manchester, or of University College, Liverpool). Matriculation takes place at stated times, in the Michaelmas term, or in June, and the fee is £2.

THE ORDINARY DEGREE OF B.A. OR B.SC.

Candidates for an ordinary degree are required to pass *three* university examinations, namely, the *preliminary*, the *intermediate*, and the *final*. Between matriculation and graduation the course of study extends over at least three years, with the exception to be noted presently. The first year's course leads up to the preliminary examination; the second year's to the intermediate; and the third year's to the final. Before presenting himself at these examinations, the candidate must furnish (with the exception about to be mentioned) certificates from the college authorities of having attended courses of instruction in the subjects of the respective examinations. Moreover, students must present themselves at the preliminary *not later than two years from the date of matriculation.* These examinations are held in June and October. At the latter, only such students as failed in the examination of the previous June may present themselves; except that students who have newly matriculated and (with the permission of the General Board of Studies, which comprises the examiners of the university for the time being) candidates for an honours degree may be admitted to the October preliminary. The exception already twice alluded to will be found in the following regulation:—Candidates may offer themselves for the preliminary examination at the time of matriculation (either in June or October), in which case no certificates of attendance on college courses of instruction are required; such candidates, if they pass,* *and are placed in the first division*, are allowed to graduate after two years' study from the date of matriculation, presenting themselves for the intermediate at the end of their first year, and for the final at the end of their second. A student of Owens College who contemplates graduation in the university, is not obliged to matriculate at the time of entering the classes of the college; but should he wish to count a given year in the college as one of the three years required by the university, he must matriculate at the beginning of that year.

Preliminary Examination.†—Candidates are required to satisfy the examiners in:—1. English Language and English History (including Geography); 2. Elementary Mathematics (including Euclid I.–III. and VI., propositions i.–xix. and xxiii. or the subjects thereof, and elementary Algebra); 3, 4, 5. *Three* of the following: (i.) Greek (including translation of prepared books, and translation of easy sentences from English to Greek). (ii.) Latin (including translation of prepared books, translation of easy passage at sight, and translation of easy sentences from English to Greek). (iii.) French (including translation of a prepared book, translation at sight, and translation of easy passages from English to French). (iv.) German (as in French). (v.) Elementary Mechanics. (vi.) Elementary Chemistry.

If, however, candidates take *neither* Greek *nor* Latin, the

* A privilege of a somewhat similar character prevails in the Scottish universities.

† Accepted by the General Medical Council and by the Incorporated Law Society, provided that Latin be one of the subjects taken up, in lieu of their preliminary examinations. It is also accepted, in lieu of the preliminary or entrance examination, by the Council of Legal Education and the Society of Chartered Accountants.

*

requirements in Mathematics will be increased by Trigonometry up to solution of triangles, *or* by practical plane Geometry (straight line and circle), and the requirements in French and in German by an additional prepared book.

If candidates take only *one* ancient language, then the requirements in *one* modern language will be increased as above.

If candidates take *both* Mechanics and Chemistry, the requirements in Mathematics will be increased as above.

Candidates must also send to the Registrar (either directly, or through the authorities of the College to which they belong), *at least* two months before the commencement of each examination, a list of the subjects in which they intend to offer themselves.

Intermediate and Final Examinations for the Ordinary B.A.—These are held in June and October, and are open only to those students who have passed in the one case the preliminary, and in the other the intermediate, and who, moreover, have furnished certificates of attendance upon a college course of instruction, approved by the university, extending over at least one academic year from the date at which they passed the preliminary or intermediate examination (as the case may be) in each of the subjects of the group in which they present themselves. The courses of instruction and the corresponding examinations are arranged in the five following groups, of which the candidate must select some *one*, in *all* the subjects of which he will be required to satisfy the examiner. The intermediate examination is in the subjects the courses on which are dropped at the end of the intermediate year; the final is in those studied during the final year.

Candidates have the option of presenting certain of these subjects at either the intermediate or final examination, the corresponding course being taken in either the intermediate examination in either case. Those who fail *only* in such a subject at the intermediate examination will not be held to have failed in the whole examination, but will have to satisfy the examiners in a corresponding paper in the final examination. The names of these subjects are printed in italics.

[The subject which appears after the letter denoting the Group is the leading and characteristic subject of the Group. For this and its cognate subjects a two years' course of study is required.]

A (CLASSICS).

Intermediate Examination.	*Intermediate Course.*
1. Pure Mathematics.	Pure Mathematics.
2. English Language.	English Language.
3. *English Literature.*	*English Literature.*
4. Logic.	Logic.
	Greek.
	Latin.
	Ancient History.
Final Examination.	*Final Course.*
1. Greek.	Greek.
2. Latin.	Latin.
3. Ancient History.	Ancient History.
4. Philosophy.	Philosophy.

B (HISTORY).

Intermediate Examination.	*Intermediate Course.*
1. English Language (history of).	English Language (history of).
2. Pure Mathematics.	Pure Mathematics.
	Two of the following, *one* of which *must* be either Greek or Latin, viz. :—Greek, Latin, French, German.
	Ancient History.
	Modern History.
	English Literature.
Final Examination.	*Final Course.*
1, 2. *Two* of the following,* *one* of which *must* be either Greek or Latin :—Greek, Latin, French, German.	Two of the following, * *one* of which *must* be either Greek or Latin :—Greek, Latin, French, German.
3. Ancient History.	Ancient History.
4. Modern History.	Modern History.
5. English Literature.	English Literature.
6. Political Economy.	Political Economy.

* An attendance of two years is required in any of these subjects.

C (ENGLISH).

Intermediate Examination.	*Intermediate Course.*
1. English Language (history of).	English Language (history of).
2. Greek *or* Latin.	Greek *or* Latin.
3. Pure Mathematics,	Pure Mathematics.
	English Language.
	English Literature.
	German.
Final Examination.	*Final Course.*
1. English Language.	English Language.
2. English Literature.	English Literature.
3. German.	German.
4. *French.*	*French.*
5. *Modern History.*	*Modern History.*

D (MODERN LANGUAGES).

Intermediate Examination.	*Intermediate Course.*
1. English Language (history of).	English Language (history of).
2. Pure Mathematics.	Pure Mathematics.
	English Literature.
	Greek *or* Latin.
	French.
	German *or* Italian.
Final Examination.	*Final Course.*
1. Greek *or* Latin.	Greek *or* Latin.
2. French Language and Literature.	French.
3. German *or* Italian Language and Literature.	German or Italian.
4. English Literature.	English Literature.
5. *Modern History.*	*Modern History.*

E (PHILOSOPHY).

Intermediate Examination.	*Intermediate Course.*
1. Latin.	Latin.
2. Logic.	Logic.
3. English Literature.	English Literature.
4. Pure Mathematics.	Pure Mathematics.
	Greek.
Final Examination.	*Final Course.*
1. Philosophy.	Philosophy.
2. History of Philosophy.	History of Philosophy.
3. Greek.	Greek.
4. *One* of the following :—*French, German, Ancient History, Modern History.*	One of the following :—*French, German, Ancient History, Modern History.*

Intermediate and Final Examinations for the Ordinary B.Sc.—Candidates are required to present themselves for the intermediate and for the final examinations in each of the subjects in one of the following groups. The courses correspond in subjects to the examinations in both the intermediate and the final years.

A (MATHEMATICS).

Intermediate Examination.—1. Pure Mathematics; 2. Applied Mathematics; 3, 4. *Two* of the following :—(*a*) Logic, (*b*) Chemistry, (*c*) Elementary Biology, (*d*) Physiography; 5. *One* of the following :—Greek, Latin, French, German, English Language (history of), and English Literature. *Final Examination.*—1. Pure Mathematics; 2. Applied Mathematics; 3. Physics (intermediate standard); 4. *One* of the following :—(*a*) † Elementary Biology, (*b*) † Chemistry (intermediate standard), (*c*) † Logic, (*d*) Philosophy, (*e*) ‡ *One* of the following :—Greek, Latin, French, German, English Language (history of), and English Literature.

B (ENGINEERING).

Intermediate Examination.	*Intermediate Course.*
1. Pure Mathematics.	1. Engineering; lectures and drawing class.
2. *One* of the following :—Physics, Geology, Chemistry.	2. Pure Mathematics.
3. French or German.	3. *One* of the following :—Physics, Geology, Chemistry.
	4. French or German.
Final Examination.	*Final Course.*
1. Engineering with Drawing.	1. Engineering; lectures and drawing class.
2. Applied Mathematics (intermediate standard).	2. Applied Mathematics.
3. Engineering Laboratory *or one* of the following :—Pure Mathematics, † Physics, † Geology, † Chemistry.	3. Engineering Laboratory *or one* of the following :—Pure Mathematics, † Physics, † Geology, † Chemistry.

† Provided the candidate has not presented this subject at his Intermediate Examination.

‡ The standard in these subjects will be that of the Intermediate Examination, unless the subject has been already presented at that Examination, when the standard will be that of the Final Examination.

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C (EXPERIMENTAL SCIENCE).

Intermediate Examination.—1. Pure Mathematics; 2. Physics; 3. Chemistry; 4. *One* of the following:—(*a*) Elementary Biology, (*b*) Logic, (*c*) Physiography; 5. *One* of the following:—Greek, Latin, French, German, English Language (history of), and English Literature. *Final Examination.*—1. Physics, with practical work; 2. Analytical Chemistry; 3. Applied Mathematics (intermediate standard), *or* Organic Chemistry; 4. *One* of the following:—Chemical Philosophy, Geology, * Elementary Biology.

D (BIOLOGY).

Intermediate Examination.—1. Physics; 2. Chemistry; 3. Elementary Biology; 4. *One* of the following:—(*a*) Pure Mathematics, (*b*) Logic, (*c*) Physiography; 5. *One* of the following:—Greek, Latin, French, German, English Language (history of), and English Literature. *Final Examination.*—Any *three* of the following:—Division I.: 1. Botany; 2. Zoology; 3. Physiology. Division II.: 4. Geology; 5. Chemistry, with practical work; 6. Physics, with practical work; 7. Philosophy.*

E (GEOLOGY).

Intermediate Examination.—1. Pure Mathematics; 2. Chemistry; 3. Physiography; 4. Elementary Biology; 5. *One* of the following:—Greek, Latin, French, German, English Language (history of), and English Literature. *Final Examination.*—1. Geology, with practical work; 2. Applied Geology *or* Elementary Mineralogy; 3. Chemistry, with practical work; 4. Physics, with practical work.

It is impossible, within the space at our disposal, to enter into the examinations for other degrees with the same minuteness as we have considered those for the ordinary B.A. and B.Sc.; for it is clear that the latter must possess most interest for the great majority of our readers. Those who aspire to higher honours will not object to consult the Calendar for the regulations and papers affecting the examinations in which they are more particularly concerned. A few general remarks, therefore, must here suffice respecting the

DEGREE OF B.A. OR B.SC. WITH HONOURS.

The degree of B.A. with honours is given in any one of the four following schools:—Classics; History; English Language; Philosophy. That of B.Sc. with honours is given in any one of these seven schools:—Mathematics; Engineering; Physics; Chemistry; Zoology; Physiology; Geology, Mineralogy, and Palæontology. Candidates are required, without exception, to have passed three years in a college of the university in attendance on certain prescribed courses of study in the honours schools selected. They must pass two examinations—the preliminary and the final examinations—for the degree. They need not pass the preliminary before entering on the three years' course of instruction in the honours subjects; but they must have passed it at least six months before offering themselves for the degree examination. They are not, however, required to present certificates of attendance on the course of instruction leading to the preliminary. Further, they must go up for their final examination at the end of the third year from the time when they entered on the course of instruction in their honours school. Candidates failing to obtain honours are permitted, under certain regulations, to present themselves for examination for an ordinary degree; and candidates may pass from an ordinary degree to one with honours.

OTHER DEGREES.

The degrees of M.A. and M.Sc. are conferred, on payment of the proper fees, upon Registered Bachelors of Arts and of Science when of three years' standing from their graduation as bachelors, and after the lapse of not less than six academic years from their matriculation. Bachelors of Arts or Science with honours will pass to the higher degree without further examination, but those who took the ordinary degree will be required to satisfy the examiners in such portions of the examination in some honours school of the university as the General Board of Studies may from time to time approve.

The degrees of D.Lit., D.Phil., and D.Sc. are conferred upon registered Masters of Art or of Science of the university who shall be deemed by the Council, on report from the General Board of Studies, to have distinguished themselves by special research or learning; but the board reserves to itself the right to require candidates to pass such an examination as it may from time to time determine.

Degrees and distinctions in the faculties of Law and of Medicine are also conferred by Victoria University, but the regulations, courses of study, and examinations for these are too important to be cursorily summarised, and reference must, therefore, be made to the Calendar or to the Registrar.

* Provided that *two* of the three subjects be selected from Division I.

It is worth while noting that the Council has power to permit members of any university of the United Kingdom, in which residence is required as a condition of graduation, after matriculation at Victoria University, to reckon the periods of residence at such other university as equivalent to periods of residence at Victoria University. Undergraduates so admitted will be allowed to count examinations passed by them at such other university as equivalent to such portions of the preliminary and intermediate examinations of Victoria University as the Council may from time to time determine.

FEES.

The following tables show the ordinary university and college fees, but special fees are payable on the conferring of higher degrees than those mentioned in the table:—

A.—UNIVERSITY FEES.	£	s.	d.
For matriculation (including preliminary examination) .	2	0	0
For the intermediate examination (ordinary degree) . .	1	0	0
For the final examination for B.A. or B.Sc. (ordinary degree)	1	0	0
For the final examination for B.A. or B.Sc. (degree with honours)	2	0	0
On the conferring of the degree of B.A. or B.Sc. . . .	5	0	0

B.—COLLEGE FEES.

These vary according to the Group presented by the Candidate, and may also differ slightly in different Colleges of the University. Exact figures, can, however, be obtained by reference to the *Registrar of the College in question*; the following must be regarded as roughly approximate only.

First Year:—Preliminary examination course, about £18.
Second Year:—Intermediate course for B.A., from about £19 to £22, according to the Group.
Third Year:—Final course for B.A., from about £14 to £28, according to the Group.

The fees for the courses for B.Sc. degree vary between much wider limits; the average fee for the intermediate course may be put at about £21, and for the final course at about £20.

In addition a small fee is charged for registration as a student, and for the use of the Library.

SCHOLARSHIPS AND PRIZES.

The youth of the university has not yet permitted a large accretion of scholarships and prizes, but, no doubt, in course of time benefactors will be found eager to increase the usefulness of the Victoria University in this respect.

The *Derby Scholarship*, founded in 1880 by the Earl of Derby for the encouragement of the study of mathematics, is of the value of about £40 a year for two years, and is awarded annually on the results of the examination for the degree of B.Sc. with honours in the School of Mathematics.

The *Mercer Scholarship*, of the annual value of about £30, founded by the late Mr. R. C. Mercer, of Accrington, for the encouragement of the study of chemistry, is tenable for one year, and is awarded on the results of the examination for the B.Sc. with honours in the School of Chemistry.

A *Cobden Prize* of £60 is offered by the Cobden Club in every third year for the best essay on some subjects in Political Economy. It is open to members of the university of not more than three years' standing from the date of their first degree.

A *Thomasson Prize* of £20 is offered by Mr. Thomasson, of Bolton, annually, for a period of years, for the best English Essay on some subject fixed yearly by the Adjudicators.

CERTIFICATES OF PROFICIENCY.

*General Regulations for Certificate Examinations for Registered Teaching Institutions.**

THE University certificate is awarded on successful completion of the examinations prescribed for any one of certain Groups of subjects, particulars as to which will be found in the Syllabus to be obtained from the Registrar of the university.

* By "Registered Teaching Institutions" are meant Mechanics' Institutes, Technical Schools, Evening Schools, and so forth, which, being under the control of a suitable committee or other governing body, provide teachers and instruction in the subjects (or some of them) named in the schedule, of such a kind as to admit of their being placed on the Register of Institutions recognised for the purposes of these examinations.

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Certificates of proficiency are also awarded to students of the evening classes in a College of the university on compliance with certain conditions as to attendance and examination, for which see Calendar.

In conclusion, it has only to be said that, like most other universities, Victoria University has the power to admit graduates of other universities in the United Kingdom to similar and equal degrees (*ad eundem gradum*), and to confer honorary degrees upon persons worthy of such distinction.

LESSONS IN GREEK.—LIII.

ATTRIBUTIVES—THE DEMONSTRATIVE PRONOUNS—THE ARTICLE.

AMONG attributive words of adjective signification stand the demonstrative pronouns and the article, as well as the possessive pronouns.

The demonstrative pronouns indicate the local relation borne by an object to the speaker, and so may be divided into two classes, the *near* (this) and the *remote* (that); for example—

DEMONSTRATIVE PRONOUNS.

The Near.	ὁ, ἡ, το, *this man, this woman, this thing.*
	ὁδε, ἡδε, τοδε, a strengthened form of the same.
	οὑτος, αὑτη, τουτο, *this man*, etc.
The Remote.	εκεινος, εκεινη, εκεινο, *that man, that woman*, etc.

ὁδε, ἡδε, τοδε, is nothing more than the article with δε appended. It is not so obvious, but nevertheless it is equally true, that οὑτος, αὑτε, τουτο is only the article with its stem strengthened.

The two demonstratives ὁδε and οὑτος, of the same origin, resemble each other in signification. A slight difference may be discovered in them, namely, that ὁδε relates rather to outward and local objects, οὑτος embraces also the inner relations or states of mind. Opposed to both is εκεινος, in so far as it indicates an object which stands at a distance from the speaker.

It may also be observed that ὁδε alludes to an object not observed in its condition, and consequently not so mentioned; while οὑτος refers not merely to an object itself, but also to its character; thus, ἡδε ἡ πολις is *this city*, the city which we see, the city in which we live, without any reference to its circumstances; on the contrary, αὑτη ἡ πολις is *this city*, considered relatively to its character, the (a) city of this kind. So ταυτα is used of that which has been already spoken of; ταδε of that of which you have to speak; as, ταυτα μεν συ λεγεις, παρ ἡμων δ' απαγγελλε ταδε, *you report these things; bear back from us this answer.*

Ταυτ' ελεξαν, *these things they said*—that is, the things reported—is used at the end of a discourse or narrative; but ελεξαν ταδε, *they said these things*, refers to those things which are to follow.

Οὑτος and εκεινος differ in this, that the former refers to the nearer, the latter to the remoter object. But this application is sometimes inverted. It is inverted when the remote object is pointed out as specially worthy of attention, and the nearer as holding an inferior position.

Οὑτος is used emphatically in order to indicate an object as universally known; εκεινος in order to point out an object as prominent and distinguished of its kind.

The demonstratives are omitted, first, when they stand with a relative clause, as a periphrasis for a substantive, as αληθη ἁ συ λεγεις; and secondly, in these phrases, τεκμηριον δε, *this is the proof;* σημειον δε, *this is the token;* αιτιον δε, *the ground is this;* κεφαλαιον δε, *the chief point is*, etc.; and the like.

The weakest form of the demonstrative pronoun—namely, ὁ, ἡ, το—is in good prose used only as an article. The office of the article is to individualise the idea conveyed in the noun—that is, to set it forth as a distinct object clearly present to the thought of the speaker and hearer. In general the use of the article on the part of the Greeks is the same as the use of it in English. There are, however, some deviations.

The Greeks use the article with proper names, but not universally; the article with proper names adds to the distinctness and individuality of the name, indicating that the person is well known, either because mentioned before or because celebrated; thus, ὁ Κυρος, *the Cyrus* previously spoken of, *the Cyrus* whom everybody knows. Generally the noun is without the article when a distinctive or characterising phrase is added; as, Κυρος, ὁ των Περσων βασιλευς, απεθανεν, *Cyrus, the king of the Persians, died.*

The article is put also before substantives which have a pronominal attribute; as a demonstrative pronoun, or the determinative αυτος, *self.* The place of the article is either between the pronoun and the noun, as αὑτη ἡ οικια, *this house*, or before the noun and the pronoun, as ἡ οικια αὑτη.

The article is used with nouns which signify a number, whether of special or general import, when reference is made to a number of objects, either previously mentioned or commonly known, or a number of objects in contrast with the remainder, or a number given as comprising a totality, no one being excluded, equivalent to our *in all;* and consequently the article is employed with numerals without nouns, when the idea of number appears as containing in itself a complete whole, considered in its arithmetical value. Special numerical determinations appear in the place of ordinary adjectives; general ones in the place of the demonstrative pronouns. Καθ' ἑκαστην την ἡμεραν is *every day without exception:* less emphatic is καθ' ἑκαστην ἡμεραν; παντες οἱ ανθρωποι, *all the mentioned men;* οἱ παντες ανθρωποι, *the whole of mankind, all men without exception*, more expressive than παντες ανθρωποι.

To the numerals of general import may be added πολυς and αλλος. With πολυς the article is employed when a greater portion is set in contrast with a smaller portion. In such cases we in English use the superlative; as, ὁ πολυς λογος, *most of the speech;* το πολυ του στρατευματος, *the main body of the army;* τα πολλα, *for the most part;* οἱ πολλοι, *the most, the bulk, the common people.* Αλλος takes the article when the whole of the part of an object is exhibited in opposition to one mentioned part, or more, of the same object; as, οἱ αλλοι ανθρωποι, *the other men, the rest.*

The article is employed in sums total; for example, ην, ὁτε ετελευτησεν, αμφι τα ἑξηκοντα ετη, *when he died he was about sixty years of age.*

By receiving the article the infinitive acquires the form of a noun, yet may it retain its verbal force. Thus it takes an adverb as a qualifier, as το καλως αποθανειν, *to die honourably*—that is, an honourable death; it may have its object, as το τους νικησαντας αμελειν, *to neglect those who have gained a victory*—that is, disregard to conquerors; it may also have a subject, as το φθονειν τοις ευτυχουσι τους ατυχουντας, *for the unfortunate to envy the fortunate.* This infinitive itself, like nouns in general, may be the subject or the object of a proposition, or it may be the object after a preposition, all the while retaining its verbal force. The infinitive in Greek, with the article, corresponds with the gerund in Latin; as—

GREEK.	LATIN.	ENGLISH.
ἑνεκα του λεγειν,	dicendi,	*of saying.*
εν τῳ λεγειν,	dicendo,	*by saying.*
προς το λεγειν,	dicendum,	*to saying*, or *to say.*

Adverbs of place and time, by taking the article, acquire the import of substantives; as, το ανω, *the upper region;* το μεταξυ, *the interval.* Also adverbs of quality having the article take the form of nouns; as, το λιαν, *excess;* το λαθρα, *secrecy.* Adverbs in combination with the article stand for adjectives; as, οἱ τοτε ανθρωποι (literally, *the then men*), *the men of that time.*

The article with a genitive stands substantively, and in English requires a noun to be supplied; as, τα των Αθηναιων, *the (affairs) of the Athenians;* οἱ εν τῃ πολει, *the (men) in the city.* In a similar manner it is taken with prepositions; as, τα μετα ταυτα, *what followed.*

Adjectives and participles, as well as adverbs, become nouns under the influence of the article; as, οἱ πλουσιοι, *the rich.* Sometimes the participle with the article is rendered by several words; as, οἱ παροντες, *those who are present.*

The article in the neuter gender prefixed to a noun, or to a phrase, denotes a quotation; as, το ανηρ, *the word* ανηρ.

When an attribute is added to a noun accompanied by the article, the position of the words may be threefold; as—

1. τα μεγαλα αγαθα, *the great benefits.*	ἡ σφοδρα επιθυμια, *the intense desire.*
2. αγαθα τα μεγαλα.	επιθυμια ἡ σφοδρα.
3. τα αγαθα τα μεγαλα.	ἡ επιθυμια ἡ σφοδρα.

These three collocations vary in emphasis in the order in which they are placed, the first being the least and the third the most emphatic.

A difference of meaning is produced by the different positions of the adjectives μεσος, εσχατος, ακρος, etc.; as εν μεσῃ τῃ αγορᾳ, or εν τῃ αγορᾳ τῃ μεσῃ, *in the middle of the market;* εν τῃ μεσῃ αγορᾳ, *in the middle market.*

With a genitive case, a noun and an article may have different arrangements; as, ὁ των Αθηναιων δημος (*the people of the Athenians*), ὁ δημος ὁ των Αθηναιων, των Αθηναιων ὁ δημος, ὁ δημος των Αθηναιων. These arrangements vary only in emphasis.

The article is wanting in Greek with abstract appellatives when they denote the general idea: thus, πλουτος κακιας ὑπηρετης εστιν, *riches is a servant of wickedness.*

The omission of the article sometimes gives the force of our indefinite *an* or *a*; that is, *one* of the race so called, or the race itself, ανθρωπος. If indefiniteness is to be given, we add the enclitic τις to the noun; as, γυνη τις ορνιν ειχεν, *a certain woman had a hen.*

A noun taken with πας, and without the article, is used distributively; as, πας ανθρωπος, *every man;* παντες ανθρωποι, *all men*, considered individually. If we add the article, we give a collective force; as, παντες οἱ ανθρωποι, *all the men* (in the world), men collectively.

An important difference is made by the different position of the article with αυτος: for example, αυτος ὁ πατηρ, or ὁ πατηρ αυτος, *the father himself;* ὁ αυτος πατηρ, or ὁ πατηρ ὁ αυτος, *the same father.*

ATTRIBUTIVE WORDS WITH SUBSTANTIVE IMPORT.

An adjective acquires a substantive import when an object, whether a person or a thing, is set forth as the material image of a quality, or when the abstract idea of the quality is designated as a substance in and for itself. Thus μελαν, in the neuter gender, is *black*, that is, blackness.

The article is prefixed to these adjectives with substantive meanings, as it is prefixed to appellatives. A participle with the article acquires the form of a noun, and may often be best rendered by a relative clause; as, ὁ μαθων, *the scholar*, or he who has learnt; ὁ βουλομενος, *the willing man*, he who is willing.

The Greeks use the genitive of possession in union with the article, to designate persons, things, and circumstances which are severally to be regarded as belonging to the idea or person contained in the relative. Thus the masculine article with the genitive denotes *the son of*, and in the plural *the relatives of, the subjects of;* in general *him*, or those persons or things which belong to the object; as, Αλεξανδρος ὁ Φιλιππου, *Alexander the (son) of Philip;* οἱ εμαυτου, *the of me*, that is, my (friends, children, etc.), mine. The feminine article with a genitive, after a similar manner, signifies *the wife* or *the daughter of;* as, Μαια ἡ Ατλαντος, *Maia the (daughter) of Atlas.*

With adjectival attributes, nouns are omitted which suggest themselves from the nature of the attribute itself. Thus χειρ is omitted with ἡ δεξια, *the right (hand)*; ἡ αριστερα, *the left (hand)*; μερις with ἡ δεκατη, *the tenth (part)*; ἡ εικοστη, *the twentieth (part)*, etc.

Other omissions of substantives are permitted only when they may be readily learnt from the verbs which, if expressed, they would accompany. Thus with verbs signifying *to go*, etc., ὁδος is omitted; as, πορευεσθαι μακραν (ὁδον), *to go a long way (far)*. On the same principle are explained ellipses (omissions) like την εναντιαν (ψηφον) θεσθαι, *to vote in opposition;* ερημην (δικην) κατηγορειν, *to bring a deserted charge*, that is, to accuse a person in his absence.

With the preposition εν and εις, you often find the genitive of a personal noun to signify the residence of the person, which is left out, as being easily supplied by the mind. Thus the Greeks commonly said φοιταν εις διδασκαλου, *to go to school;* εις φιλου, *to a friend's*—that is, to the house of a teacher, the house of a friend. Very common, and for the most part without variation, are the phrases εν Αἱδου, *in Hades;* εις Αἱδου, *to Hades* (scil. δομον and δομῳ).

GOVERNMENT OF THE OBJECT.

By the object is meant that on which the action of the subject falls. The relation of the subject to the object is either *immediate*, so that the action of the subject passes to the object without any intermediate term; or the relation is *mediate*, so that the two are connected by some medium.

Of the three oblique cases of the Greek, the accusative is chiefly employed to indicate the near object, the dative to indicate the remote, and the genitive specially to express attributive accessories.

IMPORT AND USE OF THE ACCUSATIVE.

The accusative shows that an object is under the immediate influence of another object, and consequently serves—

1. To denote the near or immediate object.
2. To denote the end towards which a movement is directed, and the space over which a movement extends, in reference to locality, as well as to time.

THE ACCUSATIVE TO DENOTE THE OBJECT.

The Single Accusative.—All verbs which signify action (transitives) put that which is immediately affected by that action, or which is thereby brought into existence, into the accusative case; as, οἱ Ἑλληνες ενικησαν τους Περσας, *the Greeks conquered* THE PERSIANS.

The application of the accusative in Greek is wider than it is in English. In poetry especially, objects are often employed with intransitive verbs, in order to show the influence or result which ensues from the verbal condition. Thus with ὀρχεισθαι, *to dance*, and κινεισθαι, *to play in pantomime*, is found the accusative of the person set forth or imitated in the dance or the mime; as, ὀρχεισθαι τον Ἑκτορα, κινεισθαι τα τοιαυτα; πυρ οφθαλμοισι δεδορκως, *looking (darting) fire from his eyes.*

Many verbs which in English are used intransitively admit in Greek of a transitive application, in consequence of which they take an accusative as their object. Such verbs are, δακρυειν, *to weep for;* οιμωζειν, οδυρεσθαι, ολοφυρεσθαι, *to moan, lament;* πενθειν, θρηνειν, κοπτεσθαι, *to mourn;* as, τους αποθανοντας δακρυουσιν οἱ οικειοι, *the domestics weep for the departed.*

In the same way, πλειν, *to sail, to travel by sea*, acquires a transitive application, and takes an accusative of the part on which the journeying goes on; as, πλειν θαλασσαν, πλειν ποντον, etc. Following the same analogy, verbs which signify to pass over take an accusative of the space or object over which the passage is made; as περαιουσθαι, περαν, διαβαινειν ποταμον, θαλασσαν, *to cross a river, go over the sea.* So we find even θρονον θασσειν, *to sit (on) a seat*, and ἱζεσθαι κρηνας, *to settle (at) a fountain.* Οικειν, meaning *to inhabit, to dwell*, may signify *to direct;* as, δει γυναικα ευ οικειν την οικιαν, *a woman ought to manage her household well.*

The application is extended to neuter adjectives, giving rise to forms of speech which require explanation; for example, τουτο ἁμαρτανειν, that is, τουτο το ἁμαρτημα ἁμαρτανειν, *to commit this error, to sin this sin, to sin in this;* μεγαλα ἁμαρτανειν, *to commit great sins;* δεισθαι μετρια, *to make moderate requests.*

The accusative of the abstract object may stand with the middle or passive as well as the active; as, πολλας λωβας λωβαται ὁ ανθρωπος, *the man endures many a disgrace.*

As the Greeks said νικαν νικην, *to gain a victory*, so by an extension of the idiom they said νικαν αγωνα, *to be superior in a contest;* νικαν πυγμην, *to beat in boxing;* νικαν παλην, *to conquer in wrestling;* νικαν Ολυμπια, *to conquer in the Olympic games.* A yet greater extension is found in the forms αισχυνεσθαι τινα, *to be ashamed before* (to reverence) *a person;* θαρρειν τινα, *to have confidence towards* (in the presence of) *a person.*

Hence may be explained what is called the *accusative of the part;* and this accusative may be expanded into *the accusative of the more exact determination*, that is, an accusative which defines the object to which the predicate relates; as—

> *Accusative of the Part.*—Τον δακτυλον αλγω, *I have a pain* IN MY THUMB.
>
> *Accusative of Exact Determination.*—Πινδαρος Βοιωτος ην την πατριδα, *Pindar was a Bœotian* AS TO COUNTRY.

Nouns of measure, as *depth* (το βαθος), *height* (το ὑψος), *breadth* (το ευρος), are in the same manner put in the accusative to signify the exact relation of the object to the predicate. So, where we say "by name," the Greeks simply used an accusative (ονομα) of exact determination; as, Λυσανδρος προσεβαλε πολει, ονομα Κεδρειαις, *Lysander fell upon a city*, BY NAME *Cedreæ.*

*

THE STEAM-ENGINE.—III.

SLIDE-VALVE—WATT'S PARALLEL MOTION—GOVERNOR BALLS.

We have now to turn our attention to the double-acting engine, which is much more commonly employed. In the simplest form of this four valves are required—viz., a steam-valve and an eduction-valve for each end of the cylinder. The upper steam-valve and the lower eduction-valve are first opened, so that the steam presses on the upper surface of the piston, while there is a vacuum below it. When it nearly reaches the bottom these are closed, and the lower steam and upper eduction-valves opened, so that the steam in the upper portion of the cylinder is condensed, and a vacuum produced there,

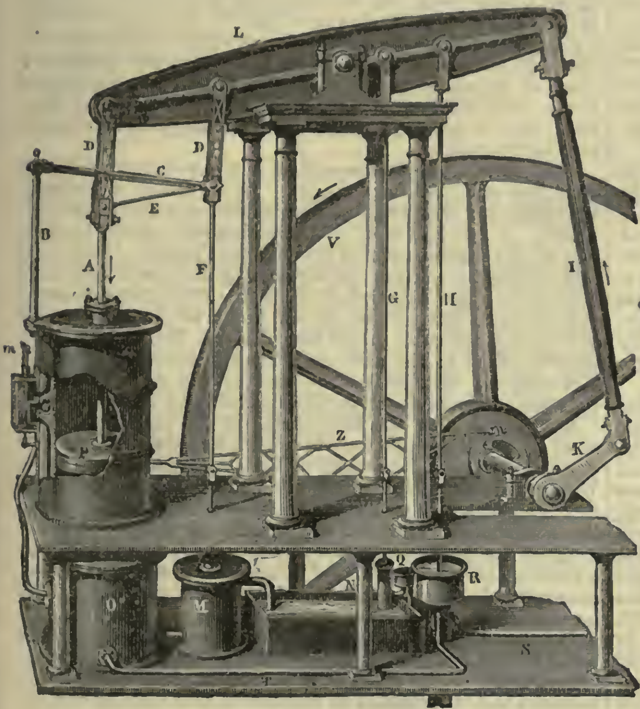

Fig. 9.

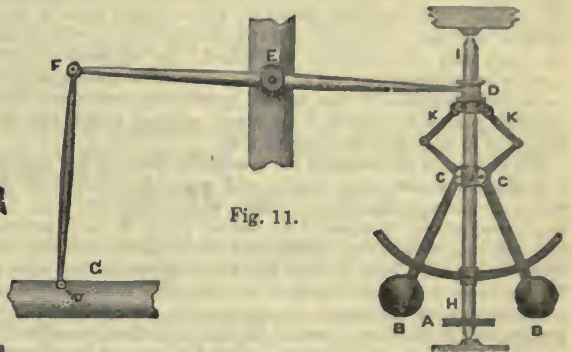

Fig. 11.

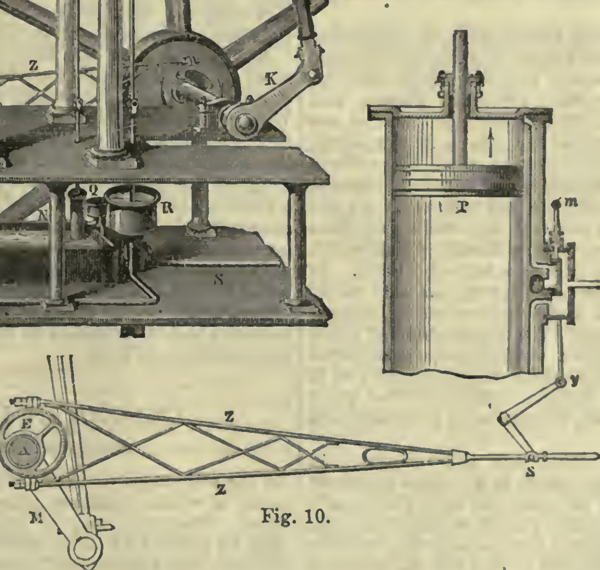

Fig. 10.

Fig. 8.

while the lower part becomes filled with steam. It will thus be seen that though there are four valves to be altered, they move in pairs, and thus only two movements are required. A great many plans have been tried for making these, but some modification of the slide-valve, the principles of which will be understood by reference to Fig. 8, is now generally employed.

In this figure C represents the cylinder, and P the piston, which is just descending. S is the pipe by which the steam enters from the boiler, while the waste steam escapes to the condenser by the pipe seen below the lower port V. D is the slide-valve, and is moved alternately up and down by the rod A, motion being imparted to this by the eccentric.

When it is in the position shown, the steam passes from S through the upper port, and presses on the upper side of the piston; at the same time the lower part of the cylinder is open to the condenser. As the piston comes near the bottom of the cylinder, the slide D is pressed down as far as it can go. The steam-pipe S is then in connection with the lower port, while the upper one communicates by the space F with the condenser, and thus the motion of the piston is reversed. The slide-valve is in practice made much smaller than here shown, the pipes leading from the boiler and from the two ends of the cylinder being made to open side by side on a true surface over which the slide moves.

Fig. 9 represents a model which conveys a very good idea of the construction of the double-acting condensing engine. The slide-valve is seen at the left of the cylinder, the valve-rod *m* being moved by the eccentric Z. The action of this will be better understood by reference to Fig. 10, which gives a detailed view of these parts.

To the axle, A, of the fly-wheel there is fixed a circular disc of metal, E, so arranged that its centre shall not coincide with that of the axle. Surrounding the disc there is a brass ring, C, connected to the rods Z, Z. This ring is not fixed to the disc, which turns in it, and thus as it rotates moves the rods Z, Z backwards and forwards. This movement is imparted to the bent lever S Y, and thus conveyed to the rod *m*, which moves the valves. The eccentric is usually so arranged as to move the valve just before the piston reaches the end of the cylinder. This has to be altered when the steam is employed expansively.

We now revert to the engine shown in Fig. 9. The piston-rod A moves the beam L. The clumsy arched ends formerly employed are, however, dispensed with, and the beautiful mechanism known as Watt's Parallel Motion employed in their place. The rods D D and E form with the end of the beam a parallelogram, one corner of which is jointed to the rod C. The other end of this rod is fixed to a pillar, B, or to the wall of the building, and the lengths of the rods are so adjusted that by their combined action the piston-rod is always vertical.

In this way the alternate movement of the piston is converted into an oscillating one of the beam, which is, in its turn, usually changed into a rotatory motion. This is accomplished by means of the connecting rod I, and the crank K, the action of which closely resembles that of the treadle of a lathe. A little thought will, however, show us that there are two points at which the crank has no power: these are when the piston is at the top or the bottom of the cylinder. At those times I and K are in one straight line, and the whole pressure of the beam is therefore transferred directly to the axle instead of tending to move the wheel. These positions are called the "dead points" of the stroke, and would cause the motion of the engine to cease altogether were there no means of overcoming the difficulty. After it has passed the dead point the crank acts with increasing advantage, until it comes at right angles to I, and then its power diminishes again to the other dead point. This tends to render the motion very irregular, but the contrivance known as a fly-wheel quite corrects this. A large wheel, V, with a very heavy rim, is fixed on the crank axis. When the crank is in its most favourable position it tends to accelerate the motion of this wheel. On account, however, of its great mass a very minute increase of velocity is produced, the power being absorbed and stored up in the wheel; the momentum thus acquired is sufficient to carry it over the dead points, and to render the motion of the engine practically uniform. The machinery may be driven by a strap passing round the fly-wheel, or in any other convenient way.

We must now just explain the remaining parts of the engine. O is the condenser, into which cold water is injected by the pump R, through the pipe T. This water, together with the condensed steam, is removed by the air-pump M, and emptied into the hot well N. Q is the feed force-pump, by which the water is pumped from N into the boiler, through the pipe S. The various pumps are worked by the rods, F, G, H, fixed on suitable parts of the beam. In practice the arrangement of the pumps seen in the lower part of the figure is often considerably modified to suit the circumstances of the case; but the changes are not of much importance.

Thus far we have only considered low-pressure, or condensing engines. Those which work with steam at a higher pressure, and do not condense, are, however, very frequently used, as, though less economical in use, they are much simpler and cheaper. In the former there is steam at a low pressure on one side of the piston, and a vacuum on the other; in the latter, the steam presses on one side of the piston, while the other is open to the air. This pressure therefore opposes the movement of the piston, and causes a considerable loss of power. As will be seen by reference to Fig. 9, much of the mechanism there shown is required for the purpose of condensing the steam, a constant supply of cold water has also to be provided. In many cases these requirements cannot be met, and they nearly always cause inconvenience, and hence non-condensing engines are now very generally employed. The mechanism by which the piston is moved in the cylinder, and its motion transferred to the beam and fly-wheel, is substantially the same in this as in the engine already described. Instead, however, of the waste steam passing into the condenser, it escapes by a suitable pipe into the air.

Frequently, however, before doing this, it is employed in some other way for heating purposes, so as to reduce the waste of heat as much as possible. In nearly all cases the beam is altogether dispensed with, the cylinder being so placed that the piston-rod is attached directly to the crank-shaft. The cylinder is very frequently laid on its side, and in this way the engine is rendered very much more compact and convenient.

In marine engines two or three cylinders are not unfrequently used to drive the same shaft. In this case the cranks are placed in different positions, so that one shall be exerting its maximum power while another is at the dead point. Some of the cylinders in such cases are frequently mounted on pivots so as to oscillate, and thus impart motion more directly to the crank. In large steam-vessels there are very frequently three cylinders, the middle one being made on this principle.

When a number of machines are being driven by one engine, one or other of them is very frequently stopped for a time, and the immediate result of this is to diminish the load of the engine, and therefore to accelerate its speed. In a similar way changes in the pressure of steam alter its rate, and in many instances these fluctuations cause great inconvenience. A throttle-valve was first placed in the steam-pipe to remedy the difficulty. This consisted of a circular disc mounted on an axis passing across its centre, and just fitting the interior of the pipe. When this disc was vertical the steam was completely shut off, but when it was horizontal little obstruction was offered to its passage. The valve, however, had to be adjusted by hand, and a self-acting regulator was much needed. This was at length supplied by the invention of the governor-balls, which are represented in Fig. 11.

H I is an axis turning in two bearings. A sheave, A, is placed on its lower end, and motion is imparted to it by a cord or chain passing round this and also round the axle of the fly-wheel, or some other convenient portion of the machinery. Two heavy balls, B, B, are fixed to the end of bent levers, which turn on pivots at C. Small bars, K, K, are hinged to the upper ends of these, and then connected with the loose collar, D. When the speed of the engine increases, the spindle rotates more rapidly, and the balls are accordingly thrown wider apart by centrifugal force. By this means the loose collar D is forced up, and carries with it one end of the rod D F, which turns on a pivot at E. The other end of this moves the throttle-valve G, and thus diminishes the influx of the steam, and checks the speed of the engine. When, on the other hand, the engine moves more slowly, the balls fall, and thus open the valve wider, and in this way the motion of the engine is maintained very nearly uniform.

The construction of a locomotive is not essentially different from that of a stationary engine. The cylinders are usually horizontal, and the piston-rods are connected with the driving-wheels. A fly-wheel is, of course, unnecessary, as the momentum of the engine carries it over the dead points. One important adjunct is known as the link-gearing, and serves to reverse the engine. The direction in which the driving-wheel moves depends upon the part of the stroke at which the steam is allowed to enter either end of the cylinder. Two eccentrics are therefore fixed to the axle, one arranged to drive the engine forwards, the other backwards, and by the link-gearing the slide-valve is connected with whichever of these we please.

Before concluding this brief sketch of the steam-engine, we must just notice the way in which its power is usually described. It is always said to have a certain horse-power. This was at first used very vaguely, but a definite meaning has now been attached to it; and when we speak of an engine of one horse-power, we mean one capable of producing, under ordinary circumstances, an effect equivalent to raising 33,000 lbs. a foot high per minute. One of 5 horse-power would, of course, accomplish five times this duty. By working with steam of a greater pressure a larger amount of work may be obtained.

It is found that to produce the effect of one horse-power, the boiler should evaporate nearly a cubic foot of water per hour. When, therefore, we speak of a boiler of a given horse-power, we mean that it is capable of evaporating that number of cubic feet of water per hour.

LESSONS IN LATIN.—LVIII.

COLLOCATION OF WORDS.

By the collocation (*con* and *locus*) of words is meant the way or order in which words are placed or stand in relation to each other. That order may be determined, or, if not determined, may be affected by three causes: *first*, the sequence of ideas; *secondly*, the grammatical construction; *thirdly*, the laws of euphony (Greek, ευ, eu, *well;* and φωνη, fo'-ne, *voice*, or *pleasing sound*). To a greater or less degree, and in varying proportions, these three causes operate on collocation in all languages; since a regard to the order of ideas, a regard to the requirements of grammar, and a regard to the laws of sound, are universal principles of cultivated speech. In one language, however, construction may predominate over the sequence of thought; in another the sequence of thought may prevail more than the usages of construction. This position is exemplified in the English and the Latin; for in the English, construction has the more force; in the Latin, the order of the thoughts. Take such a sentence as *James gave John a book;* here the construction shows that James is the *subject* and John the remote *object* to the verb *gave*. Change the place of the two proper names, *John gave James a book*, and you have reversed the sense. Hence you learn that in English the sense of words depends very much on their position.

A great and strict regard to usages relative to position is necessitated in English, because our nouns are only partially inflected. But you are not to suppose that a similar regard is requisite in other tongues; nor are you to think that the order of words which ensues is the natural order. Misconceiving it to be the natural order, grammarians have spoken of a different order, an order regulated by the sense rather than the sound: for example, that observed by the Romans, as an inversion, and young students are apt to regard the inverted order of words as unnatural. In truth, the order required by the thoughts and the order required by the construction are equally natural: the former was natural to the Romans, the latter is natural to the English; nor when the student of Latin shall have come to think in Latin, and to read and understand Latin without putting it into English, will he find anything either unnatural or difficult in the Latin arrangement of words; on the contrary, he will by practice be led to the feeling that the Latin order, following as it does the sequence of thought, is at any rate more philosophical, if not more natural, than the English.

Let us now put the sentence given above into Latin.

Johannes Jacobo librum dedit;
1 5 6 3 4 2
John to James a book gave.

Here there is no doubt that John is the *subject* and James one of the *objects* to the verb *dedit*, for such they appear to be by their form. Equally clear is it that *book* is the direct *object* to the verb *dedit*, for it is in the *accusative* case. The inflections, then, of these three nouns clearly indicate their relations. Consequently, so far as the sense is concerned, their position is of small moment. Equally obvious is it that *Johannes* and *dedit*, the *subject* and the *verb*, go together. Consequently you gain a latitude as to their position. Now the Romans were fond of throwing the verb to the end: to the end, then, the verb may be thrown without any detriment to the sense. By this arrangement, a sentence is seen to be, as it was originally called, a period, or circle; the thought is enclosed within itself: of the two principal words in a sentence—namely, the *subject* and the *verb*—the one *opens*, the other *closes* the period, and so the beginning and the end unite to make a complete whole. As now the sense is to a great extent independent of the collocation, so you may vary the relative position of the words; thus—

1. Jacobo Johannes librum dedit. 2. Jacobo Johannes dedit librum. 3. Johannes librum Jacobo dedit, etc.

These variations, however, are not capriciously produced. That regard to the order of the thoughts, which is the prevailing law in Latin collocation, determines the changes for the most part, though euphony also has its rights. Thus, if you wanted to make it clear that it was to *James* and not to *Thomas* that *John gave the book*, you would employ the arrangement No. 1. But if you wished to declare that it was a *book* and not a *coat* that *John gave to James*, then you would give preference to the form No. 2, or you might set forth the fact with still more emphasis by this arrangement:—

Librum Johannes Jacobo dedit.

A great deal of what we in English do by accent and intonation, the ancient Romans did by position. According to their general usage, there were two places of chief emphasis, the beginning and the end of the sentence. The *first* word is the most emphatic, the *last* word is *second* in emphasis. Hence you must put your most important word *first*, and the word next in importance *last*. The middle of a sentence is the place of least emphasis.

These are general principles. These general principles were more or less modified by a regard to euphony. And usages, the origin of which cannot be always traced, exert a controlling power of a general kind. Usage in a measure varies with individuals, being greater in this author and less in that. It also varies in the same person with states of mind; and an arrangement sometimes has no other explanation than that such was the order in which the thoughts and the feelings of a speaker or a writer stood at the moment.

To these general observations may be appended one or two particular observations. I have spoken of the proneness of the Romans to throw the verb to the end of the sentence; the verb may, however, be placed at the beginning, by the sense, by the sound, or by usage; for example:—

Quæritur an is qui profuit nobis, si postea nocuit, nos debito solverit.
It is inquired whether he who did us good, set us free from obligation by afterwards injuring us.

Usage formed several combinations which are never or rarely departed from; as, Civis Romanus (not Romanus Civis); senatus populusque Romanus; Pontifex Maximus; Jupiter optimus maximus; Dii immortales; Dii deæque; huc atque illuc, etc.

A difference of sense may be produced by change of place; thus, Alexander Magnus is *Alexander the Great*; but magnus Alexander is *Alexander who is really great*, whether the famous king of Macedon or not.

The *object* generally comes before the *verb*, as librum scribit, *he writes a book.*

Of two nouns, or a noun and an adjective depending on each other, the *governing* word follows the *governed*; as *reipublicæ* est *peritus*, *he is a good politician*; again—

Prudentia est *rerum* expetendarum fugiendarumque *scientia*.
Prudence is the knowledge of objects to be sought and to be shunned.

Related or contrasted words are put by the Romans so as to bring out their bearing on each other to the best advantage; for example:—

Quod non *dedit* fortuna non *eripit*.
What fortune gives not, it takes not away.

Regard to emphasis may produce so complete an inversion as to make the sentence unintelligible, if construed into English according to its Latin order; for example:—

Provocantibus ad prœlium responsum Romanus nemo reddebat.
To them challenging to battle reply Roman no returned; that is, no Roman returned a reply to them challenging to battle.

In sentences that contain a noun with its adjective governing another noun, the *governed* noun is placed between the *governing* noun and its adjective; as—

Admirabilis *benevolentiæ* magnitudo.
The admirable greatness of benevolence.

So with other governed words; for example:—

Brevissimus *in Britanniam* trajectus.
The shortest passage to Britain.

Words connected in sense and grammar are separated by euphony; for example:—

Admirabilis exardescit benevolentiæ *magnitudo;*
An admirable greatness of benevolence bursts forth.

When I speak of euphony I mean that which was *well-sounding* to Roman ears. *Alliteration*, or the succession of words beginning with the same letter, is avoided by good English writers, but instances may be found of evidently designed alliteration in the best Roman classics. Nor was it always possible for a Latin writer to avoid collocations which to us, at least, are anything but harmonious, such as the recurrence of words ending in *um*, in *is*, in *orum*, to which the language is very liable; as, null*is* sat*is* cert*is* mandat*is*.

The Romans avoided ending a long sentence with a monosyllable, or placing a short word immediately after a long one, influenced in these and similar things by laws of euphony common to all languages. Let the student read the two following sentences, and say which of the two sounds the better; in the second, *vicit* is taken from the usual place of the verb at the end of the sentence, and placed between words intimately connected in form and in import; the sentence is improved by the change:—

1. Cæsar Gallos fortissimos et omni rerum copiâ abundantes vicit.
2. Cæsar Gallos vicit fortissimos et omni rerum copiâ abundantes.
Cæsar conquered the Gauls, being very brave and abounding in all things.

The verbs *inquit*, *opinor*, *quæso*, *spero*, *censeo*, etc., are interposed in the course of the sentence, and not placed at either the commencement or the termination.

Nouns in the vocative are also generally interposed.

Those prepositions whose usual place is before their nouns are sometimes, especially in poetry, placed after or between the noun and its adjective. I finally warn the student that in all things, and especially in idiomatic usages, he must read and meditate the classics themselves with the utmost care. The practice of double translation would afford great aid. Select an easy passage from Cicero; translate it into English, as nearly as possible, word for word; to-morrow, put your English back into Latin, and then, comparing *your* Latin with *Cicero's* Latin, correct the former by the latter, taking it for granted that you are wrong when you differ from him. The steady and constant pursuit of this practice would in due time suffice to make you a good Latin scholar; and those to whom a thorough knowledge of Latin is indispensable must not grudge the time that it will involve, nor the perseverance it will demand.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XXVI.—COMMERCE OF THE NETHERLANDS (*continued*).

SOUTH NETHERLANDS.

THE early history of Flemish commerce may be considered as being divided into three eras.

The first is in the year 862, when Baldwin III. induced Frisian weavers to settle in Ghent, already a busy city, and thus laid the foundation of a staple industry. He wisely instituted annual fairs or markets, where no toll was taken for goods, and thus gave great encouragement to trade.

The second is connected with Count Baldwin IV., who in 1203 led the fifth Crusade, and turning aside to the conquest of Constantinople, was raised to the throne of the Eastern Empire, thus bringing the Flemings into communication with countries hitherto unknown.

The third period was that of the Burgundian princes, Philip the Good, Charles the Bold, and Maria. It was Philip the Good who established the Order of the Golden Fleece, the first industrial decoration known.

The Flemings laboured under the disadvantage of a short coast-line and a want of harbours. Although the land was well watered and suited for inland navigation, the mouths of all the rivers were in the North Netherlands, where transport was hampered by town dues. Flanders and Brabant were, however, more fertile than Holland, and being so near to France, the agricultural resources of the country afforded more profitable occupation for the inhabitants. Manufactures, also, were earlier established, and took a wider growth than in Holland.

While liberal principles prevailed, the Flemings continued to enrich themselves. Commerce at first was passive on their part; they had few vessels of their own, but foreign ships came to their harbours. Italian merchantmen visited Bruges in the year 1300, and Venetian vessels followed a few years afterwards. Genoa, Florence, Ancona, Bologna sent gold and silver lace, silk, cotton, camlets, pearls, oil, and alum; Venice sent spices, drugs and dyes, furs, cottons, and silks. Wines from France, and sugar, yarn, and dye-woods from Catalonia, were subsequently imported. It may be interesting to note here the striking contrast between the navigation of those days and that of our own. The Catalans occupied six months, the Genoese seven, and the Venetians eight, in making their voyages to and from their respective ports and Flanders.

A considerable amount of active trade was eventually carried on. Floris Berthold, a Flemish merchant, who was described as "richer in gold and silver, gained by means of his great traffic in merchandise, which he sends away by sea and land, than any one else in the world," dispatched his own ships to Alexandria, Cairo, and Syria. Bruges held the rank of a city in the seventh century. It was the chief trading town of the Netherlands; the emporium of the Hanseatic League, and the centre of the overland German traffic, by which goods from the Mediterranean and the East were exchanged for the raw produce of England, Norway, Denmark, North Germany, and Russia. Treaties of commerce were signed by it with Spain, Portugal, Ireland, Scotland, England, the Hanse Towns, Venice, Genoa, and Aragon. At the end of the thirteenth century its citizens numbered nearly 200,000.

Merchants were attracted to Bruges by the freedom of its markets and the humanity of its government. Shipwrecked mariners received kind attention, piracy was checked, and friendly relations were sought with all foreign states, especially with England. By these means the city flourished, and on occasions of state the citizens were able to display such magnificence in dress, that Philip IV. of France exclaimed, when the chief burghers and their wives were presented to him and his consort Johanna, in 1301, "These ladies are not burghers' wives, but six hundred queens."

Manufactures of lace, silks, muslins, damasks, and woollens employed the inhabitants, and these, together with corn, flax, and hemp, were the chief domestic exports. Wool, cotton, timber, and wine constituted the bulk of their valuable imports. The port of Bruges was at first Sluys, but in the twelfth century docks were constructed, capable of holding a thousand sail, at the village of Damme, now a fertile plain not far from the sea.

The immense trade and flourishing manufactures of Bruges declined through the altered and selfish policy of its rulers, guild-masters, and others, who bound down the different industries by so many restrictive dues and regulations, that contentions often arose. Political contests with the reigning prince, Philip of Burgundy, hastened the decay, and during the war between Flanders and Germany, at the end of the fifteenth century, the harbour became silted up from neglect.

Ghent was third in importance of the Flemish cities, though at one time as densely inhabited as Bruges and Antwerp. It is referred to as a city in the seventh century, and was of much importance in the twelfth as a manufacturing centre. The course of its history resembles that of Bruges, both in the efforts made to trammel trade and in its frequent intestine commotions. Its guild of weavers was 40,000 strong—the boldest trading corporation in Europe, and for the prosperity of the city ever too ready to test their strength. Other towns in the vicinity of the three great industrial centres just described partook of the same character. Such were Courtray and Ypres, in West Flanders; Oudinarde, in East Flanders; Louvaine, in South Brabant; and Mechlin (Malines), in Antwerp. Lille or Ryssel was, above all these secondary towns, distinguished for the lucrative character and magnitude of its industries. At a festival of the Duke of Burgundy, in 1454, the lords of the chamber were dressed in silk, and the shield-bearers in satin of Lille make, while the citizens adorned themselves with robes of gold and silk, trimmed with costly furs.

Antwerp existed as a small republic in the eleventh century. It succeeded to a good deal of the trade lost by Bruges, and attained an even greater population. From its superior facilities for reaching the sea by the estuary of the Scheldt upon which it stands, it became a great commercial as well as a manufacturing city, so that the business of a month in Antwerp eventually doubled that of a year of the best days of Venice. Textures of flax, wool, and silk were manufactured, as well as carpets, of a kind valued for their colours and fineness of texture; their weapons and cutlery, gold, silver, and bronze metal-work ranked high for quality; the most eminent tanners and sugar refiners were also to be found here. Antwerp attracted commerce by easy customs' dues, and obtained the name of the "Market of the World," which it did not lose even after the discovery of America and the route to India round the Cape. Goods were borne to its stores from east, west, north, and south, by land and by sea. The following is the scheme of its customs' charges:—

For every ship entering the harbour, 4 stivers.
Sack of wool, bale of peltry or lined leather, 1 cwt. of groceries: 8 pfennings = ½ stiver.
Bale of cloth, 1 stiver.
Bale of silks or pressed linen, 8 pfennings = ½ stiver.

CHAPTER XXVII.—GERMAN COMMERCE.

BY German commerce is meant the traffic of the regions of the Danube and the Rhine. During the Roman occupation it had steadily expanded. The vine was cultivated in the reign of the Emperor Probus, 276 to 282, at which time grain was imported from Britain. For several years, however, after the fall of the Roman empire, commerce cannot be said to have existed in Germany. Security and peace are necessary to stimulate labour and trade. Not, therefore, until the nations began to be settled, and to be illumined with the light of Christianity, did husbandry spread and the natural resources of the land become utilised. Germany is indebted for its earliest prosperity to the monks, whose quiet retreats, already referred to, were the sanctuaries of learning and the abodes of industry. Charlemagne, in the intervals of war, turned his far-sighted policy towards the improvement of agriculture and handicrafts. He made the nuns fill up their time with spinning, and settled on his own numerous estates goldsmiths and silversmiths, leather-workers, turners, carriage-builders, cutlers, soap-boilers, bakers, and brewers, and established schools of weaving and dyeing. The nature of the commerce of Germany may be inferred from its geographical position. It must be overland and river traffic, and also intermediate, that is, the articles of trade must be those of foreign countries. The native products were little more than coarse cloths, linen, beer, and Rhenish wines. Of coast-line the country had but small strips on the Baltic and North Seas. Venice, therefore, was the gate through which Southern and Oriental commodities reached Germany, and the cities of the Low Countries became the entrepôts of Northern produce. Eventually, however, German commerce was considerably extended. The importance of the sea-coast to a trading country is to be seen in the fact that one of the oldest trading stations of Germany was that of Veneta, in the estuary of the river Oder, to which allusion has been made. Its harbour would hold 300 ships. Veneta traded with Scandinavia, Russia, and Poland, on the one hand, and on the other with Greece, the Levant, Independent Tartary, India, and China. The town was cosmopolitan in law as well as trade, and every one visiting it was free to worship according to his creed. Veneta was pillaged by the Swedes and Danes, in 811 and in 830. Attracted by its wealth, Magnus, king of Denmark, pillaged it and razed it to the ground in 1043. Its ruins now cover miles of ground in Usedom. Dragovit, in Holstein, and Old Lubeck are both mentioned in the eighth century as commercial towns. Bardowick, near Luneburg, was favoured by Charlemagne, who made a road through Thuringia and Franconia to Bavaria, thus connecting this town with Celle and Magdeburg, and facilitating the transport of goods between North and South Germany. This able ruler likewise planned a canal to unite the Rhine and the Danube.

Henry the Fowler (918—936) turning his attention to the mineral resources of Germany, promoted mining to such purpose that after the year 987 gold to the value of 10,000 marks was obtained annually from the gold diggings on the Eule. Most of the early trade was conducted by the Jews, who, everywhere oppressed, could only accumulate portable wealth, especially in the form of money. The monks also, enriched as they were with the gifts of the devout, and bound to industry by their vows, undertook some part of the German trade. The profits thus made were not unfrequently confiscated wholly or in part by warlike rulers, for the support of their soldiers. A cause of disturbance peculiar to Germany prevailed in this inland trade. The roads were beset with freebooting knights, who exacted arbitrary tolls, and otherwise plundered the merchants. These knights were nobles, who, through profuse living, were unable to support themselves on their regular revenues, and who therefore became little better than highway robbers. They built strong castles out of a common fund, shared the proceeds of their plunder, and were in continual conflict with the trading towns. During the crusades and afterwards, their prodigality and rapacity were boundless, and the Emperor's mandates were openly disregarded. Occasionally they resorted to piracies at sea. To suppress this lawless state of things, the emperors assumed the protection of the market towns, appointing a governor, and raising a glove on the market-cross of each place as a token that hostilities were forbidden. Traders travelled in company, with swords hung from their saddle-bows. Rich and powerful cities, such as Vienna, Ratisbon, Ulm, Augsburg, and Nuremberg, maintained bodies of soldiers, who formed an integral portion of the imperial army, and who gained expertness in the use of arms by defending themselves on commercial journeys between their own flourishing towns and Constantinople or Italy. Besides such imperial measures, the towns formed leagues amongst themselves for mutual protection. Three such unions are of historic note—the Rhine, the Swabian, and the Hanse Leagues—and must have special mention.

The *Rhine League*, as its name implies, comprised the trading towns in the south-west of Germany and the lower Rhine provinces. Among these towns we may enumerate Cologne, Wessel, and Munster, of which Cologne was at the head. Cologne was powerful and wealthy, and of ancient foundation, with flourishing manufactures and commerce, a population of 150,000, and an armed force of 30,000 men. It was the meeting-place or market for the trade flowing through the whole of the Rhine lands.

The *Swabian League*, of greater extent, included at first the trading towns of the Danubian states, as well as the whole circle of Swabia, now divided into Bavaria, Wurtemburg, and Baden. This circle was enriched by the river traffic, and the towns of Augsburg, Ratisbon, Ulm, Nuremberg, Constance, Eslingen, Reutlingen, and Kempten grew prosperous thereby. Subsequently a still more profitable trade was pursued with the republics of Italy, and the Swabian League even extended its ramifications to the south of Russia. The towns of the league were industrial as well as commercial, and retained for their own use many of the manufactured productions of North Germany, as well as the Oriental commodities which passed through Italy, in exchange for textile fabrics and metal-work. The burghers became so wealthy that they were able to entertain kings. Augsburg was the home of merchant princes, who on more than one occasion maintained an army, or made an equivalent contribution, for the service of their sovereign.

The *Hanseatic League* derives its name from "Hansa" or "Hanse," a term applied in Germany to a guild or confederation. "Hanse" is possibly connected with the word "hand," in which the union of the fingers forms a single member. In magnitude, the union of the Hanse Towns exceeded all the other leagues of the Middle Ages, but its origin cannot now be traced. Its earliest magazines were only on the Baltic, but the reputation of the security and welcome offered to its members spreading amongst merchants who had heretofore been obliged to conduct in person every costly venture, the Hanse rapidly increased. The original members of the league did not exceed a dozen towns, of which Lubeck stood at the head, while Bremen and Hamburg ranked next in importance. An astonishing success marked its history during the fourteenth and fifteenth centuries. Wherever its factories appeared commerce throve. Its care for the safety of trade extended to both land and sea traffic, and agencies were appointed in the Hanse Towns with the special view of developing foreign trade. In 1267 a settlement was established in London, by permission of Henry III. In 1418 the French cities of Rouen, Bordeaux, and St. Malo were enrolled as confederate cities; Barcelona and Cadiz, Leghorn and Messina, also entered into like alliances for reciprocal privileges. The league was governed by a Diet, meeting every three years in Lubeck, the time of meeting being known as the Hanse Days. Lubeck, Dantzic, Riga, Cologne, Munster, Deventer, Magdeburg, Brunswick, and Hildesheim were the centres or capitals of Hanse provinces during the time of its greatest authority, and these cities alone possessed the right of signing privileges of membership in the league, which they did on stated quarterly days. Every town was called upon for its quota of men and money, to resist aggression and to punish offending nations. The average annual contribution amounted to 2,069 thalers. Among the Hanse factories (afterwards permanent settlements) in foreign parts, those of London, Bergen, Bruges, and Novgorod were the most important. They were governed by laws as stringent as those which ruled monastic life; marriage was forbidden to the officials, that their minds might not be diverted from their duty to their employers. The influence of the agents and their servants was so great as sometimes to override the local laws. In the period of he power and prosperity of the league, the towns enrolled in it were classified in accordance with their nationality and geographical position into four districts, forming a northern, a southern, a western, and an eastern group, known respectively as the Wendish, Saxon, Westphalian, and Prussian Quarters.

The Wendish Quarter.—Mecklenburg and Pomerania, the original nucleus of the entire Hanse, embraced the towns of the lower Elbe and Holstein, a territory which, though now German in language, was then Wendish or Slavonic. It contained Lubeck, "the queen and princess of the league," the seat of the central government, and depository of the public archives and treasury; also Anklaus, Hamburg, Griefswald (the capital of the Upper Wendish sub-division), and the towns of Kolberg, Luneberg, Stettin, Bremen, Straalsund, Rostock, Rugenvolde, Stade, Stargard, Stettin, Stolpe, Wisby, Kiel, Wessel, and Wismar.

The *Saxon Quarter* included the towns lying south of the Wendish division, or Saxony in its ancient wide sense, from the Weser to the Oder. Its capital was Brunswick, and among its other towns were Magdeburg, Berlin, Frankfort-on-Oder, Ascherleben; Breslau, Einbeck, Gottingen, Goslar, Halberstadt, Halle, Humela, Hanover, Helmstadt, Hildesheim, Lemgo, Magdeburg, Nordheim, Quedlinburg, Salzevedel, and Stendal.

The *Westphalian Quarter* embraced the towns of the Rhineland especially, together with Westphalia and the Netherlands

Cologne was its leading city, and the towns of Amsterdam, Arnheim, Bolsvard, Briel, Deventer, Dordrecht or Dort, Dortmund, Duisburg, Groningen, Hardewyk, Kampen, Middelburg, Muiden, Munster, Nordheim, Nimeguen, Osnabruck, Stavoren, Paderborn, Roermonde, Zierickzee, Zutphen, Wessel, and Zwoll belonged to this important and populous quarter.

The *Prussian Quarter* included the towns of the far east, viz., those of Old Prussia (not to be confounded with the modern kingdom of that name), Livonia, Esthonia, Lithuania, and Poland. Dantzic was the capital of this quarter, and among its members were Königsberg, Riga, Dorpat, Revel, Krakau, Elbing, Thorn, and Kulm.

From the constitution of the Hanse, the numbers of towns of which it was composed, as well as those in alliance with it, varied from time to time. Those mentioned above were the members in the fourteenth century.

LESSONS IN ENGLISH LITERATURE. XXVII.

DEFOE TO COWPER.

The seventh period of our literature, as sketched in the introductory chapter which begins these lessons, may be said to be the age of the great novelists, although a few poets graced it, and the king of all its men of letters was a man who partially failed both in fiction and in poetry—Samuel Johnson, critic and lexicographer.

From the artificialities of style which most of the writers in Pope's time considered indispensable marks of taste and power, the transition to such plain speech and matter-of-fact thinking as we find in Defoe is very remarkable. He was a sturdy Englishman from top to toe. He would have his ears cropped rather than forego the expression of his opinions. "'Tis hard for a man to say, all the world is mistaken but himself, but if it be so, who can help it?" The man who had a dogged mind of this kind in him was not the man to express himself with dainty phrase, or to busy himself with abstractions.

Defoe, born in London in 1663, was the son of a butcher, and became a hosier soon after leaving school. Ere he entered on this trade, however, he had already scribbled a little. He joined Monmouth's rising in 1685, thereafter speculated in one or two mercantile adventures, became bankrupt, struggled into business again as a tile manufacturer, and then obtained the post of commissioner on glass-duties. When King William came to the throne, the Jacobites called out upon him as a foreigner; but Defoe, who all through his life was a Whig partisan, defended His Majesty in a dogged satire called "The True-born Englishman." This had a prodigious success; 80,000 copies were soon sold off in the streets. Other successful works of Defoe's are, "Moll Flanders," "A Journal of the Plague" (fictitious, but often taken for true history), "Colonel Jack," "Captain Singleton," "Memoirs of a Cavalier," and "Roxana." It was not until Defoe had lost his fortune and health, and had emerged from a prison, partially paralysed, that he began his "Robinson Crusoe." This appeared in 1719. It has been translated into every European language. Founded upon a few incidents in the life of a Scottish seaman named Alexander Selkirk, it deals with fictitious circumstances in such a minute and seemingly veracious manner, that the reader feels Robinson Crusoe as living a reality in his mind as Columbus is. Defoe had a hard life, and died in London, in 1731, worn out with disease and misfortune.

"Robinson Crusoe" was Defoe's greatest work; but some of his other stories, like "Moll Flanders" and "Colonel Jack," more distinctly indicate the work he did in diverting the attention of literary men from classical and romantic subjects, and fixing them on life around them. Defoe's manner of studying life was coarse; and he could describe things and incidents better than character. Samuel Richardson, however, took up his pen, and gave us minute pictures of the manners of life in his times, with capitally executed studies of character. Samuel Richardson was born in Derbyshire in 1689, and became a printer in London. He often exercised his pen in writing indexes, prefaces, and "honest dedications" to the volumes he printed and published; but real authorship he did not attempt until he had passed his fiftieth year. Two brother booksellers desired him to write a collection of familiar letters, for the instruction and edification of youth. Richardson pondered the task for some time, and conceived that he might possibly introduce "a new species of writing that might turn young people into a course of reading different from the pomp and parade of romance writing, and, diminishing the improbable and marvellous with which novels generally abound, might tend to promote the course of religion and virtue." So the result was that this collection of letters became the first real English novel, and appeared under the title of "Pamela, or Virtue Rewarded." These letters, passing between several people, tell us of a pretty, bashful young servant girl, to whom her wealthy young master makes love in rather a free fashion. The girl's modesty prevails triumphantly in the end, and virtue is rewarded by her getting the rake to propose real marriage to her. She drives off with him to church, and goes home to make him happy ever after by helping his housekeeper "to make jellies, comfits, sweetmeats, marmalades, cordials, and to pot, candy and preserve." It was curious that the long-drawn story of this young girl's temptation should have been selected by Richardson for the reading of youth, and still more curious that divines like Dr. Slocock should publicly praise the tendency of the book from the pulpit. Dr. Watts was more near the mark when he told the author that a young woman could not read it without blushing. The moral of the whole thing is not so high-pitched as Richardson supposed, being prudential at the best. The minutely delicate touches of human character with which the novel abounds are wonderful and fascinating, and although no sentence in the book stamps Richardson as a great thinker, the cumulative effect of what he writes amounts to the effect of true genius.

"Clarissa Harlowe," in eight volumes, was Richardson's next novel. Its execution is similar to that of "Pamela," and its morality is just as doubtful. Clarissa is less lovable than Pamela, and goes through life as if she had a treatise on propriety always in her hand. This novel contains the classic Lovelace, an accomplished, ingenious, handsome, villainous profligate. As a contrast to Lovelace, Richardson has given us his idea of an English Christian gentleman in his third novel, "The History of Sir Charles Grandison." People laugh now when they read this book; and it never succeeded so well as its predecessors. Sir Charles Grandison acts and talks like a figure that had just stepped out of a "moral waxwork."

Of course, many laughed at Richardson's namby-pambinesses, even while feeling his power. Henry Fielding resolved to burlesque him. Fielding, born near Glastonbury in 1707, had been student, man of pleasure, spendthrift, playwright, lawyer, all in turn, before he brought forth his parody of "Pamela." It appeared in 1742, and was called "Joseph Andrews." He "builded better than he knew." In satirising Richardson, and aiming at burlesque, he really drew pictures of England and English people that were the most graphic ever written. His next efforts were "A Journey from this World to the Next," and "Jonathan Wild." Then came his masterpiece, "Tom Jones." In this novel he certainly takes our breath away pretty often. He is frank to a fault; he nothing extenuates, but tells us all he knows about the life of ordinary Englishmen and women of his day, who eat plenty of beef and drink plenty of ale, and love sport and horseplay, and talk in very plain speech, with jokes that would shock any of us now. Fielding, more than any other writer, has drawn John Bull. He is not particular as to the circumstances with which he surrounds his characters; but his teaching as a whole was healthy. His Tom Jones, who was meant as a sort of antidote to the priggish Sir Charles Grandison, is a sad young dog at times; but it is the very healthiness of his blood, and the heartiness of his character, that land him in such scrapes. Honesty and manliness are his backbone. After the somewhat sickly sentimentalisms of Richardson, which at the best preached negative abstention from immorality rather than spontaneous goodness and generosity, Fielding's teaching was of service. Two years after "Tom Jones" was published, Fielding received £1,000 for "Amelia," which is almost as good as "Tom Jones." The novelist's first wife was named Amelia; and this book may be said to be a tender tribute to her memory. Fielding died at Lisbon in 1754.

Fielding, whom Byron has called "the prose Homer of human nature," took large views of everything; he dealt with things in the rough, as it were. Laurence Sterne did the

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opposite. Any triviality that was odd sufficed him to make quite a series of chapters out of. He was a quiz of human nature; there is in him much of the melancholy sarcasm which Shakespeare puts into his "Jaques." Like Jaques, he rather prides himself on eccentric manners, and you never know what he will say next. In 1759 his first book began to appear, "The Life and Opinions of Tristram Shandy, Gent." This is scarcely a tale at all; it is a medley of half-told incidents, half-hinted criticisms upon life, and mad sport of wit after the manner of Rabelais. Some of the wit is quite shocking, and one must say of Sterne, as Keats said of Byron, that his was a talent that made solemnities out of trifles, and solemn things into trifles. Nevertheless, tenderness of a strangely delicate kind is not wanting in the work of this pruriently-minded man; "Tristram Shandy" contains one of the most beautifully and pathetically told stories in any language, the story of Lefevre. Sterne's other masterpiece is "A Sentimental Journey through France and Italy." He had been born at Clonmel in 1713, and spent the most of his life in a position which he neither suited nor adorned, that of an English country parson. Some volumes of his sermons were published. He died in 1768.

Sterne was a wit: Tobias Smollett was a humorist. Sterne smiles at us; but Smollett laughs with us. Sterne sees far deeper into nature than Smollett does; yet Smollett is quite as healthy reading as the author of "Tristram Shandy." Smollett is the legitimate successor of Fielding, and will move you with real fun far more than Fielding will; but the fun, after all, is romping, noisy fun, and often enough offensive to delicacy. Tobias Smollett was born near Dumbarton, Scotland, in 1721. Like Fielding, he tried several kinds of life before becoming a novelist. Playwright, surgeon's mate, city doctor, satirist, he only found his true work in 1748, when he produced "Roderick Random." This rollicking story embodies much of his personal experiences. Smollett's other novels, all marked by strong humour, are: "Peregrine Pickle," "Ferdinand Count Fathom," "Humphrey Clinker," "Sir Launcelot Greaves." Smollett executed other literary work besides, as, for instance, a translation of "Don Quixote," and a "History of England" in four volumes. This history ruined his health; he died in 1771.

Novel-writing now takes a purer strain in our literature. Oliver Goldsmith, an Irishman born in 1728, came to London, after many vagaries, and settled down as a literary man in the year 1756. He was a merry, open-hearted, reckless fellow, full of ideas, but devoid of the common sense necessary for their development. He was invited to write for the *Public Ledger*, and to the pages of this newspaper he contributed the papers now so well known as "The Citizen of the World." Dr. Johnson took him up, and introduced him to the great literary folks. "The Traveller," a fine poem, soon proved what stuff was in him. But debts lay heavily on his conscience and his imagination. One day he had to send and ask Johnson to help him out of some pecuniary difficulty. Johnson went to see him, and found he had a prose tale lying neglected in his desk. This Johnson was able to sell at once to Newbery the bookseller, for £60. It was "The Vicar of Wakefield." The idyllic, yet natural charms of this story will never die; it has proved the most popular novel in the world. Unmatched simplicity of narrative style, delicate and unobtrusive humour, variety of situation and incident, and beautiful sympathy with goodness, make this wonderful tale inexpressibly dear to all lovers of literature. There is that universality of human interest in the "Vicar of Wakefield" which appeals to readers of all ages and all nationalities. The child of nine eagerly devours it; and Goethe has recorded that it was a powerful factor in the development of his intellectual life. With the "Vicar of Wakefield," the period of the classic English novelists may be said to end. The fiction of that time had reached a perfect blossom.

The lovely artlessness of Goldsmith's expression gave its characteristic charm to his poetry, as well as to his prose. Goldsmith's verse is to Pope's what a sweet wayside hedge is to a Dutch garden. Pope's poetry is all head-work; Goldsmith's is full of affections, sympathies, charities, extended both towards man and towards nature: it is gently emotional throughout. Goldsmith, both in his "Traveller," and in his "Deserted Village," subsequently published, exhibits far more sense of external nature than Pope and his school dreamt of. His was not an exact knowledge of nature; his sense of its beauty was expressed in a general way. But the advance his time had made in appreciation of the external universe must be noted. Goldsmith wrote two successful comedies, "The Good-natured Man," and "She Stoops to Conquer." He died in the Temple in 1774.

James Thomson, a Scotchman, author of "The Seasons," "The Castle of Indolence," and other poetical works, was a contemporary of Goldsmith's, and like him helped to bring about a better feeling for the influences of nature. Akenside, who wrote "The Pleasures of the Imagination," rather harked back on the classic style of Pope, but not very successfully. Collins distinguished himself chiefly by some graceful odes, of which that addressed to Evening is the most admired. Gray wrote several volumes of good poetry, but by far the best of his productions is his very perfect "Elegy written in a Country Churchyard." The churchyard was that of Stoke Pogis. Churchill penned a good many telling, satirical poems; and William Cowper, born at Great Berkhampstead in 1731, achieved a poetical fame that will last long. His humorous ballad of "John Gilpin" is still a favourite with young and old; his "Task" contains much fine thinking and fancy; and his "Olney Hymns" express devout religious sentiment in a pure style, unhappily too rare in verse of this class. Cowper lived to the year 1800. Wesley and Watts belong also to the evangelical party of this period, while David Hume and Gibbon the historian wrote upon the free-thinking side.

Somehow or other, however, the outstanding figure among all these writers in the beginning of the eighteenth century is Dr. Samuel Johnson. It is hard to say upon what grounds he should claim so prominent a place. There were in his day several who wrote better prose than he did, and twenty who wrote better verse. The secret of his dominance over his time lies, not so much in what he directly accomplished through the pen, as in his influence as a talker. Partly because of his learning, partly because of his large-brained views of life, partly because of his sterling kindliness of heart, partly because of the dictatorial spirit and manner born in him, he obtained recognition on all sides as the literary Cato of his day. Johnson was born at Lichfield in 1709, and had many a hard struggle in London before he attained any pecuniary comfort as a literary man. His chief work is his "Dictionary of the English Language," truly a gigantic task to accomplish, and accomplish so ably. The essays published under the titles of "The Rambler," and "The Idler," were well received; his tiresome "Rasselas," a tale written to pay the expenses of his mother's funeral, was still more popular for a time, although, as Macaulay has remarked, the author in this Abyssinian romance "transferred the whole domestic system of England to Egypt." A great service was done by Dr. Johnson to our literature when he published his "Lives of the Poets." These contain condensed information and criticism of a very valuable character, though, as a critic, he occasionally went curiously far astray.

RECREATIVE NATURAL HISTORY

OUR MOST FAMILIAR NUTS.

Few of the treasures yielded by trees and shrubs have so much historical, traditional, commercial, and home interest associated with them, as have the shell-coated seeds we familiarly call nuts.

England, in its primitive and uncultivated condition—before invasion by the Romans brought new customs and new productions from a far-off land with it—possessed few fruits, and a very limited number of indigenous forest trees. The hazel nut, however, grew abundantly in the tangled thickets in which the stark wolf and the great red deer found shelter and a sanctuary from the spears and arrows of the woad-painted and skin-clad hunters, who, with hound and horn, trod the tangled mazes of dell and dingle, which have long passed away to give place to closely-packed houses, crowded thoroughfares, and toiling multitudes; and the only traces left of the old forest and that which it yielded, are perchance found in digging some deep foundation or tunnel beneath the earth, when amongst solid, though jet-black, tree trunks and vegetable mould we discover the empty shells of ebon-hued hazel nuts, and the antlers of deer.

The name by which this fruit, so much beloved by the holiday-keeping schoolboys and nimble, sportive squirrels of

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our day, was known to the Drüid and the ancient Briton, we know not.

The word *hazel*, as we pronounce it now, is derived from the Anglo-Saxon *hæsil*, a head-dress or cap; and the *hæsl-nutu*, or "cap-nut," was so called by the Anglo-Saxons because the husk or involucrum covered the base of the nut as a cap covers the head.

Both the Greeks and Romans in very early ages appear to have been perfectly familiar with the peculiarities of the hazel-nut tree; but they appear to have entertained some very curious ideas regarding it. Virgil states that it was considered injurious to the growth and prosperity of the vine, on account of the far-spreading nature of its rootlets drawing away the nutriment which the vines required, and that, as the goat was equally destructive to the young vines from the eagerness with which it browsed on them, the vine-dressers adopted a sort of double method by which the combined evil might be eradicated. The goats were therefore offered up as sacrifices to Bacchus, the god of wine, whilst the hazel bushes were cut down, and the straight poles selected for the manufacture of spits on which to roast the entrails of the sacrifice. Ancient writers inform us that the common hazel nut was by the Romans called *nux Avellana*, after the town of Avellino in Naples; whilst the filbert was distinguished by the title of *nux Pontica*, in consequence of its having been originally brought from Pontus. The term *filbert* appears to have been derived from *full beard*, long husk, *full fringe*, to distinguish it from the short-bearded nuts, of which kind the common hazel nut forms one.

Evelyn, shrewd observer as he was, thus writes of the hazel in his "Silva:"—"The coals" (produced by burning the wood) "are used by painters to draw with, lastly for riding switches and 'divinatory' rods, for the detecting and finding of minerals (at least if that tradition be no imposture). It is very wonderful by whatever occult nature the forked stick, so cut and skilfully held, becomes impregnated with these invisible streams and exhalations, as by its spontaneous bending from a horizontal posture, to discover not only mines, subterraneous treasures, and springs of water, but criminals guilty of murder, etc., made out so solemnly, and the effects thereof, by the attestation of magistrates and divers other learned and other credible persons, who have critically examined matters of fact, is certainly next to a miracle, and requires a strong faith." In this latter remark we entirely agree with Evelyn. Rhabdomancy is the term applied to the supposed occult art of divining by the use of the hazel rod, and, strange as it may appear in these enlightened days, there are many persons connected with the mining operations conducted in the western counties of England who still implicitly believe in the potency of the wand in finding metal-vein or water. *Dowsing* is the term applied to the operation, and although we have seen it most gravely conducted by a supposed expert, we have not been fortunate enough to witness the slightest manifestation of attractive affinity. The superstition, however, appears to be of very ancient origin, and we find very ancient writers speaking of the *virgula divinatoria* with due respect. Most of our readers who have perused Sir Walter Scott's admirably written novel, "The Antiquary," will remember, with pleasure, the quaint description given of the German rhabdomancist and expert, Herr Dousterswivel, who was doubtlessly as great an impostor as those who have for ages followed the same calling. As some of our readers may, perhaps, be desirous of testing the marvellous powers said to reside in the nut stick, we will, therefore, quote for their benefit the directions for divining, given by an old author and implicit believer in its supposed virtues. Thus he writes:—"The finding of gold which is under the earth, as of all other mines of metal, is almost miraculous. They cut up a ground hazel of a twelvemonth's growth, which divides above into a fork. Holding the one branch in the right hand, and the other in the left—not held too slightly nor too strictly—when passing over a mine, or any other place where gold or silver is hidden, it will discover the same by bending down violently. A common experiment in Germany, not proceeding from any incantation, but a natural sympathy, as iron is attracted by a loadstone."

Then we find, in the works of an ancient herb doctor, the following statement regarding hazel nuts:—"Some doe hold that these nuts, and not wallnuts, with figs and rue, was *Mithridates' medicine*, effectual against poysons. If a snake be stroke with a hazel wand, it doth sooner stunne it than with any other sticke, because it is so pliant that it will winde closer about it, so that being deprived of their motion, they must need die with pain and want; and it is no hard matter in like manner to kill a mad dog that shall be strook with a hazel sticke, such as men use to walk or ride withal."

If we are to believe the writers of old poems and ballads, the virtues of hazel wands, as set forth by the learned doctor already quoted from, fall into utter insignificance; but we doubt much the efficacy of the poet's prescription. Thus he writes:—

"If a man has got a wife,
Who's a torment to his life,
Let her taste a stick of hazel that is tough and strong.
In the wand there is a charm
That will work more good than harm,
For 'twill make a scolding woman hold her tongue."

The Chinese attribute the same powers of government to the bamboo; but we shall do well to confine ourselves to the utilisation of hazel sticks in the manufacture of hoops for coopers, fishing-rod joints, brewers' spigots, clothes' pegs such as laundresses use, and mole traps. The chips obtained by cutting up hazel sticks were at one time held in high esteem by the old vintners, who made bundles of them, which when placed in the wine casks were supposed to cleanse and improve the wine therein contained. Marvel-loving Evelyn, who appears to have entertained an extraordinary partiality for the hazel, thus writes of it:—

"Even after all, the most signal service it was ever employed in, and which might assuredly exalt this humble and common plant above all trees of the wood, is that of hurdles; not that it is generally used for folding our innocent sheep—an emblem of the Church—but for making the walls of one of the first Christian oratories in the world, and particularly in this island that venerable and sacred fabric at Glastonbury, founded by St. Joseph of Arimathea, which is stated to have been first composed but of a few small hazel rods, interwoven about certain stakes driven into the ground. And walls of this kind, instead of laths and puncheons superinduced with coarse mortar made of loam and straw, doe to this day enclose divers humble cottages, sheds, and outhouses in the country, and it is strong and lasting for such purposes, whole or cleft, and I have seen ample enclosures of courts and gardens so secured."

From periods of remote antiquity to our own day we find that nuts have been made instrumental in the performance of various social rites and religious ceremonies; different nuts being made use of according to the country in which the forms were carried out. In England we find a remaining trace of the custom of divination, by the aid of nuts, in the well-known fireside custom of trying for a sweetheart by nut-burning, which, for the advantage of our uninitiated young lady readers, we will describe. On a group of young damsels being assembled round the winter fire, one proceeds to test her fortune in the lottery of love by casting a chosen nut into the flames, repeating to herself at the same time the name of the swain under test and trial; then singing as follows:—

"If you love me, rap and fly;
If you hate me, burn and die."

Some degree of uncertainty prevails as to the exact period at which the walnut was first introduced into this country. The Romans are said to have cultivated it before the death of the Emperor Tiberius, and it has been stated that they were brought from Greece by Vitellius. Strabo states that, at one period of time, tables composed of the wood of the walnut tree were of greater value than those made from citron timber. Research shows us that amongst the ancients the walnut, like the hazel nut of our own island, played an important part in domestic life. From a poem written by Ovid, it appears that at the celebration of the marriage ceremony, walnuts were scattered broadcast amongst the assembled children by both bride and bridegroom, and it appears probable that this custom was instituted to show that the bridegroom now and for ever cast aside childish desires and pursuits, and that the bride remained no longer a votary of Diana. The following lines point to this custom:—

"Now bar the door: the bridegroom puts
The eager boys to gather nuts."

It also appears very probable that the French term for nuptials, *des noces*, might have been originally derived from this ancient custom. Great importance has been attached to the growth of the walnut tree in England by past Governments, on account of the vast quantity of walnut wood used in the manufacture of musket, pistol, and carbine stocks—no other wood being considered available for the purpose. We are informed that for one large walnut tree-trunk of peculiar excellence as much as £600 have been paid. In the year 1806 a careful calculation was entered into in order to ascertain the amount of timber annually consumed for the manufacture of military arms in this country, and the result was a statement that 12,000 fully-grown trees were required to meet the demand. We are not aware of any source from which information can be gained as to the enormous quantity of this wood now consumed for gun-making purposes. It must, since the commencement of the Volunteer movement, have greatly increased; but, fortunately, America and the ports of the Black Sea furnish large quantities to the British market, to help the home supply, which is comparatively small. The French are fully alive to the importance to be attached to the welfare of the walnut tree, and such was the panic caused in France by a disease which attacked the trees, that, fearing a consequent scarcity of walnut timber, an Act was passed in 1720 prohibiting its exportation, under pain of confiscation of property and a fine of 3,000 livres.

The walnut tree, like the hazel, enjoys a reputation for the possession of numerous attributes. Collinson, when describing the Glastonbury thorn, thus refers to a very remarkable walnut tree growing near the same locality. Thus he writes:—"There grew, also in the abbey churchyard, on the south side of St. Joseph's Chapel, a marvellous walnut tree, which never budded forth before the feast of St. Barnabas (the 11th of June), and on that very day shot forth its leaves and flourished, like other trees of the same species." We are also told by the same author that this tree was much sought after by the credulous, and that Queen Anne, King James, and many of the nobility of the realm, gave large sums of money for mere cuttings.

THE EATING CHESTNUT.—*a.* LEAVES AND BLOSSOM. *b.* BLOSSOM ENLARGED. *c.* COROLLA AND STAMENS. *d.* OVARY. *e.* ANTHER. *f.* SPIKY INVOLUCRUM OF NUT. *g.* NUT. *h.* SECTION OF NUT.

An examination of our fruit market shows us that there are several varieties of walnuts grown in England. Amongst them may be mentioned the description popularly known as the Highflyer or Thetford nut; the thin-shelled, or Titmouse walnut, so named because the shell is not thick enough to resist the attacks of that tiny bird; and the huge, apple-shaped nut, *nux juglans fructu maxima*, commonly known as the Warwickshire walnut. It is in the shells of these giant nuts that kid gloves and other articles of utility and taste are packed for sale to the curious. The kernels of walnuts yield an excellent oil, and the husks furnish a dark and durable stain, as false gipsies know full well.

A curious notion prevails that walnut trees are greatly benefited, and their fruitfulness added to, by being beaten and roughly knocked about. It has been said that—

> "A woman, a dog, and a walnut tree,
> The more you beat them, the better they be."

No certain date can be assigned for the first introduction of the chestnut to this country; but it is probable that it was first brought to Europe by the Greeks from Asia Minor about the year 504 B.C. The early name, *castanea*, appears to have been derived from Kastanea, a city of Pontus in Asia. The Romans appear to have been well acquainted with the chestnut, which was first sent to Rome in the reign of Tiberius Cæsar. Pliny describes eight well-known kinds. Chestnut trees are not, as a rule, as large or fruitful in this as in more genial climates; some noteworthy exceptions may, however, be found. The most remarkable specimen of the chestnut ever grown in England is, without doubt, the celebrated "Tortworth Tree," which is in Gloucestershire, on land belonging to Lord Ducie. This remarkable tree was sketched in the year 1772, and the following inscription was appended to the picture:—

"The east view of the ancient chestnut tree at Tortworth, in the county of Gloucester, which measures nineteen yards in circumference, and is mentioned by Sir Robert Atkins in his history of that county, as a famous tree in King John's time, and by Mr. Evelyn, in his 'Silva,' to have been so remarkable for its magnitude in the reign of King Stephen (1135), as then to be called the great chestnut tree of Tortworth, from which it may be reasonably presumed to have been standing before the Conquest (1066)."

The fruit of the chestnut tree appears to have from very early ages been held in high esteem, not only as a wholesome and substantial article of food, but as associated with festivity and home comfort. Virgil, in writing of a condition of abundance and plenty, says—

> "Ripe apples and soft chestnuts have we there,
> And curd abundant to supply our fare."

In more modern days, Herrick, in his quaint style, pays tribute to the memory of old English merry-making and chestnut-roasting:—

> "Remember me in cups full crowned,
> And let our city health go round;

Quite through the young maids and the men,
To the ninth number, if not ten;
Until the fired chestnuts leap
For joy to see the fruits ye reap,
From the plump chalice and the cup,
That tempts till it be tossed up."

Old records serve to show us, not only that the chestnut was valuable for the table, bnt that it is extremely difficult to discover an entirely novel fashion or custom. The following extract plainly proves that the fashionable tint, which the belles of our own day are so desirous of imparting to the hair by the aid of cunningly compounded chemicals, was in Evelyn's day produced by levying contributions on the chestnut tree; thus he writes: "A decoction of the rind of the chestnut tree tinctures hair of a golden colour, esteemed a beauty in some countries."

A reference to the illustration in the preceding page will serve to show the form of leaf and husk or outer covering of the edible chestnut. Nature has wisely defended its nuts, or seeds, by a covering of sharp, needle-like spines or prickles, whilst the walnut is protected from the attacks of feathered and furred marauders by the acrid and astringent juices given forth by the rind in which it is enclosed.

Marvellously beautiful are the provisions thus made by an all-seeing Creator for the reproduction of the trees best calculated to afford sustenance to man.

POLITICAL ECONOMY.—VI.

BY J. E. THOROLD ROGERS, M.A.

MONEY AND BANKING.

In these days I suppose nobody believes that wealth consists in bits of gold and silver, or that these metals alone make a nation rich. The singular delusion, however, that money is wealth, occupied men's minds for many a century, and has been the motive for an amazing amount of wickedness and wrong, and of a great deal of mischievous though well-intended legislation. The notion arose entirely from one fact, that of all articles on which men set store, the two metals, gold and silver, are the most saleable, and therefore are most competent to supply, under ordinary circumstances, the wants of an individual. I propose in the present lesson to show why it is that these two metals have been chosen by civilised communities, what are the uses of money, and what is the part which money and its substitutes play in the machinery of trade.

Adam Smith pointed out that it is a peculiarity of man to effect exchanges with his fellow-man, and observed that this propensity to truck or exchange is the motive to those acts of which the economist takes cognisance. Perhaps the analysis ought to go a little deeper. It is more correct to say that as society becomes more settled and civilised, as men have more wants, and there is a greater power to gratify these wants, they find that they can each do one or a few things infinitely better and more easily than they can a plurality of things. The most moderate idea of comfort requires the supply, say, of fifty different objects. Now it is possible, perhaps, for the individnal to furnish himself with all these objects by his own labour, as Robinson Crusoe does in Defoe's romance. But he will not be able to do any one of these necessary operations except in a very rude and imperfect manner, if he attempts the whole; whereas, if he devotes his energies to the production of one article only, or even to the part of one article, he contrives to do that with great dexterity and quickness. Now his special dexterity is a saving to the aggregate of human labour, a means for cheapening the supply of hnman wants. That community is able to provide itself the most fully with all it requires, whose members are as quick and clever as possible, each on his own industry or craft. And as each man finds it to his advantage to shorten his own labour, or, in other words, to make his own labour as effective as possible, the energies of a civilised community, in which labonr is free, and industry is honourable, are directed towards continually increasing the skill or effectiveness of those processes of labour by which conveniences are supplied. For however much we may press material forces into our service, we must remember that all these agencies are subordinate to labour, and are set in motion by it. It is plain, therefore, that labour, to be effectual, must be accompanied by the machinery of exchange.

Now if an exchange is to be effected on a very large scale—that is to say, if two countries are trading together, and each has some special object which it changes reciprocally, and the value of each object were equal—the mutual transfer of the goods would be a settlement. But the trade between any two civilised countries is never exactly equal, and, therefore, though to a very great extent international trade is mere barter, it is not entirely so, and, moreover, could not be. Besides, the development of an international trade is in the history of civilisation long subsequent to that of domestic trade. And the mere exchange of commodities could never satisfy a thousandth part of the exchanges which civilisation renders necessary.

What is to be done then? It is requisite that something should be found which everybody will be willing to buy, and everybody will be able to sell, in order that it may form a sort of measure by which everything else may be valued. This article must itself vary very little in value, else persons will hesitate to take it, in the fear that it may very much fall in value, or hesitate to give it, in the fear that it may very much rise. For example, wheat varies very much in value from year to year, and therefore is an unsatisfactory measure for the value of other things. Nor must it be perishable, for if it be, it will vary in value. Nor must it be itself very cheap or very easily procured, else it will be too cumbrous for use, and will also be liable to vary exceedingly in value as it is more or less easily obtained. For the same reason it must be capable of such easy division and such easy reunion, that there shall be no appreciable difference in value, however small or large the pieces may be, provided that the weight of a certain number of small pieces is equal to that of a number of larger pieces. Precious stones contain all the above-named characteristics except the last, and the want of this last entirely prevents them from answering the purpose of a measure of value.

The discovery of some such measure is a matter of absolute necessity. It has been said, and perhaps with much truth, that it is not possible to reason without speech. It is even more true that it is impossible for exchange to take place between the inhabitants of any country, unless some such measure be discovered. Hence, in the absence of the best medium of exchange, communities have adopted some expedient so universally, that we may fairly declare that community to be incapable of civilisation which cannot understand or employ some such medium. Thus we are told that rock-salt has been used in Abyssinia for this end; salted hides in South America, cod in Newfoundland, tobacco in the infancy of Virginia. Nay, some African tribes have actually invented an imaginary measure, by which they estimate values. For many ages, India, which had for small transactions no convenient medium, employed little shells, called cowries, for this purpose. So again, Speke and Grant found that in that portion of Central Africa which they explored, pieces of American or British cotton cloth were used for purposes of exchange, or, at least, as a unit of value. But the best, the most convenient, the most general, and, as civilisation extends, the universal medium of exchange is and will be what are called the precious metals—*i.e.*, gold and silver.

My reader will see why it is that these articles have been recognised and employed for the purpose of trade. They are each obtained at different times by nearly equal quantities of labour, the labour of obtaining gold being on an average about fifteen times greater than that of obtaining an equal weight of silver. They are nearly indestructible. And here, I may observe, that since they are so lasting, a great addition made to the existing stocks of the precious metals makes very little difference to the value of the whole, because the new supply is lost in the vastness of the old. It is different with other things which are rapidly consumed. A storm in the hills will swell a mountain stream from a rill to a torrent, but will produce very little effect on the lake into which the stream falls, because the existing volume of the lake is so great. Again, the precious metals—thence called—represent great value in small compass, and therefore are convenient instead of being cumbersome. And lastly, they can easily be divided and re-united so easily, that a heap of gold and silver dust is worth as much, weight for weight, and fineness for fineness, as a single solid lump. These, then, are the principal reasons which have induced civilised communities to adopt one or both of these metals as a means of exchange, a measure of value, or, as they are called when they are thus employed, the *currency* of a country.

At first it is probable that these pieces of metal were melted into rough ingots or bars, and stamped with some symbol used by the person who first melted them. Both gold and silver are susceptible of an easy assay or test, by rubbing them on a hard stone, called a touchstone, and by looking at the streak which is made. The issue of rude masses of silver, stamped with the trade-mark of some well-known and reputable merchant, is still practised in China. The central Government and its officials are too weak and too corrupt to issue coins on their own authority, with any hope that the Chinese public would take them.

From stamped lumps to coins is an easy step. A coin is a mass of metal of specific fineness and weight, issued by some public authority. If the authority is honest and intelligent, such an issue is of considerable advantage, more for certifying the fineness than the weight, since it is much easier to weigh a quantity of coins, than it is to interpret the fineness of each coin. Unfortunately, Governments have not been either honest or intelligent in this matter. They have frequently issued base money, and frequently lowered the quantity in the coin. The latter, though an evil, is comparatively a slight inconvenience; the former is a terrible mischief, and inflicts lasting injury on the community, the greater part of the suffering being endured by the poor. They who trade in money can easily make themselves masters of the extent to which the fraud has been committed, and may even make a profit out of their acuteness and knowledge; but they who are poor and live by wages, are mulcted by the fraud, and have great difficulty in obtaining that advance in the price of their labour which dealers in other articles of value speedily effect.

We have now brought our society—and the progress is verified by the experience of economical history—to such a state as that of a sufficient supply of metallic money. It is found convenient to employ gold for large values, silver for transactions of a smaller kind, copper for the least exchanges. In order, however, to prevent confusion, only one of these metals should be taken as a standard, and the others should be overvalued. We have adopted gold and have overvalued silver and copper, that is, have assigned the pieces issued a higher proportion to gold than their intrinsic value. Thus the silver in twenty shillings is worth a good deal less than a sovereign; the copper in 240 pence very much less. No inconvenience ensues, for any person who has to receive a sum in liquidation of a debt can refuse to take more than forty shillings in silver, and twelve pence in copper. In France a debtor can pay either in gold or silver, a fixed ratio of value being established by law between these metals. Most communities, however, use only silver as the fixed measure of value.

My readers will now see that money is the machinery, the necessary machinery, by which exchanges are effected. The true or complete exchange is between the producers. But the use of money enables one of the producers, who receives money, to postpone his part in the completion of the exchange till such time as it may be convenient to himself. Hence a sale effected by the payment of money has been called half an exchange. It will also be seen that a person who takes money takes it in order to get rid of it. Its utility is not immediate, but derivative. Except in so far as gold and silver are employed in the arts, they are of no direct service to mankind. Their indirect value is very great, because, as I have said, they who take them accept them on the understanding that they are, of all articles of value, those which are most easily exchanged, which are most serviceable, because they enable their possessor to satisfy his own wants with the greatest certainty and ease. But except for such purpose nobody would take, retain, or store them.

Now my reader will remember that gold and silver have been adopted as the measure of value for this reason among others, that they represent great value in small compass. In other words, it has cost great labour and pains to obtain them. Much of their existing value, as far as their use is concerned, would be sacrificed, if they were ever procured very cheaply and abundantly. I am not referring to the effect which such a discovery would have on the existing stocks of the precious metals. Double this quantity: suppose that every person who had a sovereign found himself to-morrow in the possession of two, and the value of his money would be reduced to one-half, or, which is the same thing, the price of everything would in a brief space be doubled. But I am referring to the future use of these metals. In order that they should maintain their utility, as part of the machinery of exchange, they should be costly.

If, however, they are costly, and everybody who possesses them for his own purposes wishes to get rid of them, it is clear that society in the aggregate will try to do with as small a stock as it possibly can. The wisdom of our Government in ancient times was believed to consist in collecting as great a hoard as possible of the precious metals. But every individual in his private capacity was irresistibly constrained to do his best to reverse this policy of the Government, and to make the circulation of the pieces of money which he might possess as rapid and as effective as possible. In brief, society wishes, as far as it can, to economise the use of this very costly mechanism of exchange. But except under a certain condition, it can effect this economy only to a very limited extent. This condition is *credit*, applied to the operations of banking. Credit is the trust or confidence which the possessor of property reposes in the integrity and solvency of another, and by which he is induced to trust his property in the hands of such a person, not that, in case he lends money, the very same pieces of money should be restored to him, but that he shall get their equivalents at his pleasure, sometimes with interest. Hence comes banking.

Banking was known in its most rudimentary form to the ancients. Persons devoted themselves in Greece and Rome to the business of receiving deposits from customers, which they pledged themselves to pay on the production of a cheque or tally. There is no doubt that these ancient bankers made loans with the funds which were put into their hands, for, as we read in the Scriptures, they paid interest or usury on such deposits. But the modern system of banking had its beginnings in great commercial cities like Venice, Genoa, Amsterdam, and Hamburg. The merchants who carried on trade in these towns took in exchange for goods the moneys of all civilised nations. A Venetian trader might have in his possession the florins of the Papal treasury, the byzants of the Greek empire, the deniers of France, the silver pence of England, coins in different metals, and of different degrees of weight and fineness. Now such a currency would be very cumbrous and inconvenient, and a remedy for the hindrance and delay involved in such a system would be very gladly welcome. A bank was therefore established, which took all this money, and issued, in exchange for it, receipts. Such a bank, called a bank of deposit, pledged itself to issue no more receipts than it had money, and of course, as the expense of conducting such an institution must have been a considerable sum, it charged some slight premium on its notes or receipts. So useful, however, was this paper found to be, that merchants were often glad to pay a considerable premium for the convenience. In the long run all these banks failed, and for the same reason. The bank lent its metallic money, and so broke faith with its depositors. It might perhaps have avoided this consequence, if it had lent its money for short periods or on merchandise. But it unfortunately lent its funds to public companies, who failed, for in those days people did not understand the very rudiments of banking. Thus, for example, the Bank of Amsterdam, which for many generations had the highest character for integrity and solvency, was found, when the Low Countries were occupied by the revolutionary armies at the close of the last century, to have lent nearly all its silver to the Dutch East India Company, and to be totally insolvent.

The Bank of England, which is the parent of the modern system of banking, was established at the conclusion of the seventeenth century. It did not profess to retain the money of its depositors or shareholders, for it lent the whole or nearly the whole of its funds to the Government, issuing notes upon this security, and giving interest on its notes. As a consequence, its notes were frequently inconvertible, that is, the parties possessing them could not obtain cash in exchange for them, and the notes were therefore at a discount, that is, they were sold or exchanged for less than their nominal value. The Bank of England avoided the error of the old banks of deposit. It did not lend its notes for long periods, but only for short or mercantile bills. But it fell into an opposite error, which is indeed remediable, but a great inconvenience. It did not back its notes by a sufficient amount of gold or silver. But the originators of the Bank of England were not acquainted with some of those conditions of banking which are now matters of scientific certainty.

I have already stated that it is the object of individuals and of the community at large to make the precious metals, in the shape of coin, as useful as possible. The individual does so by getting rid of all the money which he knows by experience to be in excess of his current necessities. The community does so by diminishing the amount of the metals which it employs as a means of exchange, and this in two ways, by making them circulate as rapidly as possible, and by discovering and employing some substitute for them, which will act as an equivalent for them. Thus, though it may seem strange at first, the efficiency with which stocks of the precious metals may be made to perform the work of exchange, is frequently relative to the facility by which means are devised under which they will not move at all. Let me illustrate this fact in the simplest manner. Let us suppose that Smith of London owes Black of Edinburgh £100, and Black of Edinburgh owes Brown of London £100. If some expedient can be adopted—and it is adopted on a prodigious scale in practice—by which Smith's debt may be made to pay Black's debt, the circle will be completed, and the transactions liquidated, without making use of any single piece of gold or silver. And, again, even if notes were issued in exchange for gold only, the community would save something in the costly machinery of the precious metals, for it would prevent the loss which ensues from their wear, when they are transferred from hand to hand, in the ordinary process of buying and selling. Those operations, therefore, by which cheques or bills are exchanged against each other, and by which notes are employed instead of gold or silver, are economics—the one in saving the cost of carriage and risk, the other in saving wear.

But this is by no means the only advantage which ensues from the issue of notes. It will be or should be plain to every one, that no one takes a note willingly, except on the distinct understanding that he can get what the note represents itself to be worth, at his pleasure. A five-pound note will not buy five pounds worth of food, unless the receiver is as certain as man can be, that he can get five pounds for his piece of paper. Neither State nor individual can create wealth or money, by putting valueless bits of paper into circulation, as has been found over and over again. The severest penalties, the most despotic authority, will not give such pieces of paper any value beyond that which their possessor finds the general public assigns to them. When in the early days of the French Revolution the Government of that country strove to put paper into circulation which was issued by its authority—when it denounced as traitors those who would not take these notes at their nominal value, and actually punished persons with death who declined to part with their property in exchange for such notes—the Government was utterly baffled. It is not hard to see the reason. The whole community refused to submit to such a command, and it was impossible to execute the whole community.

Again, when a person takes a note, he expects to get gold or silver, and not any other kind of property. Notes entitling the bearer to be paid in a certain amount of public stock, or of land, or of tea, sugar, corn, or any other kind of food, will not circulate. Such instruments—properly, warrants to receive goods—are or may be very valuable kinds of property, but they are not paper money. They are securities which may be bought and sold, but they have to be reckoned in money, and turned into money before they can be of avail to the holder. It is impossible to circulate bank-notes on any other security than that of gold and silver, however valuable the security may be; and attempts to effect such a circulation, though they have been made over and over again, are invariably failures, and invariably end in bankruptcy. A bank-note to be capable of circulation must be and remain an order to receive so much money, and nothing but money will be its equivalent.

It does not, however, follow that everybody who holds a note is determined to turn it as soon as he can into gold or silver. It is enough for him to know that he can do so when he pleases. Hence, not one note in ten thousand is presented to the Bank for change into gold or silver. If there were any doubt about the possibility of changing them at their full value, they would be presented soon enough. But as long as people believe that their notes could be and would be paid on demand, they do not present them for payment, and for the simple reason that to do so would be to abandon the advantages which a note possesses. These are, that it is easily portable; that it much facilitates the counting of money; and that if it be lost, the sum which it represents may be, under certain conditions, recovered. The holder of notes is in some particulars more safe from fraud, violence, or mischance than the holder of gold or silver.

Long experience enables bankers to calculate the likelihood of persons presenting their notes for payment, and therefore instructs them as to the quantity of gold and silver which they must keep in order to cover the contingency of these notes being presented. Let us suppose that this is one-third of the amount of notes in circulation. It will be plain, then, that in case the banker has sufficient property to warrant him in circulating the other two-thirds (and he is a swindler if he has not sufficient property), he can retain his property in his own hands, and get such profit as comes from it, and lend the other two-thirds to the public, and get a profit by them. Nor does this practice go against what I have stated above. It is true that there is no gold or silver to back up two-thirds of the notes, but there is property which can be, or ought to be, on an emergency turned into gold or silver, and the proceeds of which may be therefore devoted towards meeting these obligations, should the necessity arise. A banker is bound to keep his property in such a shape as to be able to obtain, as soon as he requires it, the funds which are necessary towards cancelling all the debts which he incurs by the issue of his notes. One source, then, of a banker's profit is derived from the issue of his notes. But it is by far the smallest part, and in the United Kingdom very few bankers are allowed by law to obtain this profit.

The chief profit of a banker is derived from using the amounts left in his hands by his customers. There is a great convenience in keeping an account with a banker—*i.e.*, in depositing a sum of money with him, and in drawing it out by cheques. The cheque is as convenient as notes are to the debtor and creditor, and it has other advantages. By a little precaution, the transmission of the cheque may be made absolutely safe. A payment by cheque is virtually a receipt. The aggregate of cheques drawn by a person in a year represent his expenditure, and form a record of it. Now the banker, who expects his customers always to have a certain sum with him, is able by experience to calculate what will be the average number of cheques drawn on him, and will keep such a sum by him as will enable him to meet these liabilities. In a great many cases, the person who draws and the person who receives the cheque keep an account with the same banker, and then the payment and receipt are only the writing down a set of figures on one side of one account, and the same figures on the other side of another account. Sometimes, however, the banker offers his customer a share of the profits which are made by lending money, and in this way some banks attract an enormous amount of capital in the form of deposits, and get their profit for the pains they are at in receiving and managing the sums left with them, and for the risks they run.

By these means a small sum of metallic money is made the means for effecting a prodigious multitude of transactions. Every bill of exchange, bank-note, cheque, is expressed in money, and the person who undertakes the obligation stipulates to provide the money expressed in the security. In the great majority of instances no money is either used or needed. The cheques which pass from hand to hand on a great day of business in one room in London, are equal to all the gold in all the banks in London. But these cheques are exchanged without the use of a single piece of money. Nothing can exceed the perfection with which this mechanism is carried on. But I repeat, the presumption on the face of all these cheques is that they will be paid in gold. If any risk arose that they could not be, a demand would be made that they should be, and what is called a *panic* follows. That such a risk does not arise is due to the *credit* in which dealers stand, and this credit is a trust in the merchant or dealer's honesty. The motive force in the great engine of commerce lies in the virtues of integrity and good faith.

LESSONS IN NAVIGATION.—III.

MIDDLE LATITUDE SAILING—MERCATOR SAILING—TO TAKE A DEPARTURE—GREAT CIRCLE SAILING.

VI. *Middle-Latitude Sailing.*—The occasions on which a ship sails due east or west, and can take advantage of the easy means of finding her longitude just explained, are of course rare. But by the rule called mid-latitude sailing, the diff. long. can be deduced from the departure found by plane sailing.

It will be remembered, in connection with Fig. 4, that the departure on the course A B was explained to be an imaginary line or value, greater than the arc of parallel C B, and less than A *d*, and therefore equal to some similar parallel lying between them. If we can find a parallel on which the departure can be taken as the true change of longitude, we can ascertain the latter by the last rule, the departure being taken as distance sailed due east or west. The difficulty is to say exactly where such parallel is to come, but the general practice is to put it *half-way* between "lat. left" and "lat. in," a practice never strictly correct, and sometimes glaringly wrong. In low latitudes, where meridians incline to each other but slightly, and in all cases where the difference of latitude is slight in comparison with the departure made, the rule may be trusted for practical purposes; but in high latitudes, where the meridians converge rapidly, or wherever the diff. lat. is considerable, it cannot be relied on.

Suppose a ship, steering southerly, makes a difference of latitude of 4°, from 22° to 18° N., and a departure from long. 30° W. of 160 miles west; what is her difference of longitude according to the mid.-latitude rule?

Half-way between 22° and 18° N. is 20° N.; 160 miles on an arc of a parallel in 20° N. lat. is therefore the measure of the difference of longitude. In other words, the ship's oblique course—a curved line, the exact position of whose finial point is unknown to us—has been resolved into two straight courses, one pointing due south, the other due west. The length of both is known in miles, but this gives no direct clue to the measure of longitude contained in that pointing west, unless we can tell in what latitude it is to be measured. Knowing this under the rule, we apply formula (6)—

$$\text{Diff. long.} = \frac{\text{dist.}}{\text{cos. lat.}} = \frac{160}{\text{cos. } 20°} = \frac{160}{\cdot 9397} = 17 \cdot 3' = 2° \ 50 \cdot 3' \text{ W.}$$

Present position of ship is therefore 18° N. lat., 32° 50·3′ W. long.

Formula (6) may be recast for middle-latitude sailing, as follows, as the last example shows:—

$$\text{Diff. long.} = \frac{\text{departure}}{\text{cos. mid. lat.}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

These relations, like those in plane sailing, are involved in the construction of a right-angled triangle, and the two can be united in a single figure, which shows at a glance the relations subsisting between course, distance, diff. lat., and diff. long.—the four things which we alone care to know—and the intermediate expressions departure and mid. lat., which serve only to link the others together. See Fig. 8, where A B is the *distance* representing the rhumb line in Fig. 4, and where in fact the triangle A B C is a reproduction of Fig. 5. Here all the lines (except C D, which represents nothing) are measured in a like denomination, viz., *minutes;* for the nautical miles, in which C B and A B are measured, are identical with minutes of latitude, and D B of course is measured in minutes of longitude.

Fig. 8.

It has been said that the particular latitude in which the departure just equals the difference of longitude due to the ship's oblique course, is not quite truly found by the mid-latitude rule. There is, however, a table, called *Workman's Table of Corrections to be added to Mid. Latitude* (not commonly included in books of tables), by which the true latitude can be found. In the column headed by the number of degrees nearest to the diff. lat. found, and opposite to the degree of latitude given as "mid. lat." by the rule, will be found the number of minutes to be added to the latter to give the true latitude in which departure will represent diff. long. In the case just worked out, where diff. lat. = 4°, and mid. lat. (by rule) = 20° N., it appears by Workman's Table that 3′ should be added, and that the calculation should have stood—

$$\text{diff. long.} = \frac{160}{\text{cos. } 20° \ 3'}.$$

The difference in the result would have been insignificant. But suppose the ship had made as much as 10° diff. lat. from the high latitude 65° N., then mid. lat., by rule, would have been taken as 60° N., whereas by the table it should be 60° 19′ N. With a departure of, say, 500 miles, this inaccuracy would cause dangerous error in the longitude, as may be seen by working (7) with the corrected and uncorrected values of mid. lat. Nevertheless, by using Workman's Table we may safely find the longitude by "*mid-latitude sailing,*" which we may regard as an appendix by which the *theory of plane sailing* is rendered complete.

VII. *Mercator Sailing.*—Besides mid.-latitude sailing, there is another plan by which the difference of longitude may be deduced from the departure, and as it is scientifically accurate if correct *data* be given, it is usually to be preferred. This is *Mercator sailing,* so named after a Flemish chart-maker, Gerard Mercator* (1512-1594), whose charts were based upon the principle now to be explained.

As a nautical mile everywhere, except at the equator, exceeds a minute of longitude, it follows that the number of miles of departure is always *less* than the number of minutes of longitude traversed. Hence it is clear that some *greater* departure (expressed in miles) than that which properly belongs to the course and distance traversed will exactly express the *real* departure in minutes of longitude—in other words, will give us the difference of longitude. All we have to do, then, is to exaggerate the diff. of latitude *in some known proportion,* and take the corresponding exaggerated departure, in miles, as the diff. of longitude in minutes. Of course the exaggerated diff. lat. is merely a means to an end, and the ship's position, as to latitude, is not to be fixed by it, but by the true diff. lat. found by plane sailing. We will now prove the rule by which the requisite addition to diff. lat. is found, premising that, owing to the increasing convergence of meridians towards the poles, the proportionate addition to be made increases with increased distance from the equator.

In Fig. 9, let A *b c* be one of the infinitely small triangles in Fig. 4. The diff. lat. A *c* being infinitely short, *c*, the "latitude in" does not differ sensibly from mid. latitude. Hence we may consider *c b*, the departure, as the parallel from which diff. long. may be deduced. (For convenience we shall speak of these "infinitely small" lines as containing miles and minutes; millionths of miles and minutes would do as well, of course.) Now suppose A *c* "exaggerated" to *c′*, so that the increased departure *c′ b′* shall be the arc of the equator corresponding to *c b*, or in other words, shall contain as many miles as *c b* contains minutes. *c′ b′* is thus the diff. long. made. Therefore, by formula (6) or (7), $c' b' = \frac{c b}{\text{cos. lat. of } c b}$.

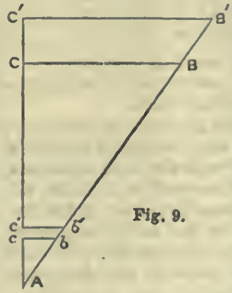

Fig. 9.

Expressing this as a proportion, $c' b' : 1 :: c b : \text{cos. lat. of } c b$, and transposing, $c b : c' b' :: \text{cos. lat. of } c b : 1$.

$$\text{But } c b : c' b' :: \text{A} c : \text{A} c';$$

$$\therefore \text{A} c : \text{A} c' :: \text{cos. lat. of } c b : 1;$$

$$\therefore \text{A} c' = \frac{\text{A} c}{\text{cos. lat. of } c b} = \text{A} c \times \text{sec. lat. of } c b \ \ldots\ldots \ (8)$$

A *c′* is called the "meridional difference of latitude," as distinguished from A *c*, the diff. lat., and it is obtained, as we have just seen, by multiplying the diff. lat. by the secant of the latitude of *c b* (the "latitude in"). The position of *c′* being

* Properly Gerard Kauffman, of which name Mercator is the Latin translation.

known, $c\,b$ can be computed in minutes ($=c'\,b'$ in miles) without difficulty.

This reasoning only holds good where A c is so small that the diff. of latitude between c and the point midway between A and c can be neglected, and "mid. lat." treated as identical with "lat. in." If A C represented diff. lat. resulting from an ordinary day's sailing, we cannot fix C′, and therefore C′ B′, in the same simple manner; we must split A C into minute parts, say 1′ each, and calculate the meridional diff. lat. for each; the sum will be the meridional diff. lat. A C′, by which we can compute C′ B′. The other sides of the triangle being measured in nautical miles, B′ C′ will of course be in miles, equal in number, as already explained, to the minutes of longitude in the departure. Or we may say that B′ C′ will work out in equatorial degrees of longitude.

Tables have been calculated of the meridional latitude in minutes—called meridional parts—corresponding to every degree and minute of latitude, from 1′ to 89° 59′, whence the meridional diff. lat. can be found for any given diff. lat. Thus a ship sails from 30° N., on a course and distance which give 10° = 600′ as her diff. lat., by which her "lat. in" is found to be 40°. Her merid. diff. lat. is thus found:—

Meridional parts equivalent to 40° (lat. in)	= 2622·7′
,, ,, 39° (lat. left)	= 1888·4′
Merid. diff. lat.	734·3′

The side C′ B′ of the right-angled triangle A B′ C′, of which angle A and side A C′ are known, has now to be computed. The simplest formula is thus arrived at—

$$\text{Tan. A} = \frac{C'B'}{AC'};$$

$$\therefore C'B' = AC' \times \tan. A;$$

or, diff. long. (in minutes) = merid. diff. lat. × tan. course (9)

If departure be given instead of course, we may say—

Diff. lat. : merid. diff. lat. : : departure : diff. long.

The increased latitude in minutes, or the "meridional parts" corresponding to any given latitude, are thus arrived at:—For the first minute from the equator we multiply 1 by the natural secant of 1′; result is still 1, the nat. sec. not differing from unity in seven places of decimals. The increased equivalent of the second minute is 1 × nat. sec. of 2′ = 1·0000002; increased equivalent of 2′ = sum of two increased lats., or 2·0000002.

		NAT. SECANT.	MER. PARTS.
1′ . . .		1·000000	= 1·000000;
2′ . . .	1·000000 +	1·000002	= 2·000002;
3′ . . .	2·000002 +	1·000004	= 3·000006;
4′ . . .	3·000006 +	1·000007	= 4·000013;

and so on, up to 5399′, which is only 1′ short of the pole.

Tables of meridional parts are now, however, calculated on a more accurate plan, which we cannot explain here.

Referring to the specimen traverse table given under plane sailing, it should be explained, now that the ways of finding longitude by account have been shown, that although the nett departure obtained by addition and subtraction is accurate enough for use in finding the direct course and distance, it is safer to find the diff. longitude separately for each course, and take the balance at the end as the nett diff. long. on the day's work. Thus, if the mid.-latitude rule be followed, do not total the departure columns, but *opposite each course* note lat. left, lat. in, mid. lat., and diff. long. E. or W., deduced by formula (7). If diff. long. is to be found by Mercator sailing, leave out departure columns altogether: opposite each course, besides distance and diff. lat., put latitude in, meridional parts corresponding thereto, and meridional diff. lat., found by subtracting merid. parts of lat. in from merid. parts of lat. left (noted as lat. in against previous course). Then by (9) deduce diff. long. for each course, which put in columns for E. or W.; strike the balance at foot. To find merid. diff. lat., the lat. left at commencement of first course must be included in the table (at top) with its equivalent merid. parts.

The sea-charts used by navigators are always on what is termed *Mercator's projection*, which is intimately connected with the above theory of sailing. The earth, instead of being a globe, is assumed to be a *cylinder*, which is *unrolled* as a flat map. Hence every parallel of latitude is a circle, or rather line, equal to the equator; and hence degrees of longitude are equal in all latitudes. As 60′ of long. in a latitude where they really equal only 30 nautical miles are made to occupy the same space as at the equator, where they equal 60 miles, the map is evidently distorted, but the distortion is made *symmetrical* by the device of increasing each minute of *latitude* in proportion to the increase given to the minutes of longitude on its parallel. Thus, though countries and distances lying towards the poles are enormously exaggerated in size, they are comparatively symmetrical in shape. The degrees of latitude are increased in accordance with the table of meridional parts. The benefit conferred upon mankind by Gerard Mercator, in the invention of his cylindrical projection of the earth's surface, can scarcely be overrated. To get rid of the *curved* meridians, substituting parallel straight lines for them, was a device which breathed a new life into Navigation.

Scientific and satisfactory as is the theory of Mercator sailing, it is better to obtain the longitude by the mid.-latitude method, if the course exceeds, say, 60° from the meridian, because diff. long. is obtained by multiplying merid. diff. lat. by *tangent* of course. If the angle of course exceed 45°, then tan. of course exceeds unity, so any error in estimating the course may lead to a large error in longitude. Thus by either mid. lat. or Mercator sailing, we may consider the theory of plane sailing completed and extended.

VIII. *To take a Departure.*—Although the mariner estimates and records his vessel's movements as well as he can, yet he loses no opportunity of fixing her position by observations of land or sky. The bearing of the last headland, lighthouse, or other prominent object expected to be seen, is taken from two positions, and noted, together with the course and distance run from the first point of observation to the second. Unless one of the observations is taken, by chance or design, when the object is exactly on the beam—*i.e.*, at right angles to the course—or the course is of such length as to subtend 90° at the object, the fixing the ship's distance from the object at the last observation will involve the computation of an oblique triangle, the only one we have yet had to do with.

Suppose a ship sailing down Channel observes Beachy Head bearing N.W. After running 10 (nautical) miles W.S.W., the Head bears N.N.E.½N. How far is the ship from the Head at the last time of observation?

Let C (Fig. 10) represent the Head, A ship's first, B ship's second position. We have now to solve an oblique triangle of which two angles and included side are given, viz., A B = 10 miles; B A C = 6 points = 67° 30′; and A B C = 4½ points = 50° 37½′. This can be done by Case 3, Section XXI., Lesson V. on Trigonometry, in POPULAR EDUCATOR. The distance being found, the ship's position is marked on the chart, and she is said to *take her departure* from the object observed. The position marked can be taken as lat. and long. left, and the day's work reckoned from it, or, as is the usual practice, the bearing of the ship *from the object* (just the opposite on the compass card to the bearing of the object from the ship), and the distance, are reckoned as giving the ship's first course, and are entered in the traverse table as a course run.

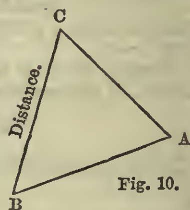

Fig. 10.

IX. *Great Circle Sailing.*—The advantage of sailing on a rhumb line is that the successive meridians are cut at one angle; in other words, one compass course may be steered throughout the whole voyage. The rhumb line between any two places, though a spiral on the globe, becomes a straight line on the chart. This makes it very easy to lay down the compass course to be steered to reach a given point on the chart; but it has been known for centuries that the rhumb line is not the shortest route between two places, though the fact that it is steered on a uniform compass course gives the idea that it must be a straight and therefore direct line. But the fact that it cuts at the same angle successive meridians which are *not parallel* is sufficient proof that its direction is constantly changing, and that the ship's head never points in the same direction, if properly steered, for two miles together. The real direct course is an arc of the *great circle* passing through the two places (and the centre of the earth), as will be readily found by stretching a thread between them on the terrestrial globe. People who look only at maps often wonder why our ocean steamers should take Cape Race, in Newfoundland, on their way to New York, instead of going, as they call it, straight across the Atlantic; and they wonder why their passengers should talk about icebergs encountered. Careful study of a good-sized globe will dispel these illusions, and show that the stretched thread between England and New York actually reaches latitudes so high that at all seasons of the year it cannot be followed. Apply the same length of thread in the line indicated by the (apparently) straight course on the chart, and it will fall short by some hundreds of miles.

For all this, great circle sailing has been little practised until late years, for although it is easy enough to find the great circle course between two places, it is less easy to steer it, as the *compass course* is always changing, owing to the course—a truly straight line in its relation to the earth's surface—cutting the converging meridians at different angles. The calculation involved in ascertaining the incessant but varying change of compass course until lately barred the way against ordinary navigators. Now, however, tables drawn up by Mr. Towson, of Devonport, are published by the Admiralty, based on the principle of breaking up the arc into short rhumb-line stages equal to one degree of longitude. The tables show the change of course to be adopted at each stage; thus the sailor keeps up his familiar and, it must be owned, simple rules of sailing, and yet the great circle, though not exactly, is tolerably followed.

Of course when a ship sails on the old system on a meridian, or on the equator, she is practising great circle sailing without probably intending it.

We have now finished our exposition of the mathematical principles and processes by which the mariner traces his vessel's track upon the ocean, or keeps his "account by dead reckoning." It has been stated that the data from which he calculates are themselves greatly liable to error, and in view of this it may be thought we have bestowed unnecessary exactness upon results which can never be taken without question. In practice, too, there is no doubt that many things we have made subjects of calculation are simply guessed by the mariner—with results usually accurate enough for the purpose, if he be up to his work. This is true, but nevertheless there is no groundwork for practice so sure as a good knowledge of theory, and even the practical work of *guessing* results is best done by those who understand how to evolve them with scientific accuracy.

The science of Nautical Astronomy—or rather the art of using the instruments by which longitude and latitude are found at sea by celestial observations—is too technical and limited in its character to find place in elementary lessons like these, which seek only to apply to navigation those mathematical principles of general utility which have been taught in other sections of this work. But just as the mariner must learn the practical work of observing speed and course, currents and leeway, and the use of the observing instruments, the log and compass, so must he learn to use sextant and quadrant as a check upon his own estimates and calculations.

MINERALOGY.—VII.

NITRATES.

ONLY two important nitrates appear in Nature.

Nitrate of Soda, or *Chili saltpetre*.—This mineral is found in many places on the coast of Chili. At Tarapaca, 3,300 feet above the sea, is a vast deposit of several feet thick, and it bears every indication of having a marine origin. It is said that the natives build their huts of blocks of this salt, proving the absence of rain in the district, as nitrate of soda is soluble in water. It crystallises in rhombohedra. When thrown on live coal it causes a vivid combustion, the soda imparting its characteristic yellow tinge to the flame. It would be used largely for making gunpowder, but it deliquescent—that is, it imbibes water from the air.

Nitrate of Potash, or *saltpetre*, is peculiarly valuable as being the chief ingredient in gunpowder. It is frequently found in caves of limestone districts, and in India and other countries appears as an efflorescence on the soil in the hot weather which succeeds copious rains. In Norway and Sweden it is artificially prepared by exposing refuse heaps to the action of the air. At the end of three years the "nitre bed" is lixiviated —that is, washed with water. This water on evaporation yields crystals of saltpetre in long thin prisms. The salt is trimetric.

CARBONATES.

Carbonate of Lime.—This mineral is very widely distributed in Nature, since of it are composed all limestone and chalk rocks. When it appears in a crystalline form, it is as a rhombohedron of the hexagonal system—a figure which is the hemihedral form of the icosahedron (see page 176). When crystallised it is called *Calc Spar*, and if the crystals are transparent it is termed *Iceland Spar*. The fact that it possesses the property of double refraction has been alluded to and illustrated in page 49. Its constitution is, 1 atom of carbonic acid and 1 of lime.

Aragonite has precisely the same composition as calc spar. Some specimens contain a little carbonate of strontia; but this is not an essential ingredient. It crystallises, however, in the *trimetric* system; hence carbonate of lime is said to be dimorphous. Aragonite is of a wine-yellow colour; its crystals are usually clustered and radiating. It is frequently associated with gypsum, is found in the fossil belemnite, and it is said that cold springs containing carbonate of lime deposit calc spar, while hot springs yield aragonite. It is named from Aragon, in Spain. Carbonates of lime effervesce when touched with acid.

Several of the ores of the metals appear as carbonates.

Clay Ironstone is found in beds in the Carboniferous system. It is a carbonate of iron, and is the chief source of that useful metal in England.

Spathic Iron Ore is the carbonate of iron when crystallised, and appears in the hexagonal system in rhombohedrons and six-sided prisms; frequently the faces are curved. When foliated and massive it is called *Sparry* iron. Its colour is light greyish to brown, and the scales are often translucent.

Calamine, carbonate of *zinc*, is the most valuable ore of that metal. Calamine has silica usually present; but when only the oxide of zinc and carbonic acid are the constituents of the mineral, it is termed *Zinc Spar*.

Malachite is *carbonate of copper*. It contains 1 atom of carbonic acid, 2 of oxide of copper, and 1 of water. It is found on the walls of lodes as a stalactitic growth, and the well-known appearance of the green stone at once indicates that it was enlarged by aggregations; it is most probably the result of the action of water containing carbonic acid on decomposing sulphuret of copper (copper pyrites).

Azurite is blue, and contains 2 atoms of carbonic acid, 3 of oxide of copper, and 1 of water. It is frequently found associated with malachite. The largest deposits of the latter mineral were in the Ural Mountains, and because it was susceptible of a high polish the stone was in great favour for all species of ornamental work, and always commanded a high price; but latterly such enormous quantities have been discovered in Australia that its value is much deteriorated.

Cerusite is carbonate of lead, which is sometimes found with galena, to whose decomposition it is due.

PHOSPHATES.

Apatite is *phosphate of lime*. It is never pure, but the fluoride and chloride of lime are invariably associated with it in small quantities. When found crystallised it is in short six-sided prisms of a greenish colour. It is found in many metamorphic rocks, and in some granites. When present in nodules in stratified rocks it is accounted to be of organic origin, for phosphate of lime is the chief constituent of bones.

Wavellite is a *hydrated phosphate of alumina*; it is usually found as small hemispheres which have a finely radiated structure within, attached to the surface of the rock, generally of a greenish shade of colour. When forced off, they leave a stellate circle on the rock.

Turquoise is also a *hydrated phosphate of alumina*. It usually contains a trace of copper. It is valued as a gem. It is found amorphous, occurring in veins in the mountainous districts of Persia. It is capable of a fine polish, and loses its beautiful blue colour in muriatic acid.

Vivianite is a *hydrated phosphate of iron*. It has a deep-blue colour, and is found with bog iron ore. It has been found in the interior of fossils, and in veins traversing clay slate.

BORATES.

We have already seen that boracic acid enters into the composition of *tourmaline* and *axinite*, but only as a subordinate, not a prominent ingredient. There are two minerals, however which are formed by this acid united to a base.

Borax, or *tincal*, crystallises in the monoclinic system in short columnar crystals. It is a hydrated borate of soda. Borax was originally brought from the shores of a salt lake in Thibet; the crude salt was termed tincal, and was purified when it reached this country. Other countries now produce it, especially certain lagoons in Tuscany. It is used as a flux in metallurgical operations, and in the manufacture of imitation gems.

Boracite is *borate of magnesia*. It crystallises in the first system, and is found, with gypsum and common salt, near Luneberg, in Lower Saxony, and other German localities.

TUNGSTATES, TANTALATES, TITANATES, ETC.

Wolfram is a *tungstate of iron* and *manganese*. It is trimetric, occurring in modified rectangular prisms; sometimes it is massive. It is dark-coloured, and usually found with tin ores.

Scheelite is a *tungstate of lime*.

Tantalate, or *columbite*, is often confounded with tinstone, which it closely resembles in appearance. It is a compound of tantalic acid with iron and manganese, and occurs in rocks containing albite and oligoclase.

Sphene, or *Titanite*, is a silico-titanate of lime. It is monoclinic, occurring in very oblique rhombic prisms. It has a greyish-brown colour, and is found disseminated in separate crystals through granite, gneiss, and other metamorphic rocks. The crystals, from their wedge shape, give the mineral its name (σφην, a wedge). The darker variety was termed titanite. Titanic acid occurs in *Brookite*, *rutile*, and *anatase*.

Having finished those minerals in which oxygen occurs, we pass on to those which are devoid of that element.

THE SULPHURETS.

The compounds of sulphur with the various metals are what may be called the primary ores, all other ores being derived by decomposition and oxidisation from them. It is supposed that the combination of these elements was determined either when the earth was in a molten state, or that it took place far down in the earth's crust, and that by the internal heat the ore was sublimed into the cracks of the rocks forming the crust, where it to-day appears as lodes and veins.

Realgar, or *Red Orpiment*, is the sulphuret of arsenic, and is composed of 2 atoms of sulphur and 1 of arsenic. Its crystals are oblique prisms of a splendid red, and having a resinous lustre.

Orpiment contains 3 atoms of sulphur. It is trimetric. Its crystals are a beautiful yellow, and possess a pearly lustre. Both these minerals have been used as paints.

Grey Antimony, or *Stibnite*, is the sulphuret of that metal, and is its chief ore. It is found massive, but when crystallised it appears in trimetric prisms. Its colour is a lead grey. This ore occurs in veins with silver, lead, zinc, or iron, or it is associated with heavy spar or quartz. It was used by the Greek ladies to blacken their eyebrows.

Silver Glance (sulphuret of silver) crystallises in dodecahedrons of the first system. It possesses metallic lustre, and is a most valuable ore. It is found in Saxony, Norway, Mexico, and Peru.

Brittle Silver Ore is a *sulphuret of silver* and *antimony*. It is trimetric, possesses metallic lustre, but, being an iron black, is readily distinguished from *silver glance*.

Ruby Silver is a variety of the above ore when the colour approaches a cochineal red. In Mexico it is not uncommon.

Light-red Silver has a similar composition to ruby silver, but arsenic takes the place of the antimony. As the name implies, the colour is not so dark.

Galena, the *sulphuret of lead*, is monometric, possessing a very perfect cleavage in planes parallel to the faces of the cube. Its lustre is highly metallic, and a lead-grey. It is the chief ore of lead, and is usually found with heavy spar for its matrix. When the galena contains silver it is granular and less lustrous.

Blende, or *sulphuret of zinc*, is monometric, with a perfect dodecahedral cleavage; it is also found massive. It has a resinous lustre, and varies in its colour from yellow-brown to black. It is found in lodes, frequently with galena, and sometimes in positions which prove that it must have been deposited from water. The miners call it *Black Jack*, as we have seen. *White Vitriol*, *Zinc Spar*, and *Calamine* owe their existence to the decomposition of blende.

Cinnabar, the *sulphuret of mercury*, is the source of the metal. It is rhombohedral when crystallised. Its colour is bright red, sometimes verging to grey. Its general situation is in slate rocks, but at Idria it is found in limestone. Almaden, in Spain, is the only other European locality which yields it.

Copper Pyrites, or *yellow copper ore*, is our principal source of the metal. Cornwall is its great repository, where upwards of 150,000 tons are annually raised. It generally crystallises as an octahedron with a square base, or in the hemihedral form—a tetrahedron. Its colour is brass-yellow. It may be scratched with a knife, which distinguishes it from iron pyrites. Its composition is 4 atoms of sulphur, combined with 2 of copper, and 2 of iron. By its decomposition many minerals are produced—*blue vitriol*, *malachite*, *chrysocolla* (hydrated silicate of copper), *black copper ore*, and *limonite* (hydrated oxide of iron).

Grey Copper Ore, whenever crystallised, so invariably appears in tetrahedra that it has been called *tetrahedrite*. No ore has such a variable composition as grey copper ore. When it contains 30 per cent. of silver in place of part of the copper, it is called *argentiferous grey copper ore* or *silver fahlery*. It is known in Germany to contain mercury, and when from 7 to 16 per cent. of this metal is present it is called *spaniolite*. The grey copper ore of the Cornish mines is seldom argentiferous.

Iron Pyrites is sulphuret of iron, and contains 2 atoms of sulphur in combination with 1 of the metal. When 1 atom of sulphur is combined with 1 of iron, *magnetic pyrites* is the result—a mineral which is slightly attracted by the magnet. When found in crystals, which is seldom, they belong to the hexagonal system. It is softer than ordinary pyrites.

Pyrites is found when crystallised in cubes, or in pentagonal dodecahedrons; but it occurs massive, and in radiated lumps. Its colour is bronze-yellow, is very hard, and strikes fire with steel; hence its name, from πυριτης. It is found in rocks of all ages, and is used to procure sulphur, sulphate of iron, sulphuric acid, and alum. Good iron cannot be got from it on account of the difficulty of entirely separating the sulphur.

Erubescite, or *horse-flesh copper ore*, is a double sulphuret of copper and iron, containing 3 atoms of sulphur, 4 of copper, and 1 of iron. Its colour is a dark flesh-red, hence its name; but this it soon loses, and becomes iridescent, exhibiting a very variegated appearance.

Copper Nickel contains 1 atom of arsenic and 2 of nickel. It is copper-coloured, hence its name. It is frequently found with cobalt, silver, and copper ores, and is the chief source of nickel.

Nickel Glance, or *white nickel*, is another arseniuret of nickel, but it contains sulphur. Its colour is tin-white, and it crystallises in cubes. Nickel is used to whiten brass, producing German silver.

Smaltine, or *grey cobalt*, is also monometric. It is usually massive, having a granular and uneven fracture, and a tin-white colour. It is an arseniuret of cobalt. Any ore of cobalt is readily recognised by the blue it imparts to a borax bead in the blow-pipe flame.

Cobaltine and *cobalt pyrites* are other ores of cobalt.

Mispickel is *arsenical iron pyrites*. It resembles arsenical cobalt, but is much harder. It occurs in trimetric rhombic prisms. It is frequently found in veins and in many crystalline schists and serpentines.

THE FLUORIDES AND CHLORIDES.

Fluorine and chlorine are members of the group termed *halogens*, because they combine directly with metals forming salts. (See Hart's "Elementary Chemistry," Chap. XIII.) The minerals thus formed are not numerous.

Fluor Spar is fluoride of lime. It is the Blue John of the Derbyshire miners, and is also termed Derbyshire spar. It crystallises in cubes, and is usually of a violet colour. It is frequently found in metallic lodes, particularly with galena and barytes. It is found in the dolomite of Saint Gothard; a rose-coloured specimen is shown at the top of the Pass, for which the collector asks 2,000 francs!

Cryolite is a double fluoride of sodium and aluminium. It is semi-transparent and light-coloured, and has been called "ice stone," because it melts in the flame of a candle. It was first found in West Greenland.

Rock Salt is the chloride of sodium. It crystallises in cubes of the first system. Its origin will be found discussed in the chapter on the Triassic period in "Lessons in Geology."

LESSONS IN ETHNOLOGY.—VII.

THE NEGROES *(continued)*.

THE tribes south of the tropic of Capricorn are not of the proper negro race. They may be divided into Caffres and Hottentots. The former are so superior a race that temptation has arisen to hold without proof that they must have a large infusion of Arab blood in their veins, but their physical appearance shows them to be almost wholly African. Yet those who have had to do with them speak highly of their intellect. The name Caffre is a Mohammedan one, signifying that the individual or tribe so designated is "infidel." The proper name of the Caffres is Amakosas; the first two syllables of which are the same as those of the term Amazirghs, applied, it will be remembered, to the Berbers of Northern Africa.

Fig. 10.—GROUP OF NEW CALEDONIANS.

The Hottentots, though occupying territories adjacent to those of the Caffres, are a totally distinct tribe. They have never shown themselves able to hold their own like the Amakosas; and, unless when raised by missionary exertions, they have simply sunk lower and lower as civilisation has advanced. The Bushmen are the most degraded of all, being mostly stunted in stature, deformed in appearance, and despised even by the other native Africans around. It is pitiable to see a tribe of mankind reduced to so hopeless a plight.

With so large a part of Africa yet unexplored it would be premature to attempt extensive classifications of its varied tongues. When, however, these shall become known and be properly compared, both in their grammatical structure and in their roots, there can be little doubt that a flood of light will be thrown on many ethnological problems at present obscure. A very interesting subject of inquiry cognate to that of the relations subsisting among the African languages—we mean, the affinities of the religions in that continent—is also most promising; in fact, it has already begun to yield interesting results.

THE NEGRITOS AND NATIVE AUSTRALIANS.

This name has been applied to a race which, though negro in its characteristics, yet occupies regions so remote from Africa, that it is not easy to suppose it in any way connected with that continent. It inhabits the Eastern Archipelago, being found in Borneo, the Philippine Islands, the Moluccas, New Guinea, and portions of Polynesia. Among the most remarkable specimens of the family are the Papuas of New Guinea, who have immense mops of frizzled hair, which give them a very odd appearance. Some have thought them not a pure but a mixed race.

The aboriginal Australians are readily distinguished from the Negritos by their hair, which is not short and woolly, but long and curly. Nevertheless, they occupy a very low place in the intellectual scale. The most persevering missionary effort among them has effected but little, and the race hastens to extinction.

CONCLUSION.

Among all the plants and animals of the world a struggle for existence is continually in progress, and the same is the case with the several races of men. When civilisation and barbarism come in contact, the option which natural law gives to the less advanced race is a very stern one: You, within a brief period, accept the higher culture placed within your reach, or you perish. Unhappily, this natural law, which the Divine Creator has seen fit, in his unerring wisdom, to make stringent in its operation, has been considerably quickened in its action by civilised men of low moral feeling, who have systematically acted to the inferior races in a manner in which, had the relative positions of the parties been reversed, they would very much have deprecated these inferior races acting towards them. In America, at the Cape of Good Hope, in Australia and elsewhere, it has been so, and thus many tribes of mankind are being thrust prematurely from the world. The Esquimaux are passing away, and the great mass of American Indians, and the islanders of the Pacific, including the New Zealand Maoris and the Hottentots at the Cape of Good Hope. In all likelihood most of these would ultimately have perished, whatever kindness they had received from the ruling races, but the injustice with which they have been too frequently treated has tended to effect in a short time what else would have required a longer period for its accomplishment. We trust that, year by year, the treatment of the uncivilised races by their more cultured brethren will be less open to objection, and that special kindness in the future may partly atone for its too frequent absence in the past. Still, whatever may be done, many races will disappear; and whoever is in a position more definitely to ascertain their physical characteristics, their language, their historic traditions, and their religious beliefs, should regard himself as bound, in the interests of science, to make the best use of his opportunities, so that knowledge which else would be lost may be preserved to the world.

Though mourning the human guilt which has so often been shown in the treatment of the inferior by the superior races, we still most deeply admire the wisdom and the goodness displayed in the natural law which makes that struggle for existence, so plainly discernible among the plants and animals of the world, operative also in the case of our species. Its tendency is slowly, and, where man does not criminally intervene, almost painlessly to extinguish tribes unpleasing in person, low in understanding and morality, and unlikely, within a moderate period of time, to rise to the level at which they might be able markedly to benefit humanity. While these are passing away, their places are being rapidly taken by races of better organisation and higher mental and moral development. The ultimate effect produced by the perpetual elimination of whatever is less perfect must be to raise the general level of humanity, and conduct it ultimately to heights which, but for this unceasing and dire struggle for existence, it would for ever be forbidden to reach.

LESSONS IN ALGEBRA.—XLIV.

Exercise 77.

1. Given $x^4 + \frac{1}{2}x^2 = 28\frac{1}{2}x$, to find x by quadratics.
2. Given $x : y :: y : z$, $x + v + z = 42$, and $x^2 + y^2 + z^2 = 1092$, to find x, y, and z.
3. What number is that, the double of which is as much above 40 as its half is below it?
4. A had £80, and B £30. B gave away a certain sum, and A twice as much; and then A had 3 times as much as B had. What did A give away?
5. Tea at 5s. 3d. per lb. is mixed with tea at 4s. 3d. per lb., and 10 lbs. of the mixture are sold for 44s. 6d. How much was there of each?
6. Divide £153 between A and B, giving B $1\frac{1}{4}$ times A's share.
7. Divide 77 into two parts, such that the sum of the quotients of the one by 4, and the other by 11, shall be 14.
8. A father's age is 49, and the son's is 11; in how many years will the father's age be treble the son's?
9. A farm of 2,850 acres is divided between three sons (A, B, and C), so that A's share is to B's as 6 : 11; and C has 300 acres more than A and B together. Find their shares.
10. A garrison consists of 2,600 men, of which there are 9 times as many foot soldiers and 3 times as many artillerymen as cavalry. Find the number of each.
11. A bill of £7 19s. has been paid with 51 coins; some are crowns, the rest are florins. Find the number of each.
12. There is a number of 2 digits; their sum is 10, and if these digits be transposed, we obtain a number greater by 15 than 4 times the original number. Find the original number.
13. The sum of two numbers is 23, and 3 times their difference is 21. Find the numbers.
14. Sold a watch for £24, and by so doing lost as much per cent. as the watch cost. Find the cost of the watch.
15. The area of a triangle is 6 square feet, and the base is known to be 3 times the height. Find the base and height.
16. Compound the ratios of $b^2 : b^2 - x^2$, $b + x : b - x$, and $b^3 - x^3 : b^3$.
17. Show that $\sqrt{11} + \sqrt{7}$ is greater than $\sqrt{19} + \sqrt{2}$.
18. Which is greater, $\sqrt{5} + \sqrt{14}$ or $\sqrt{3} + 3\sqrt{2}$?
19. Show that the ratio compounded of $a : x$, $x : y$, and $y : b$, is the same as the ratio compounded of $x + a : x + b$, and $a(x + b) : b(x + a)$.
20. Find the number to which, if 2 and 5 be successively added, the resulting numbers are in the proportion of 3 : 8.
21. Find two numbers in the proportion of 3 : 4, and their sum : the sum of their squares as 7 : 50.
22. Find the 64th term of the series 4, $6\frac{1}{2}$, 9, etc.
23. Find the 7th term, and the sum of 7 terms of the series $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{8}$, etc.
24. Find the sum of $5 + 4\frac{3}{4} + 4\frac{1}{2}$, etc., to 21 terms.
25. How many terms of the series 19, 18, 17, etc., amount to 124.
26. Two hundred stoues are placed at the distance of a yard from each other, in a right line with a basket, which is one yard from that next to it. A person starts from the basket, and brings them one by one into it. What space does he travel over?
27. Insert 4 arithmetical means between 5 and 6.
28. Given the first term of an arithmetical series = 2; and the sum of 17 terms = 102. Find the common difference.
29. The first term of an arithmetical series is 3; the 13th term is 55. Find the common difference.
30. The sum of three numbers in arithmetical progression is 21, and the sum of their squares 179. Find them.
31. Find the 8th term, and the sum of 8 terms, of the geometrical series 81, − 27, 9, etc.
32. Find the sum of 3, − 6, + 12 −, etc., to 6 terms.
33. Find the limit of the sum of the series $1 + \frac{1}{2} + \frac{1}{4}$, etc.
34. Find a geometrical series whose 1st term is 2, and 7th term is $\frac{1}{32}$.
35. Insert 3 geometrical means between 2 and $10\frac{1}{8}$.
36. The perimeter of a piece of ground in the form of a right-angled triangle = 96 rods, and the radius of its inscribed circle = 44 yards. Find the sides of the triangle, the area of the inscribed circle, and the area of the ground.
37. If a candle, in the form of a cone 12 inches high, burns 12 hours, and the bottom inch burns 1 hour longer than the top one, what time will the fourth inch from the top burn; and also find the time the top inch will last?
38. At what height must a persou be to see $\frac{1}{10}$ of the earth's surface, supposing it to be perfectly spherical, and its diameter 7,960 miles?
39. Given $\dfrac{x^4 + 1}{(x + 1)^4} = \frac{1}{2}$, to find x.
40. Given $\dfrac{x^2 + 1}{a^2 + 3ab + b^2} = \dfrac{2x}{a^2 + ab + b^2}$ to find x.
41. Given $x^3 = \sqrt{x^2 - 1} + \sqrt{x^4 - 1}$, to find x by quadratics.
42. Given $3x + 5y = 73$, to find integral values of x and y.
43. In how many ways may £80 be paid with sovereigns and guineas?
44. What number is that which, if divided by 5, 7, and 9, leaves the remainders 1, 1, and 0.
45. Divide 150 into three parts, so that one of them being divided by 9, another by 7, and the other by 2, the quotients will together amount to 25.
46. What number is that which when divided by 2, 3, 4, 5, etc., to 12 has for its remainder 1 less than its divisor?
47. How must I mix three kinds of spirits at 2s. 4d., 2s. 6d., and 3s. 4d. per gallon, to make 100 gallons at 3s.?
48. Find the side of a square, inscribed in a given semicircle, whose diameter is (a).
49. Find the side of an equilateral triangle, inscribed in a circle whose radius is (a), and that of another circumscribed about the same circle.
50. Find the sides of a rectangle, the perimeter of which is equal to that of a square whose side is (a), and its area equal to $\frac{1}{2}$ the area of the square.
51. An ingot of gold was sold at a loss for £420. If it had been sold for £570, then the gain would have been exactly 4 times as much as the loss is at present. What did it cost?
52. Find a number such that when it is added to 15, 27, and 45, there arise three numbers which are in geometrical progression.
53. A, B, and C wanted to buy a horse, but neither of them had money enough for the purpose; A begged of B and C the half of their money, in order to enable him to buy it. On the other hand, B asked A and C only for the $\frac{1}{3}$ of their money, because he then would be able to buy it himself; on which C said to A and B, "Lend me $\frac{1}{4}$ of your money each, and then I can buy it." How much money had each, and how much did the horse cost, supposing we know that they had no other money than sovereigns?
54. Five friends, A, B, C, D, and E, jointly spent a certain sum at an inn. This sum is to be paid by one of them, but on counting the sovereigns they had in their pockets (for none of them had smaller coin) no one had enough to pay it alone. If one pay it alone the others must add a part of their money; so that A must contribute $\frac{1}{4}$; B, $\frac{1}{5}$; C, $\frac{1}{6}$; D, $\frac{1}{7}$; and E, $\frac{1}{8}$ of the others' money. How much did they spend, and how much had each?
55. Find two numbers such that their product is equal to their sum, and their sum, added to the sum of their squares, is equal to $15\frac{3}{4}$.
56. A traveller starts from a certain place, and goes 1 mile the first day, 2 the second, 3 the third, 4 the fourth, etc. Five days after another traveller starts from the same place, takes the same road, and goes 12 miles daily. On what day after the departure of the first will they be together?
57. A bookseller sold me 2 bound books, the one which contained 48 sheets for 14s., the other of 78 sheets for 19s. The binding and paper were the same in both. What was the price of the binding?
58. A person buys a piece of cloth, and pays £7 for every 5 ells; he then sells every 11 ells for £16, and gains by the bargain £24. How many ells did the piece contain?
59. A sum of £156 was to be divided amongst 16 poor children, in proportion to their ages, in such a way that each of the elder ones received exactly twice as much as the next younger. If, therefore, the youngest, according to this division, received £6, how much more did each preceding one receive, and how much the eldest?
60. A schoolmaster gave his pupil two numbers to multiply, one of which was greater than the other by 75. When the scholar had finished the multiplication, he proved it; and the product divided by the least factor gave the quotient 227, and remainder 113. The schoolmaster then found that it was multiplied wrong, and ordered the error to be corrected. When the pupil had found out the error, he said that he had calculated only 1 too little in the multiplication. "No," said the

master, "not 1; but 1 thousand." What numbers were given to multiply?

61. In a solution of salt and water, the weight of the fresh water $= a$, the weight of the salt $= b$; therefore its contents $= \frac{b}{a+b}$. How much water must be added to it that its contents $= g$?

62. The sum of two numbers $= 9$, and the sum of their cube roots $= 3$. Find the numbers.

63. The sum of two numbers $= a$, and the sum of their fourth powers $= 14$ times the product of their squares. Find the numbers.

64. Find the value of R, in terms of v, r, and H, in the formula $v = \pi(R^2 + r^2 + R + r)\frac{H}{3}$.

65. Find the value of v, in terms of g and e only, from the following: $v = gt$, and $e = \frac{gt^2}{2}$.

66. I offered to buy the nuts a boy had for sale at the rate of 1s. per gross, but he could not say the exact number he had: he, however, remembered that when he counted them over by 2, 3, 5, 7, and 11 at a time, there remained 1, 2, 3, 4, and 5 respectively, and that he expected to make nearly 11s. of them. I offered him 10s. 6d. for the lot, which he agreed to. Find how many nuts there were, and whether I gained or lost, and how much.

67. Bought $21\frac{1}{2}$ cwt. of rice at x shillings per cwt., and 324 lbs. of Assam tea at y pence per lb. for £59. Find the values of x and y in integers.

68. A fortunate gamester counted the sovereigns he had won twice successively; the first time, having counted them by threes, he had 2 over; the second time he counted by fives, and had 1 over. After this he played again, and lost £6; and then counted the sum left by 7 and 11 at a time, and found he had 3 over each time. How many sovereigns did he win the first time he played?

69. Find two numbers such that the 1st multiplied by 17, and the 2nd by 26, the 1st product is 7 greater than the 2nd.

70. Divide 240 into 3 parts, so that the 1st divided by 8, and the 2nd by 6, and the 3rd by 4, the quotients and remainders are the same in each.

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XLIII.

Exercise 75.

1. Base $= \frac{\sqrt{(2h^2 - d^2)} - d}{2} = 6$; perpendicular $= \frac{d + \sqrt{(2h^2 - d^2)}}{2} = 8$.
2. Base = 12 rods, and perpendicular = 16 rods.
3. Length $l = \frac{\sqrt{2d^2 - p^2} + p}{2} = 12$; breadth $b = p - l$.
4. BC $= \frac{d}{a} \pm \sqrt{\frac{d^2}{a^2} - \frac{2bd}{a}}$; from this AB and AC can be found.
5. Hypothenuse $= \frac{s}{2} - \frac{2a}{s}$.
6. DG $= \frac{b}{2} \pm \sqrt{\frac{b^2}{4} - \frac{bc}{a}}$.
7. CD $= 3\frac{3}{5}$; DA $= 6\frac{2}{5}$.
8. x or PR $= \sqrt{ab + \frac{1}{4}d^2} - \frac{d}{2}$, and PQ $= x + d$.
9. 11 feet 4 inches.
10. 9.
11. 6.
12. 9, 12 & 15: general solution, $\frac{1}{2}\sqrt{6a}$; $\frac{2}{3}\sqrt{6a}$; and $\frac{5}{6}\sqrt{6a}$.
13. 7 & 14.
14. One of the equal sides $= \frac{1}{2}m(2 - \sqrt{2})$; the hypothenuse $= m(\sqrt{2} - 1)$.
15. $\frac{1}{33}(6 + \sqrt{3})2d$.
16. Hypothenuse = 39, and side = 36.
17. $\sqrt{m}(\sqrt{20} + 2)^{\frac{1}{2}}$.
18. $a = (d\sqrt{2} + d)^2 = 576$.
19.
20. FG $= \frac{b}{\sqrt{2}}$, and perpendicular CE $= \frac{2a}{b\sqrt{2}}$.

Exercise 76.

5. $2\left(\frac{a^2 - ab + b^2}{a^2 - b^2}\right)$ or $\frac{2ab}{a^2 - b^2}$.
6. $\frac{2}{a + b}$.
7. $\frac{1}{(x + a).(x + b).(x + c)}$.
8. $\frac{1}{a^4 - x^4}$.
9. $1 + 3x + 4x^2 + 7x^3 + 11x^4$, etc.
10. $\frac{(a + b + b^2).(a - b)}{b(a^2 + b^2)}$.
11. $1 + x + 2x^2 + 2 \times 4x^3 + 2 \times 4^2x^4$, etc.
12. $\frac{8x + 5}{24x^3 + 46x^2 + 29x + 6}$.
13. $\frac{a^2 + 2ab - b^2}{a^2 + b^2}$.
14. $x - \frac{1}{x} + 1$.
15. $x - \frac{1}{2}y + 1$.
16. $2\frac{a}{b} + 3\frac{b}{a}$.
17. $5a - 4b$.
18. $\sqrt[4]{2x}$.
19. $a\sqrt{b}$.
20. x^3.
21. $(a^2 - b^2)^{\frac{m+n}{mn}}$.
22. $x^2 + 6xz^{\frac{1}{2}} + 9z^{\frac{2}{3}} - 4y$.
23. $\frac{\sqrt[3]{x}}{\sqrt[3]{x} + \sqrt[3]{y}}$.
24. $\left(\frac{b^{\frac{1}{m}}}{a^{-\frac{1}{n}}}\right)^{mn}$.
25. $2x^2$.
26. G.C.M. $= 2x - 3a$; $\frac{2x - 3a}{4x^2 + 6ax + 9a^2}$.
27. $\frac{a^2 - ab + b^2}{a^2 + ab + b^2}$ and $\left(\frac{a + b}{a - b}\right)^2$.
30. $n^3 + 1$; and $n^{\frac{3}{2}} - 1$.
32. $ba^2 + 5ab\sqrt{-1} + 6b^2$.
35. $2x^{\frac{3}{2}}$ and $2y\sqrt{x}$.
36. $(a^{12})^{\frac{1}{12}}$, $(a^6)^{\frac{1}{12}}$, $(a^4)^{\frac{1}{12}}$, and $(a^3)^{\frac{1}{12}}$; and $(x^n)^{\frac{1}{12}}$, $(y^n)^{\frac{1}{12}}$, and $(z^{10})^{\frac{1}{12}}$.
37. $\frac{b^2}{a^2}$ and $x^{\frac{1}{3}} + a^{\frac{1}{3}}x^{\frac{1}{3}} + a^{\frac{1}{3}}$.
38. $x + 1$.
39. $4x^{\frac{1}{3}} - x^{\frac{1}{2}}$.
41. $\frac{(11y^3 + z^3)x^n}{a^m - 11x^ny^3}$.
42. $\frac{3}{2x^{m+2}} = \frac{3}{2}x^{-m-2}$.
43. $c^{-2}z^{-2}(xy)^{m+n}$.
44. $1 - 8x^{\frac{1}{2}m} + 28x^m - 56x^{\frac{3}{2}m} + 70x^{2m} - 56x^{\frac{5}{2}m} + 28x^{3m} - 8x^{\frac{7}{2}m} + x^{4m}$.
45. $\frac{m}{1} . \frac{m-1}{2} . \frac{m-2}{3} . \frac{m-3}{4} . \frac{m-4}{5} . \frac{m-5}{6} . \frac{m-6}{7} . \frac{m-7}{8} . \frac{m-8}{9} . \frac{m-9}{10} . x^{m-10}y^{10}$.
46. $\pm a^{\frac{1}{3}}b^{\frac{2}{3}}x^{\frac{1}{3}}$ and $-2x^{\frac{1}{6}}yz^{\frac{n}{4}}$.
47. $-\frac{x^2y^m}{v^{\frac{2}{n}}z^{\frac{1}{3}}}$.
48. $x^2 + 3x - 7$.
49. $(-32x^{15})^{\frac{1}{5}}$ and $(243^{\frac{1}{3}}x^{\frac{10}{3}m})^{\frac{1}{5}}$.
51. $64a^6c^6b^{-12} + 48a^5c^7db^{-9} + 15a^4c^8d^2b^{-6} + \frac{5}{4}a^3c^9d^3b^{-3} + \frac{15}{64}a^2c^{10}d^4 + \frac{3}{512}ab^3c^{11}d^5 + \frac{1}{4096}b^6c^{12}d^6$.
52. $24310a^9b^8 - 24310a^8b^9$.
53. $192192a^6b^6c^8d^8$.
54. $-161700a^{97}b^5$.
55. $d(d + 1)^{-1}$.
56. $\frac{1}{2}\sqrt{11}$
57. 49.
58. $\sqrt[5]{15}$ or 1·718771.
59. 16.
60. $\frac{1}{3}a\sqrt{3}$.
61. $-\frac{1}{2}$.
62. $x = 64$, and $y = 14$.
63. $x = 9$, and $y = 4$.
64. $x = 32$, and $y = 10$.
65. $x = 6$, and $y = 5$.
66. $x = 63$, and $y = 24$.
67. $x = \frac{2a\sqrt{d}}{\sqrt{8a^2 + 3c^2}}$; $y = \frac{c\sqrt{d}}{\sqrt{8a^2 + 3c^2}}$
68. $x = 5$, and $y = 4$.
69. $x = 2\frac{1}{3}$, and $y = 23$.
70. $x = 5$, and $y = 2$.
71. $x = 7$, and $y = 11$.
72. $x = 4$, and $y = 30$.
73. $x = 10$, and $y = 3$.
74. $x = 5$, and $y = 2$.
75. $x = 5$, and $y = 2$.
76. $x = 11$, $y = 7$, and $z = 1$.
77. $x = 90$, $y = 6$, and $z = 21$.
78. $x = 5$, $y = 2$, and $z = 3$.
79. $x = 5$, $y = 8$, and $z = 2$.
80. $x = 3$, $y = 4$, and $z = 5$.
81. $w = 2$, $x = \frac{1}{2}$, $y = 1$, and $z = 4$.
82. $v = 16$, $w = 9$, $x = 12$, $y = 3$, and $z = 8$.
83. $x = 2$ or $-2·2$; $y = 3$ or $\sqrt{10·68}$.
84. $x = (\sqrt{5\frac{1}{4}} + \frac{1}{2})^{\frac{1}{3}}$.
85. $x = 2$ or $\sqrt[3]{-6}$.
86. 4 and 2.
87. $x = 2$, and $y = 6$.
88. $x = 8$, and $z = 5$.
89. $x = \frac{1}{2}(\sqrt{5} + 5)$, and $z = \frac{1}{2}\sqrt{5}$.
90. $x = 5$, and $y = 4$.
91. $x = 6$, and $y = 4$.
92. $x = 2$, and $y = 5$.
93. $x = 7$, and $y = 3$.
94. $x = 4$, and $y = 2$.
95. $x = 4$, and $y = 7$.
96. $x = 5$, and $y = 3$.
97. 2315.
98. 2189.
99. 4 or -3.
100. 5.

Exercise 77.

1. 3.
2. $x = 2$, $y = 8$, $z = 32$.
3. 32.
4. £20.
5. 2 lbs. and 8 lbs.
6. A, £68; B, £85.
7. 44 and 33.
8. 8 years.
9. 450, 825, and 1575.
10. 200 cavalry, 600 artillery, and 1,800 foot soldiers.
11. 19 crowns and 32 florins.
12. 19.
13. 15 and 8.
14. £40.
15. Base = 6 ft., and height 2 ft.
16. $\frac{b^2 + bx + x^2}{b^2 - bx}$.
18. $\sqrt{5} + \sqrt{14}$ is the greater.
19. Both $= a : b$.
20. $-\frac{1}{2}$.
21. 6 and 8.
22. $161\frac{1}{3}$.
23. $-\frac{1}{2}$ and 0.
24. $52\frac{1}{2}$.
25. 8 or 31.
26. 40,200 yards, or 22 miles 1,480 yards.
27. $5\frac{1}{3}$, $5\frac{2}{3}$, $5\frac{3}{4}$, and $5\frac{4}{5}$.
28. 2, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, etc., to 10.
29. $4\frac{1}{2}$.
30. 3, 7, and 11.
31. $-\frac{1}{13}$, and $60\frac{2}{3}\frac{9}{}$.
32. -63.
33. 2.
34. 2, ± 1, $\frac{1}{2}$, $\pm\frac{1}{4}$, etc.
35. ± 3, $4\frac{1}{2}$, $\pm 6\frac{3}{4}$.
36. 132, 176, and 220 yards are the three sides; 6082·1376 square yds., area of inscribed circle; and 11616 square yds. = area of triangle.
37. Top inch, $\frac{1}{2}$ hour; the fourth from the top, $46\frac{1}{11}$ minutes.
38. $\frac{1}{8}$th of a diameter, or 995 miles.
39. $x = (1 \pm \sqrt{3}) \pm \sqrt{3 \pm 2\sqrt{3}}$.
40. $x = \frac{a + \sqrt{ab} + b}{a - \sqrt{ab} + b}$.
41. $x = \sqrt{\frac{1}{2}} + \frac{1}{2}\sqrt{5}$.
42. $x = 21, 16, 11$, etc.; $y = 2, 5, 8$, etc.
43. Three ways: 59, 38, or 17 sovereigns; 20, 40, or 60 guineas.
44. 36.
45. 45, 91, and 14, or 90, 42, and 18.
46. 3959.
47. At 2s. 4d., 5 lb., 10, 15, etc. (+ 5); at 2s. 6d., 34, 28, 22, etc. (− 6); at 3s. 4d., 61, 62, 63, etc. (+ 1).
48. Side of square $= a\sqrt{\frac{1}{2}}$.
49. Side of inscribed triangle, $a\sqrt{3}$; side of circumscribing triangle, $2a\sqrt{3}$.
50. Length $= \frac{a}{\sqrt{2}}\left\{\sqrt{2} \pm 1\right\}$; breadth $= \frac{a}{\sqrt{2}}\left\{\sqrt{2} \mp 1\right\}$.
51. £450.
52. 9.
53. The picture either cost £17, and then A had £5, B £11, and C £13; or the picture cost £34, and A had £10, B £22, and C £26.
54. They spent at least £879, and then A had £319, B £459, C £543, D £599, and E £639, etc. etc.
55. 3 and $\frac{3}{4}$.
56. On the 8th day, and if they continue their journey they will meet again on the 15th day.
57. 6s.
58. 440.
59. 10s. and £13 10s.
60. 159 and 234.
61. $\frac{b}{g} - (a + b)$. The unit of the weight the same as that in which a and b are given.
62. 8 and 1.
63. $\frac{a}{2}(\pm\sqrt{3} + 1)$ and $\frac{a}{2}(\mp\sqrt{3} + 1)$.
64. R $= -\frac{r}{2} + \sqrt{\frac{3v}{\pi H} - \frac{3r^2}{4}}$.
65. $v = \sqrt{2ge}$.
66. 1523 nuts, 10s. $6\frac{11}{12}$d. value, and gain $= \frac{1}{12}$ of 1d.
67. $y = 23$d. per lb.; $x = 26$s. per cwt.
68. 86 or 1241, or any term of the progression formed by the common difference, 1155.
69. 1st = 5, 31, 57, or any term of the progression increasing by 26; 2nd = 3, 20, 37, or any term of the progression increasing by 17.
70. 106, 80, and 54.

LESSONS IN ENGLISH LITERATURE.—XXVIII.

THE ROMANTIC SCHOOL.

JUST about the time when Dr. Johnson grew sick of life, and lay down to die, a great idea fell sick also and died. This was Classicalism. It had become a sorry, drivelling notion in the hands of the Della Cruscans, and still later poetasters, who remind us of people trying to dance a minuet on stilts. The world just then was in a state of unrest. Certain contemplative thinkers were searching for something a little better for the imagination and the heart than so-called "classical" commonplaces. Other thinkers, more actively disposed, were formulating into words the feeling which was slumbering inarticulately in the hearts of the masses. This feeling was a great hunger for freedom. At last these two pent-up desires made themselves potent. Romance, "like a pilgrim come from far, sounded his horn, rousing peasant and king." And the wild French mobs, in the turmoil of their great Revolution, were cheered on by some of our greatest poets. Poetry was to be no longer a plaything, a dainty amusement for educated dandies. Burns was one of the first to cut away the stilts from under the feet of the poetasters. Poetry was now to be a safety-valve through which a whole band of intensely excited and earnest men were to ease the mighty pressure of wild aspirations.

Revolutionary ideas worked strangely in the mind of Burns. A young man lilting behind his plough on an Ayrshire farm was not a likely being to rebel at every conventionality regnant in his conventional country. But his over-sensitive soul found every circumstance of his life an oppression, and his whole poetry is a cry for freedom,—freedom of love, freedom of creed, freedom from cant, freedom from social tyranny. Turbulent, lawless, libertine even, his nature was in some of its aspects; but it was also filled to overflowing with exquisite sympathies for all that is delicately beautiful in God's earth and the human spirit. His was a soul—to use a line from Shelley—

"Struggling fierce toward Heaven's free wilderness."

That soul wandered often, and wandered into sad ways, but it never had fair play, and with all its faults, it made most precious music for itself and for us.

Robert Burns was born near Ayr in 1759. He worked on his father's farm when a lad, and had little to read except Mackenzie's "Man of Feeling" and a book of songs. Verses of his own began to be circulated about his home, and afterwards in the neighbourhood of Mauchline, where he settled for a time. Boon companions liked to drink with him, and hear poetry from him. His life grew disreputable in several ways. It had its gleams of triumph however. He was fêted for a season at Edinburgh, and a collection of his poems, originally printed at Kilmarnock in 1786, went through more than one edition. But fortune never smiled serenely upon him. The staple of his income was about £70 a year, earned in the capacity of exciseman at Dumfries. Broken by the strife of a proud spirit with hard circumstances and inflammable inclinations, he wasted himself away in drink and riot, and died miserably in 1796. The world had not taken the least care of him. It was only after he had been snatched from it that it recognised what a gift of God to humanity a heart like his is. It had throbbed and thrilled itself into lyrics as purely beautiful as ever pen transcribed. He is all heart, as a poet. You feel the warm blood pulsing warmly through his writings. Any one who reads the poetry of Burns gets as near the secret sources of pure human emotions as can be.

Walter Scott was also a revolutionary, but only in a strictly literary way. His was a happy, sound nature that goes with steady work and strong digestion and undisturbed sleep. He did not feel himself "born to put the crooked straight;" but he was sick of the sillinesses and commonplaces that were so rife in the fashionable literature of his time, and he determined to try his hand at something better. He was the son of a lawyer practising in Edinburgh, where he was born in 1771. He was rather a dunce at school, and even at college he was nicknamed Duns Scotus. By-and-by, pinned to a desk in his father's office, he secretly regaled himself, not with deeds and statute-books, but with ballads and romances of chivalry. Scott's mind would have echoed the whimsical saying of Charles Lamb, "Hang posterity! Let me write for antiquity." His heart was in bygone ages, and he made the past a pageantry. His first novel was "Waverley" (1814). When this had taken the kingdom by storm, he went to work steadily to produce a long series of romances of the same kind. In earlier years he had also created a sensation with his romances in verse, of which the best are "The Lay of the Last Minstrel," "Marmion," and "The Lady of the Lake." George IV. made him a baronet. He had built himself a sort of baronial palace at Abbotsford, and entertained there in princely style. Then disaster came through commercial relations with Constable and Co., printers. Scott lost £150,000. At once he began the task of paying off all his creditors and retrieving his fortunes. He wrote "Woodstock" for £9,000, and a "Life of Napoleon" for £18,000. Many other labours succeeded these, and wore him out. He died at his beloved Abbotsford, with the Tweed murmuring in his ear, on the 21st of September, 1832. Sir Walter Scott is free enough in his treatment of history; he is content to extract from it romance, not bare fact. Yet to him we owe, not merely the pleasure of the ordinary novel-reader, but a sense of vivified history which duller, if more accurate, chronicles do not afford us. The historian peers into the dim past with a candle, and shows us facts in their truth. But Scott leads us into it with a many-coloured lamp, and lights it up with dazzling hues.

Scott had been tempted by popularity to stake his chances of fame on his poetical efforts. But he was wise, and recognised that a far truer poet was competing with him. That was Byron. George Gordon, Lord Byron, was born in London in 1788, and as early as the year 1807 he had acquired notoriety as a clever but selfish man of pleasure. In that year he published a volume of verse entitled "Hours of Idleness." This was ridiculed by the *Edinburgh Review;* and the article in this periodical drew from him the bitter satire, "English Bards and Scotch Reviewers." Byron soon developed to maturity all the vices of Burns, in fuller measure, and without the excuses Burns had. With Burns poetry was the life, vice the accident. It almost seems as if, for a time at least, vice was the life of Byron, and poetry the accident. In 1812 he published the first two cantos of his languidly voluptuous "Childe Harold," and he records that "he awoke one morning and found himself famous." The romance that was in the air at that time now impelled him to write tales in passionate verse such as "The Giaour," "The Bride of Abydos," "The Corsair," "Lara," "The Prisoner of Chillon," "Manfred." His "Childe Harold" was likewise completed, and he startled the world with an amazingly clever licentious poem called "Don Juan," about which almost anything bad or good may be said. Byron wrote many memory-haunting lyrics; his descriptive powers were of a high order; and his dramatic talent, though irregular, was strong. His chief fault is poetic egotism; his self pervades all that he writes. Macaulay likens him to the india-rubber face in the toy-books, which thrusts itself through page after page, and puts the same head on all sorts of figures. One admires Byron without respecting him. He died in 1824 at Missolonghi, whither he had gone to give a little glory to his tarnished life by fighting for the cause of Greek independence.

We have still to notice two bands of poets in whom modern ideas were fermenting during this period. One of these bands was what was called the Cockney School of Poetry. It was for a time headed by Leigh Hunt, a poet and essayist whose reputation still lives. Perhaps his best poem is that for which he was most assailed, "Francesca da Rimini." It deals with a somewhat unpleasant theme. Hunt had all a Londoner's ways about him, and "babbled of green fields" in rather a second-hand style. His language was perhaps rather luscious at times, and there was a gush about his expression of emotion that critics were not accustomed to. They attacked him severely, but not so irrationally as they attacked Keats, whom they pronounced a pupil of Hunt's Cockney School.

John Keats, the son of a livery-stable keeper, was born in London in 1796, and became articled to a surgeon, and afterwards attempted to practise for himself. His real bent, however, was towards literature, and his first poem, "Endymion," appeared in 1818. The *Quarterly Review* and *Blackwood's Magazine* vilified this grand poem as maundering, meaningless trash. Keats by-and-by brought forth another volume entitled "Tales and Poems." This contained the noble fragment, "Hyperion," besides the mystically beautiful "Eve of St. Agnes," and several other rich additions to our literature. Keats was of a consumptive tendency, and went to Italy to ward off the complaint. A hopeless love, however, combined with the consumption to prey upon him, and he died at Rome in 1820. In sensuous appreciation of the beautiful, Keats is unsurpassed. Richness of phraseology gives to his pages the many-hued glory of stained-glass. Beauty is everything to Keats, undeveloped as he was; he has little to teach but the joy of existing.

Percy Bysshe Shelley, born at Field Place, Sussex, in 1792, was Keats's twin brother in some characteristics. He was still more of a rebel to conventionalities nevertheless, and committed far more errors, though these were counterbalanced by many splendid moral qualities. His poetry has much of that impalpable beauty which cloudland has; his spirit seems to hover about the lonely peaks of human thought like the fantastic mists. His qualities are all ethereal. His verse has a pure cold Alpine beauty; but it is only rarely that it stirs the warmer human instincts. Shelley was drowned in the Gulf of Spezia, in 1822, with Keats's Poems in his pocket. His principal works are: "Queen Mab," "Alastor," "The Revolt of Islam," "The Prometheus Unbound," "The Cenci" (a drama), and "Adonais." Shelley was, like Keats, generally supposed to be a disciple of Hunt's. He was a disciple of nobody, however.

The other band of poets was the famous Lake School, so-called because the writers who formed it dwelt more or less among the English Lakes. Coleridge, Southey, and Wordsworth were the great Lake Poets. In their youth they favoured revolutionary and socialistic notions. They hatched a grand scheme for setting up a miraculously innocent colony "on the banks of the Susquehanna." It sounded very well; but as they had scarcely a five pound note among them at that time, they had to abandon the emigration scheme. They married instead, and two of them at least settled down into staid Conservatism. Samuel Taylor Coleridge, born in 1772, was an incessant thinker and a desultory writer. The chief poems he has left are the weird ghost ballad called "The Ancient Mariner," and "Christabel," a poem which everybody is compelled to admire, and nobody clearly understands. He was full of metaphysical and poetical power. His male intellect, wedded to the female intellect of Keats, would have produced a Shakespeare. Coleridge died in 1834.

Robert Southey, born in 1774, is not much valued now, though he was poet laureate, and a great man in his day. He wrote an enormous quantity of romantic verse, as well as prose. His best poems, scarcely ever read in our day, however, are "Thalaba," "Madoc," "The Curse of Kehama," and "Roderick." Southey worked himself into a state of mind bordering on idiotcy, and died in 1843.

William Wordsworth, born in 1770, changed the whole current of English poetry. He it was who first truly loved and studied external nature in its simplicity and its mystery. He is the high-priest of nature. It had been the aim of Coleridge and Southey, as well as of Wordsworth, to cultivate the study of nature at first hand; but Wordsworth had the truest instincts and sympathies to guide him in that loving reverential study. He spiritualises the hills, finds, "in the meanest thing that grows, thoughts that do often lie too deep for tears," and draws purification and sanctification for the human soul from communion with the spirit of the green world around us. He has his philosophy of life too, as well as of nature, and a noble philosophy it is, as any one will remember who has read his "Intimations of Immortality from Recollections of Early Childhood." Wordsworth's most important works are, "The Excursion" (a long semi-philosophic poem), "The White Doe of Rylestone," "Yarrow Revisited," "Ecclesiastical Sketches," and "Sonnets on the River Duddon." No poet ever held a higher ideal before him than Wordsworth. We get no passion from him. As some one has said, "There is no trumpet stop in his poetry." Yet at any rate he raises our imagination and interest to a very high and pure range of thought, and teaches us, with a very direct teaching, how we may ennoble ourselves.

Wordsworth, who, like Southey, had become poet laureate, died in 1850. The poets who have been mentioned in this chapter had few contemporaries who wrote first-rate prose—except their critics. The poetical spirit was completely dominant in the early part of this century. That poetical spirit, as we have seen, was characterised by political fervour, and also by a revived interest in romance. Many of the poets who then dreamt and sang of liberty lived to see their political hopes dispelled. The romance which they opened up to us, however, has not yet been exhausted by our writers. Perhaps what most distinguishes modern poetry, as a development from the poetry of Keats, Byron, and Wordsworth, is a tendency to increased study of character in its more dramatic phases.

INDUSTRIAL AND POLITICAL HISTORY OF COMMERCE.

CHAPTER XXVIII.—HANSEATIC LEAGUE—INFLUENCE AND DECLINE.

1. *Old Prussia, or Eastern Division.*—Trade with this province of the Hanse originated in 1309, after the Grand Master of the Teutonic Knights had subdued the Lettish tribes possessing the country, and had forced them to adopt Christianity. Some German colonists who accompanied him quickly perceived the resources of the country, and devoted themselves to trade. The natives, excluded from manufactures and commerce, were compelled to engage in agriculture and cattle-rearing. The traffic in corn and timber was considerable; that in beer, mead, amber, cloth, and iron stood next. Marienburg was chosen as the seat of government, and its old castle is still an object of interest to the traveller. Thorn, Elbing, and Königsberg were the depôts of commerce. A battle took place in 1410, as a result of which the territory was converted into a Polish fief. Connection with the Hanse, however, was still maintained, and the prosperity derived from trade was but triflingly affected.

2. *Esthonia and Livonia.*—A similar blending of theology and commerce brought the heathen races of these parts under the power of a fraternity of Bremen traders, calling themselves Knights of the Sword. After this rude conversion the people were set to work, and the Knights of the Sword were eventually absorbed by the Teutonic Knights.

In Russia the Hanse found a field of enterprise almost uncultivated. Timber, grain, flax, hemp, ropes, skins, furs, Russian leather, wax and tallow, and raw forest products, could be bartered to any indefinite extent for salt herrings and serge for the labourers, and jewels, wines, and brocades for the wealthy. The first factory in Russia was at Riga, the trade of which was especially encouraged by Archbishop Albert. Novgorod at a later date was chosen a member of the league by the Diet, with a provision thenceforward throughout the league that only a native of Lubeck should be the secretary of a factory, although any free burgher might be an alderman. A decree at the same time interdicted all trade with the Russians on credit, under a penalty of fifty marks for every such transaction. Novgorod was resorted to as a residence by many German traders, and soon grew into a great and wealthy town. Continual conflicts with the Grand Dukes of Muscovy checked its latter growth, and drove many of the Germans to the rival emporium of Dorpat, in Livonia.

So obvious were the advantages of Novgorod for trade, that Peter the Great in after times thought of making it his capital; in the present day Nischni-Novgorod is the scene of the largest cosmopolitan fair the world has ever seen. The ramifications of this division of the Hanse trade extended up the Neva, through Lake Ladoga, the river Volchoff, and Lake Ilmen. The transport of goods was almost exclusively conducted by Lubeck.

3. *Sweden.*—The kingdom of Sweden took no active part in commerce during the Middle Ages, and the inhabitants, compared with other European states, had made but little progress. Nevertheless, its kings, by wisely offering freedom of trade, induced traders from every part of the world to bring goods for barter against the raw produce of the country. Lubeck, Hamburg, and other towns were exempted about the year 1250 from wharfage and customs' dues, and in the fourteenth century, by the favour of Eric Valdemar and Magnus of Sweden, the Hanseatic traders resident in the country were put on a footing of equality with the king's own subjects. There was a reciprocal benefit in these extensive privileges, for the Swedish sovereigns thus obtained the powerful aid of the Hanse against the Danes, who

had conquered Schönen, the fairest part of the kingdom, and the best suited for commerce. Schönen was the south-western extremity of the peninsula. It was the greatest resort of herring shoals then known. While Denmark held this province, Sweden was shut out from profitable fisheries, having no place near for the necessary operations of drying, smoking, salting, packing, and shipping the produce. For the varied freights that the Hanse traders offered Sweden she gave in exchange iron and copper, timber, pitch, ashes, and hemp. The market-places of Skänor and Falsterbro monopolised the principal portion of the trade. The latter was the port of the Danish island of Falster, called from its fertility the orchard of Denmark.

4. *Norway.*—Bergen, on the Norwegian coast, was one of the four foreign factories maintained by the Hanse. As a trading station it was important not only to the country in which it was situated, but to the league itself. Concentred in Bergen was the commerce with Iceland, Greenland, the Faröes, and the Scottish Isles, consisting of skins, timber, resin, feathers, herrings, salted fish, and fish oils. Bergen was not gained over by Hanseates with such ease and rapidity as other towns. Some privileges were granted to the settlers for services rendered against the Norse pirates; but others had to be wrested from the Norwegian kings. In course of time the traders by purchase obtained possession of the old town, which they joined to the new one by a bridge. The factory they reared was an establishment of great magnitude. It consisted of twenty-two courts, in blocks of nine and thirteen, each court capable of accommodating fifteen households. The members of the community were, as we have previously stated, forbidden to marry, and subjected to severe discipline. Apprentices from the Hanse Towns came to Bergen, to be taught the business of a merchant. With the half-barbaric customs of the age, they were made to pass through the cruel ordeals of "the fire, the smoke, and the scourge," as a part of their training. In spite of these precautions, the Hanseates are described as extremely licentious, and as incessantly engaged in broils with the citizens. They proceeded so far in 1456 as to put to death the governor and the bishop who had offended them, together with sixty of the inhabitants. Yet it was not until 105 years later that the power of the Hanseates was destroyed by the vigorous measures of the reigning sovereign (Frederick II.) of Denmark.

5. *Denmark.*—The attitude of Denmark to the Hanseatic League was one of war rather than of trade. There was seldom peace between them, each in turn being the aggressor. Valdemar III., of Denmark, in 1361 attacked Wisby, or Wisboro, a wealthy Hanseatic town in Gothland. Enraged at losing 1,800 of his troops in the siege, he utterly destroyed the town, and provoked thereby the retaliation of the Hanse. Before the year expired he received seventy-seven declarations of war from the German Hanse towns. His fleet was defeated, and he was compelled to sue for peace. Soon afterwards the war was renewed, and lasted until 1370. In this interval an army of 16,000 citizens of Lubeck, commanded by Everhard von Mose and Gotschalk von Attendorn, two of the city senators, gained much renown. The Hanseates deprived Denmark of Schönen, and compelled Copenhagen, Elsinore, Nyköping, and Falsterbro to capitulate.

6. *The Netherlands.*—The Dutch were not slow to perceive the benefit of union with the Hanseatic League. Dort, Haarlem, Rotterdam, and Amsterdam, in Holland; Nimeguen, Zutphen, and Hardewyk, in Guelderland; Zwolle, Campen, and Deventer, in Overyssel, joined in federation. The Hanseates, on their part, were equally ready to buy and sell in the Dutch markets, using their own vessels for transport. They here met foreign merchants, with whom they carried on a considerable trade, especially that connected with the Mediterranean, which was beyond the reach of their own direct personal enterprise. In the South Netherlands, Flanders and Brabant vied with each in the welcome they offered the Hanseates. Louis of Flanders interdicted them from acting as bankers, but otherwise left commerce freely open. Antwerp, in 1315, promoted a commercial treaty, under the auspices of John, Duke of Brabant, and the example was followed in 1360 by Ghent, Ypres, and Bruges. In all these cities the Hanseatic traders were brought into contact with civilisation more advanced than their own. They met with institutions better than those which they themselves possessed, and learnt new principles of business. One example, among others, was that of the Insurance Chamber at Bruges, the utility of which, now universally recognised, was a new discovery to these Northern merchants.

7. *England.*—Henry III., as we have seen, permitted an entrepôt under the rule of the League to be instituted in London in the year 1267, and conferred upon the Hanse traders exemption from the duties on grain. The Hanse community accepting these terms was so numerous as to establish a government of its own, consisting of an alderman, two suppliants, and nine councillors. In consideration of these and other privileges, the Germans undertook to maintain one of the city gates, and to defend *it* in time of war.

8. *France.*—Several French cities have been mentioned as among the number of the Hanse towns; very little trade, however, was carried on with them. Beyond the limits of the usual Hanse trade, the waters were infested with pirates. The fatal policy of heavy shore dues also was blindly enforced by France. Wine and salt, the chief commodities that the country could provide, were to be obtained elsewhere. Rhenish wine was drunk in preference to French, and was a staple commodity in the Netherlands.

9. *Spain.*—Cadiz and Barcelona were in alliance with the league for mutual defence, but were not enrolled as members. The direct trade with Spain was more limited even than that with France. Indirectly, Spanish produce was obtainable through the Netherlands, which country was for a long time an appanage of the sovereigns of Spain.

INFLUENCES AND UTILITY OF THE HANSE.

In order to sustain the prestige of the league, and to enforce compliance with its mandates, the noblemen and most eminent burghers of every city trained themselves for cavalry service, while the citizens or lower ranks formed the infantry, and were armed with bows, cross-bows, battle-axes, maces, and lances. Martial ardour was kept up by an annual review known under the name of the Wapen-Shaw. In addition to citizen soldiers, the large trading towns employed mercenary troops, both horse and foot, sometimes so numerous as to form an army in themselves.

These forces were used not only to crush the German freebooters, but for sea service against hostile states, and against pirates. The Baltic was scoured by such "Victuallers," "Brethren," or "Vitaliers," whose chief seat was Embden, in Hanover, and who were encouraged in their piracies by the Count of Oldenburg. Hamburg, the chief sufferer from these pests of the sea, was mainly instrumental in their extermination.

Although barter had to be adopted in the commercial intercourse of the league with the undeveloped Northern races, yet coin was in extensive use, and many of the Hanseatic towns possessed their own mints. There was no common standard, but the coins of several of the towns were current through a large district. Those of Lubeck, for example, served for Holstein, Mecklenburg, Pomerania, and the Wendish towns. Gold was employed in the settlement of large accounts, and silver was often weighed by the mark. The system of credit which has been such a powerful stimulus to production in recent times appears scarcely to have been known. Bills of exchange were not in use, and the precious metals were necessarily carried to and fro in the same way as merchandise.

Security and peace, the vital elements of commercial prosperity, were the first fruits of this federation. Princes were taught the duty of respect for property at a time when the lesson was especially needed, and subjects learnt how much can be done by self-dependence, perseverance, honourable dealings, and co-operation. The necessity of a code of maritime law to regulate the conduct of men removed from state control, particularly in relation to shipwrecks and war, had been long felt. The laws of Wisby and Oleron were promulgated, the principles being gathered from the earlier code of Barcelona, which, in turn, was the revival of that of Rhodes, acted upon for ages by the Romans. These laws regulated for many ages the commerce of Europe, and their spirit animates the maritime codes of our own day.

CAUSES OF DECLINE.

Several causes, both direct and indirect, combined to limit the duration of the league. The direct causes, which were inherent in the institution itself, may be summed up thus:—1st. The purpose was served for which the league was instituted. 2nd. The principle of nationality was lacking. 3rd. The sphere of its action, as compared with the new areas and routes opened up in the progress of maritime discovery, was too confined.

We will consider these in detail. The Hanse League arose when a semi-barbarism prevailed throughout much of Europe, and when the right of the strongest was law. In promoting commerce and increasing wealth, the league acted as a great civilising agency. Towards the end of its course, the evil against which it had been an international safeguard no longer existed. Nations had grown prosperous and powerful, and law and order had become respected. The Netherlands, Denmark, Sweden, and Norway felt that they could stand alone. Labour was organised, and traders could travel by sea or land, without fear of pirates or freebooters. Mutual defence, the great bond of union, had become unnecessary; the constituent parts of the league, being no longer coherent, fell asunder.

Again, the Hanseates were of no one country. Its members joined for their own advantages, and fought to defend themselves. There was no loyalty to the league itself as an institution. If the private interest of any town could be better served by severance from the league, there was no spirit of fellowship to prevent a secession, and, in consequence, as states grew settled and wealthy, and therefore powerful, they threw off their allegiance. Lastly, with the opening up of new fields for enterprise, by the discoveries of Vasco de Gama and Columbus, another epoch was inaugurated. The Western states, from their superior geographical position, took the lead in the new commerce, and the Hanse trade became relatively insignificant, especially when Central Europe and the Mediterranean were no longer in the highway to India. Minor causes of decay had their origin in faults of policy and conduct. The league abused its power. From the defence it proceeded to the monopoly of trade. The commerce of the east and north-east of Europe was virtually in its hands. It compelled foreign merchants to trade in Hanseatic ships, and destroyed any vessels in the Baltic belonging to nations outside the confederation. In order to suppress all interference with its sources of gain, it waged long and costly wars to crush the trade and maritime power of its rivals. It not only drove the flag of the Netherlands from the Baltic, but made Norway and Sweden succumb, while its contests with Denmark were almost continuous. Quarrels with Prussia, Poland, and Livonia enabled the English and Dutch to supersede the Hanse in their markets. Hamburg, Lubeck, and Bremen were, at the Peace of Utrecht, in 1713, the only remaining representatives of this union, and in our time these cities have been absorbed by Prussia.

LESSONS IN GREEK.—LIV.

THE PREDICATE WITH A DOUBLE ACCUSATIVE.

THERE may be a double accusative with a transitive verb when the action of the verb operates equally on a person and on a thing. Such verbs, in Greek, are the following:—

1. Verbs which have as their object the abstract idea conveyed in the verb take also in the accusative the person affected by the verbal action; as, Σωκρατης ἑκαστον επειρατο ευεργετειν την μεγιστην ευεργεσιαν, *Socrates endeavoured to confer on each the greatest benefit.*

2. Verbs which signify to do good or ill to a person, to say good or ill of a person, take the person in the accusative, and, when the thing is indicated by a noun, have in consequence a double accusative. Accordingly, we say in Greek, αγαθα or κακα ποιειν, or δραν, or εραζεσθαι τινα.

3. The following verbs also take an accusative of the person and an accusative of the thing; namely, διδασκειν, *to learn*; παιδευειν, *to educate*; αναμιμνησκειν, ὑπομιμνησκειν, *to remind*; and many others.

4. Verbs which signify *to put on, to take off*, and the like, put both the person and the thing in the accusative; as, τα ἡμετερα ἡμας αποστερει Φιλιππος, *Philip deprives us of our own.*

IMPORT AND USE OF THE DATIVE.

The dative denotes the person or thing which is mediately affected by the action of the verb, and consequently serves to express the mediate or remote object.

The dative is employed to express proximity in space, as well as conditions which cannot be realised without such proximity. Hence the dative is used in Greek with words that signify—

(1) *Near, nearness, approach;* and especially verbs which denote—

(2) *To meet, come together, be together*, whether in a friendly or unfriendly manner; also verbs which signify *to have intercourse with, to discourse, to stand by*, and the like.

(3) Also verbs which signify any kind of mental or moral communication from one person to another, whether by deed, as *to give, to bestow;* or by word, as *to say, to announce.*

The verbs προσηκει and πρεπει, *it is proper, it becomes*, admit an accusative as well as a dative with an infinitive; δει has generally an accusative, and χρη always.

In general, the dative implies that for or against which an action takes place; and so involving advantage or disadvantage, convenience or utility, is called the *dativus commodi aut incommodi.*

IMPORT AND USE OF THE GENITIVE.

The numerous applications of the genitive may be ranged under three principal heads:—1. To denote an object to which another belongs as a part or member; this is called the *genitivus partitivus* (the *partitive genitive*). 2. An object to which another belongs as a possession or property; this is called the *genitivus possessivus* (the *genitive of possession*). 3. An object from which another proceeds, by which another is produced (hence the name *genitive*, from gigno, *I beget*) or occasioned; this is called the *genitivus auctoris*, or the *genitivus materiæ*, or again, the *genitivus causalis* (the *causal* or *originating genitive*).

1. THE PARTITIVE GENITIVE.

With nouns denoting a part or number of a whole, the whole is put in the genitive case. So are collective nouns put in the genitive, being governed by the word that signifies a part, a portion, or an individual involved in their collective signification; as, τα του σωματος μερη και μελη, *the parts and members of the body.*

Adjectives in the superlative degree govern a genitive of the class; as, μεγιστον εστι των αγαθων αρετη, *virtue is the greatest of good things.*

Verbs which denote an action that affects the object only in part, put the object in the genitive. Such verbs are, μετεχειν, *to share;* κοινωνειν, *to have in common;* μεταλαμβανειν, *to partake of;* μεταδιδοναι, *to give another a portion of;* τυγχανειν, *to fall upon, to obtain.*

The construction of these verbs is followed by a number of adjectives which involve the idea of participation, or the idea of proximity and touching.

2. THE GENITIVE OF POSSESSION

is generally used when it is intended to intimate that an object in some sense belongs to a person. This is the strictly proper use of the possessive genitive. By analogy, the use is extended to animals, and even things without life; as, ἡ Περικλεους οικια, PERICLES' *house.*

With adverbs of place and time, the indications of place and time are put in the genitive; as, πανταχου της γης ἑυρησεις αγαθους τε και πονηρους, *everywhere in the world you will find both good men and bad.*

After a similar manner is the genitive employed after demonstrative pronouns and adjectives in the neuter gender to signify the extent or degree of a quality; as, εις τουτ' ηλθεν ὑβρεως, *he went to such a pitch of insult.*

Determinations of time may be put in the genitive. Properly such determinations are those which indicate a continuance. But an object which extends may be regarded as simply a point, as in our phrase "by night"—that is, through the night, all night long. Accordingly, the genitive may be used to denote a point of time.

Here belongs what is called the genitive absolute; as, εκεινου ειποντος, παντες εσιγων, *he speaking, all were silent.*

The genitive (in Latin the *ablative*) absolute, or the genitive which *in construction* (not sense) is independent of other words, is in reality an abridged or elliptical sentence, which indicates the circumstances under which the ensuing statement is made or becomes true.

3. THE CAUSAL GENITIVE.

The genitive considered as denoting that whence anything comes may refer to place. Accordingly, the genitive is used with verbs which signify *to remove from, to separate*, as χωριζειν, διοριζειν, αποκρινειν, and the like. Again, verbs which mean *to yield, to give way before*, as εικειν, ὑπεικειν, παραχωρειν. Moreover, verbs which signify *to free, loosen, emancipate, deliver*, as απαλλαττειν, λυειν, απολυειν; *to get off* (απολλαττεσθαι); *to fail* (ἁμαρτανειν). Once more, the genitive is used with verbs which mean *to abstain, to turn from* (εχειν, αφισταναι); *to hinder* (κωλυειν, ειργειν), *to cease, stop, discontinue* (πανεσθαι, αφιεσθαι).

The genitive of origin, or the genitive properly so called, denotes not only the author or source and the material of which a thing consists, but in a restricted manner the object also, from the consideration of which our opinion or judgment is given. This use, then, may be divided into the proper and the improper.

The proper use of this genitive is seen when it gives the substance or material (*genitivus materiæ*) of which a thing is made, partly in using substantives and partly in using ειναι, ὑπαρχειν, γιγνεσθαι; also ποιειν, εργαζεσθαι, κατασκευαζειν, etc. Thus we find οικημα ξυλων, *a house of wood*, that is, a wooden house; λιθου εστρωμενη εστιν ἡ ὁδος, *the road is paved with stone.*

The causal genitive, strictly so regarded, denotes the object which is set forth as the occasion of a condition or result.

The occasion may be an object of sense, as with οσφραινεσθαι, *to smell;* so with οζειν, πνειν; also with verbs of hearing, as ακουειν, ακροασθαι, the object is constantly in the genitive.

The causal genitive appears further in cases where the occasion of mental or moral influence is expressed; as with μνημονευειν, μεμνησθαι, *to call to mind, to remember*, and similar words.

The causal genitive, moreover, is found with verbs which denote an excitement or passion of the mind, as ζηλουν, *to be envious of;* ευδαιμονιζειν, *to congratulate;* φθονειν, *to envy;* ελεειν, *to pity;* μνησικακειν, *to be revengeful;* μεταμελεσθαι (μεταμελει μοι), *to repent*, which, with a dative of the person, take a genitive of the thing.

THE PREPOSITIONS.

Prepositions may be divided into such as are found with one case, such as are found with two cases, and such as are found with three cases.

PREPOSITIONS WITH ONE CASE.

1. With the accusative: εις or ες, *into;* ανα, *up;* ὡς, *to, toward.*
2. With the dative: εν, *in;* συν (sometimes written ξυν), *with.*
3. With the genitive: αντι, *opposite;* απο (Latin, *ab*), *from;* εκ or εξ (Latin, *ex*), *out of, from, after;* προ, *before, for;* ανευ, *without;* ἑνεκα, *on account of;* χαριν, *for the sake of;* αχρι, *up to;* μεχρι, *up to.*

PREPOSITIONS WITH TWO CASES.

1. δια, with the genitive, *through;* with the accusative, *on account of.*
2. κατα, with the genitive, *down*, the opposite of ανα; with the accusative, *on.*
3. μετα, with the genitive, *with* (denoting community); with the accusative, *after* (Latin, *post*). The poets connect μετα also with the dative in the signification of *among.*
4. ὑπερ, with the genitive, *over, for;* with the accusative, *over.*

PREPOSITIONS WITH THREE CASES.

1. αμφι, *around;* with the genitive, *around;* with the dative (only in the poets), *around* (in space); with the accusative, *around* (of time).
2. περι, *around* (denoting presence on all sides); with the genitive, used of surroundings in space, only by the poets; with the dative, *around* (of space), *for the sake of, for;* with the accusative, *around, in respect of.*
3. επι, *on* (denoting the point on which an object rests); with the genitive (*of place*), *on, upon;* (of time), *during.* With the dative, when used of place, it has the same meaning as with the genitive, only that with the dative the object on which anything supports itself is conceived of as more definite, more of a point, while extension is rather implied with the genitive.
4. παρα, *by the side of, with;* with the genitive, *away from;* with the dative, *at;* with the accusative, *near, alongside, extending alongside*, as two parallel lines do.
5. προς, denoting proximity, *near;* with the genitive, *on the side of, on behalf of, for;* with the dative, *at;* with the accusative, *at, near, towards, in relation to.*
6. ὑπο, *under;* with the genitive, of space, *under;* with the dative, of space, *in, among;* with the accusative, *under, towards.*

INTERROGATIVE SENTENCES.

Interrogative sentences are formed in Greek by means of interrogative words. Such words are numerous in Greek, if only because the language has two forms of words, one for the direct and one for the indirect interrogatory. The indirect interrogatives are formed from the direct, by prefixing to the latter the syllable ὁ, by which it is indicated that the question rests on the foregoing sentence or clause.

DIRECT.	INDIRECT.
τις; who? τινα; whom?	ὁστις, who.
ποτερος; which of the two?	ὁποτερος, which of the two.
ποιος; of what kind?	ὁποιος, of what kind.
ποσος; how much? how great?	ὁποσος, how great.
πηλικος; how old?	ὁπηλικος, how old.
ποδαπος; from what country?	ὁποδαπος, from what country.
που; where?	ὁπου, where.
ποι; whither?	ὁποι, whither.
ποθεν; whence?	ὁποθεν, whence.
πως; how?	ὁπως, how.
πη; in what way?	ὁπη, in which way.

Causal interrogatives, or such as ask for the cause or reason of a thing, are formed by the interrogative pronouns in connection with a preposition; as, δια τί; *why?* του ἑνεκα; *on what account?* επι τῳ; *on what condition?* Indirect, διοτι, ὁτου ἑνεκα, αφ' ὁτῳ, etc. In the same way are formed some of the temporal interrogatives; as, μεχρι του; *how long?* so, μεχρι ποσου; μεχρις ὁσου;

Sometimes the direct interrogative is employed instead of the indirect, the question being put independently; as, ειπε μοι, ποιον τι νομιζεις ευσεβειαν ειναι; *tell me, what do you consider piety to be?*

Sometimes the direct and the indirect are connected together; as, ου γαρ αισθανομαι σου, ὁποιον νομιμον η ποιον δικαιον λεγεις, *I do not learn from you what you call lawful, or what just.*

When the person interrogated repeats the question asked, the indirect form of interrogation is employed; as, (A.) τίς γαρ ει; *who art thou?* (B.) ὁστις; *who am I, do you ask?*

Of indirect interrogative sentences the single are introduced by ει (*if, whether*), εαν, αν, and μη (*or not*); and the double by ειτε — ειτε, less frequently by ει — ειτε and ειτε — η (*whether — or*).

The subjunctive appears in direct questions when a person directs a question to himself, so as to give the idea that he is undetermined as to what opinion he should form of the matter; as, ειπωμεν η σιγωμεν; *shall we speak or be silent?*

The subjunctive takes αν with it when reference is made to a completely hypothetical foregoing proposition; as, πως αν ευ φρονησαντες ταυτα καλως εχειν ἡγησωνται; *how can the wise consider these things to be in a good condition?*

The optative, in direct questions, denotes the same kind of uncertainty as the subjunctive, only in regard to circumstances which appear as belonging to the past, whereby the matter looks very doubtful for the present; as, τι αισχιον και κακιον ειη; *what could be more shameful and base?*

The particle αν, as in the subjunctive, increases the uncertainty.

In indirect interrogative sentences the employment of the moods is generally governed by the same rules as in direct interrogative sentences. The mood depends on the tense of the principal verb, and on the degree of doubt or uncertainty; even the indicative may be used after the accompanying μη, if full conviction is intended; as, νυν φοβουμεθα μη αμφοτερων ἁμα ἡμαρτηκαμεν, *now we fear, lest we have at once missed both.*

IMPERATIVE SENTENCES.

An imperative sentence contains an expression of the speaker's will. As this expression is more or less decided, you have either a request or a wish. A request is set forth by the imperative, a wish by the optative. The negative in imperative sentences is the particle μη. The imperative of the aorist and the imperative of the present are employed, with this difference, that the imperative of the aorist is used when a strictly single act is intended, and the imperative of the present when continuance or repetition is meant. In the passive, the Greeks had a perfect imperative, by which they expressed a completed and continued condition. To the optative, as expressive of a wish, there may be prefixed the particles ει and ειθε, *O that.*

The imperative, which properly expresses a command, may be used so as to imply a concession or permission (*imperativus concessivus*); as, τουτο ιτω δπη τῳ Θεῳ φιλον, *let this take its course as God pleases.*

As a representative of the imperative, you may, with a softened import, employ the subjunctive; also the optative, with αν, when hesitation is intended. Sometimes a question is used instead of a command, as in the phrase, ου μ' εασεις; *won't you let me alone?*

POLITICAL ECONOMY.—VII.

BY J. E. THOROLD ROGERS, M.A.

TAXATION AND PUBLIC DEBTS.

It is very rarely the case that a Government makes a direct addition to the wealth of the community whose affairs it administers. It is seldom the case that, even when it can do so, it is expedient for it to make the attempt. But there are occasions when it may undertake this duty. For example, the sovereigns of Ceylon or Candy, who ruled that island before Europeans got possession of it, constructed huge tanks for purposes of irrigation, and thereupon conferred a great benefit on the country. It is to the discredit of the British Government that these artificial lakes have been suffered to go to ruin. So, in the present generation, the British Government in India has constructed railways. On the Continent, the railways have partly been made by Government; in the United Kingdom, they have been a product of private enterprise. The fact is, there are great works of public utility, which individuals cannot singly effect. In order that a community should possess them, either individuals must associate, or Government must undertake the duty. The extent to which the aid of the latter is required denotes the weakness of the joint-stock principle in the former. There is an advantage in dispensing with the immediate action of Government to the greatest possible extent. A community which is able to manage industrial operations of the largest kind by its own power of voluntary organisation, has developed its civilisation to a greater extent than one whose power of such organisation is weak, because the former has developed those moral qualities which are an antecedent condition of all corporate or combined action. The essence of these associations is mutual trust or credit, and credit is the mainstay of industrial civilisation.

But though these works are not and should not be, except to a very limited extent, the province of Government, there are certain functions which can be performed by nothing but an administration. The public authorities of a country must provide the means of defence against foreign foes and domestic enemies; must administer law; must define rights; must correct wrongs; must, in general, protect the weak against the strong. In the performance of these duties, the State is, or is supposed to be, wholly disinterested, just, impartial, as well as competent to execute or enforce the decisions at which it arrives. It is not difficult to see the reason why all these functions are interdicted to private individuals and conferred on Government. Society would become a chaos if everybody were constrained to defend himself against wrong; such, indeed, is the condition of the very lowest savages. But the private vindication of rights would lead to intolerable wrong-doing, for there is hardly any person who is a competent judge of his own right when his private interest clashes with that of another. Men who wish to be just and fair take very various views of what is just and fair to themselves and to their neighbours, and therefore need a permanent tribunal to which they may appeal in order to settle a difference, the adjudication of which they are utterly incompetent to supply by themselves. So thoroughly is this understood, that even an indolent or partial administration is better than no administration at all; and men will submit to the tyranny or caprice of one man, rather than risk the disorder and confusion which would ensue were all authority abrogated.

The functions of Government, then, arise from a real and permanent necessity. An administration is only another illustration of the need that there exists for the division of labour or employments; only that in this case the need is marked, urgent, and continual. A Government exists for the public good, and is perpetually tried by this standard. Ages ago, it was thought a paradox of the great Greek philosopher, when he said that the governor has only one object, and must have one only—the good, namely, of those he governs. Up to within comparatively recent times, people have frequently spoken of the hereditary, inalienable, or divine rights of particular individuals in particular families, and of other men being their natural or necessary subjects. But this language is now becoming obsolete, not because men are less loyal to the institutions under which they live, but because they have become competent to interpret the reason why these institutions are maintained. There is nothing which rivets the attachment of a people to its government so closely, as the clear apprehension that great and enduring benefits arise from its action, and that these are capable of being rationally expounded. And it may be added that no science has contributed so much assistance towards interpreting the real significance of Government as Political Economy, because it has always detected and exposed those false theories by which the general beneficence which Government purposes has been perverted to the selfish interests of particular classes in the community. The political economist has taught mankind that obedience is due to authority, because the very existence of society, with the enormous advantages which accrue to the individual by his connection with a civilised society, depends on order.

But, like any other service which is of value to man, the service which Government renders is costly. The benefits of order and civilisation are not obtained without sacrifice, and the sacrifice must be submitted to. An administration may call upon the members of a community to give their labour. In England, the highest function—that of debate and legislation—is performed gratuitously. So, in great measure, another very important service—that of giving a judicial decision on facts and motives—is performed by unpaid jurymen, who are liable to conscription for this end. In theory the State still claims (what a few years ago it enforced in practice), the right, namely, of compelling seamen to serve in the navy, if a public necessity supervened. Nor has the State renounced—indeed, it could not renounce—the right of calling on all the inhabitants of a country to take up arms at their own charges in order to supply the means for public defence. Again, there have been times in which labourers have been impressed for the performance of public works. The *corvée*—a custom which prevailed in France before the Revolution, by which the peasantry were constrained to render so many days' annual labour to the repair of the public roads, and which was odious because it was a partial impost—had its counterpart in this country. The military systems of France and Prussia, by which the males of these respective countries are required to furnish either a quota to the army, or to uniformly undergo military training, are similar examples of the payment of Government expenditure in kind, or by contributions of compulsory labour. In this country, for the most part, people contribute in money to the expenses of the State, but each kind of contribution is equally a tax. And generally it may be said, that the form of payment with which we are familiar—that of a money contribution—is the least onerous charge, or at least that which is least likely to interrupt those industrial energies which are characteristic of the United Kingdom.

A tax, then, is a contribution which the community pays to Government, in order that certain services may be performed which joint-stock enterprise could not supply, and private interests would not adequately comprehend and satisfy. As the service which the State renders is universal, the contribution should be universal also. If everybody is benefited by the outlay, everybody should do his part towards meeting the charge imposed. Such a proportionate payment must be regulated by the resources at the command of the person who is liable to the claim. People are not to be taxed according to their comparative weakness or strength. A woman or a child appear to enjoy more protection at the hands of society than a vigorous and active man does; but, in reality, the difference between the two, in point of weakness and strength, when estimated by the protection which society confers on both, is not considerable. Take away the securities to labour and property which the police of society provides, and the strong man is as helpless as a child—as much paralysed as if he had suddenly been bereft of his strength. The more abundant the resources which a person has when a Government gives efficient guarantees of order, the more indebted is he to the organisation which confirms him in the possession of these resources, and the more really helpless is he by himself against that violence which an efficient Government represses. If the life and liberty of all are equally guaranteed by the administration of law and the preservation of order, the property which each person possesses is secured in proportion to its amount, and therefore it is reasonable that property should supply the funds for defence proportionately to its amount, or, as I have said above, proportionately to the resources of its possessor. The word "resources" is used advisedly.

It is impossible to tax what cannot be saved, without destroying the source of that from which all wealth arises—labour. They who earn must be maintained in their work; they must be supplied with the proper tools, implements, appliances, which are necessary towards carrying on their calling. In order to work, a man must eat, be housed, and be clothed. There are very few occupations which do not require tools. In some callings, the tools are very costly. So, again, the appliances needed for carrying on a calling vary with the calling. The usages of society allow an artisan to dress himself in a coarse and cheap kind of clothing; the same usages require that a clerk in a counting-house, whose wages, maybe, are not higher than those of an artisan, should wear a far more expensive kind of dress. In the great majority of cases, the possession of a horse and carriage is a piece of voluntary expenditure; with a country doctor they are as necessary tools as a saw and plane are to a carpenter. Instances could be multiplied to prove the position, that it is impossible to tax necessary outlay, unless to the destruction of the industry which is visited by the impost. Hence there is always a stratum of society which cannot be taxed; for, assuming that its industry is in demand, and that it earns no more by its industry than is sufficient to support life, the abstraction of a portion of these earnings must be followed by one of two things: either a certain number of those who are occupied in the calling perish or are otherwise taken away, or such an addition is made to the wages of such persons as will be sufficient to make up the deficiency caused by the tax. It has been long ago observed that when wages rise and fall with the price of food, or rise and fall with the pressure of taxation, the wages paid are only just sufficient to sustain life. In India, the only tax which the mass of the people can pay is the salt-tax, because everything else which they get by their labour is necessary for their subsistence, and this is the only article in which they can save.

The greater part of the taxation of this country is levied on consumption which people could avoid, and is therefore paid out of resources which they could save. Thus, out of the total sum raised in the United Kingdom by taxation, more than one-half is got by customs—*i.e.*, duties paid upon articles imported from abroad—and excise, *i.e.*, duties levied on articles produced at home. Out of this vast sum, about one-eighth—*i.e.*, the taxes levied on tea, coffee, cocoa, etc.—may be said to be imposed on articles of necessary consumption; for tea and coffee, though not necessary to life, are so familiar that they could hardly be disused. But the remaining seven-eighths are taxes on intoxicating liquors and tobacco—articles which people can certainly do without, and which, in the opinion of many, could be very advantageously dispensed with. Meanwhile, however, a very large part of the revenue which the legislature collects is derived from voluntary expenditure, or, as I said above, from that which might have been saved.

A great deal has been said and written on the comparative merits of direct and indirect taxation. By the former is meant an impost levied on property or income; by the latter, a tax put upon voluntary consumption. But all which can be written or said on this subject resolves itself into two questions—Which is the most equitable form of taxation? Which is the most expedient? Now it is plain that if indirect taxation is levied on those articles only which are of voluntary use, no kind of taxation can be more equitable; because, both in quantity and form, it takes from that which may be saved, and it takes it with the full knowledge, and practically with the full concurrence, of the person who pays it. The condition of using such and such articles is that the use shall be burdened with a contribution to the exigencies of Government, and the use is discretionary. Now it is impossible that an income-tax should be equitable, because it is impossible, or at least it is said to be impossible, to make any difference between industrial and spontaneous incomes, still more between industrial incomes, the necessary outgoings of which are considerable, and those, the necessary outgoings of which are unimportant; between, for instance, the charges to which persons are put whose marriage has been followed by a family, and those incurred by persons who are childless. Nothing but the most preposterous alarms about excessive population would induce any one to characterise the latter state as fortunate, or a matter for public congratulation. A man who brings up a family honourably in the practice of virtue, and in habits of industry and thrift, is, say what one will, a more valuable person than one who has, either by choice or chance, no one in the world to call his own.

But the expediency of direct taxation has been frequently alleged. It is said that it is undesirable, not to say immoral, that the greatest part of the public revenue should be derived from that kind of expenditure which is mischievous and destructive. To this it may be answered that the Legislature is not to blame for the existence of those habits which lead to such an expenditure, and that, if anything, it puts some check indirectly on their indulgence. Nor is the reasoning, that this kind of expenditure is precarious, and therefore may, on its diminution, involve a collapse of the revenue, much more to the purpose. When such a collapse arises, the deficiency can be supplied from some other source, and notably from that which would otherwise have been expended and now is saved. Again, it is alleged that the costs of collecting customs and excise duties are considerable, that the existence of a custom-house service prevents the United Kingdom from becoming a free port to the whole world, and that the interference of the excise officer with domestic industry is a hindrance and a nuisance. Much, however, of the force of this reasoning, whatever it originally had, has been taken away by the fact that the objects on which customs and excise are now levied are few and bulky, and by the general decline of the practice of smuggling.

Forty years ago nothing was more natural than the practice of smuggling. There were hundreds of customs' duties, every imaginable article of commerce being burdened by some tax or other. Many of these duties were levied with a view of protecting some kind of home industry; in other words, the English consumer was made to pay more for what he wanted, in order that some English producer might get a better price for the articles with which he supplied the market. To smuggle, then, was to rectify this partiality—to relieve some persons from the burden which the manufacturer had, through his interest in Parliament, been able to impose on the public. But besides, while the Government declared that smuggling was highly criminal at home, it considered it patriotic and laudable abroad. It was thought the highest wisdom to increase the exports of the country; and there is this very important truth in such a view, that unless we sell, we cannot buy. Hence the British smuggler was encouraged, or at least excused, if he contrived to introduce British hardwares or cotton cloths into France and Spain. People argued over and over again that the retention of Gibraltar was necessary for the commerce of Great Britain, because this fortress was conveniently situated for smuggling British goods into Spain. But during the last forty years, we have arrived at the conclusion that prohibitive duties and protectionist regulations are no use to the persons in whose favour they are enacted, and are a great loss to the country which endures them; and thus there is no political sympathy with the smuggler, who has at last fallen into his proper position—that, namely, of a rogue who cheats the tax-payer, and would put, were his operations generally successful, an unfair burden on the honest dealer.

A great deal of the taxation of this country does not come into the imperial exchequer, but is levied and expended by local authority. Such, for example, are the poor-rate, highway and paving rates, rates levied for police and light, and county-rate. It is the practice to value the property which the ratepayer occupies, and to tax him according to this valuation. It is supposed that though the occupier pays the tax immediately, the person who ultimately pays it is the owner, who, it is imagined, would be so much the better off in his rent if the tax were not levied at all. But this position, though a question too abstruse to be discussed in these elementary lessons, is not by any means so clear as those who support it avow.

A large proportion of this local taxation is levied for what are called beneficial or reproductive purposes. In some cases this is perfectly plain. A good road is necessary in order to bring agricultural produce to market, just as a wagon and team are. To call the outlay which is necessary for making a road and keeping it in repair a tax, is a mere abnse of words. This charge is met by a contribution levied on all those who would or could use the road, because it is thus only that the cost is equitably distributed. To leave its construction and repair to purely voluntary effort would be to present the selfish and stingy with the labour of the public-spirited and generous.

The poor-rate is a little less manifestly a beneficial tax. It is so, however, to the employers of labour. Wages must include, for reasons now familiar to my readers, enongh to maintain the labourer, to snpply him with a reserve-fund against sickness and old age, and enough also to bring up his children so as to fill his place when his work is over. Now there is very little doubt that, even with their existing wages, many of those who obtain poor-law relief could make provision for sickness and even against old age; for benefit-clubs having the first of these objects are common among the agricultural poor. But it is doubtful whether they could maintain their families without this assistance; and it is certain that agricultural labourers accept and are content with lower rates of wages than they would submit to, if no provision were made on their behalf against the emergencies referred to. But higher wages, with no increase in the effectiveness of labour, mean a greater cost of production; and a greater cost of prodnction means less profit to the employer or less rent to the landlord. It does not follow, therefore, that the tax levied under the name of a poor-rate is a loss to employers. It may be an indirect means of paying wages; and there are persons who have argued that ultimately a poor-rate is virtually paid by those who receive it, because they have, by its operation, to put up with lower rates of wages.

The amount of annual income raised by local taxation is abont one-fourth of all the contributions which are paid for public purposes, *i.e.*, out of every £100 raised and spent, £75 goes into the exchequer, £25 is collected and spent locally. And furthermore, it will be seen from what I have already said, that when any person attempts to calculate what is the real burden of taxation, he mnst not contemplate only what people earn, bnt he must reckon what they can save. For instance, suppose we reckon £500 as the amount annually earned, and £100 as the amount which the Government claims either through the imperial or local tax-gatherer, we must not argue as thongh the pressure of taxation was merely 20 per cent. on labour, for, as I have said before, we must deduct the necessary maintenance of the people from the amount of their annual earnings. Make this deduction, and it will be found that the bnrden is much more heavy; that it may absorb or divert 70, 80, or even more per cent. of the possible savings of the people; that it may even absorb every penny of that which some persons might otherwise save. At the same time it certainly does not absorb nearly the whole, for the nation annually accumulates a large amount of wealth, and invests it.

As a matter of fact, taxation is distributed with a fair amount of equity, when we take into acconnt the general resources of those who are made liable to it. It has been shown with sufficient clearness that the aggregate earnings or income of those who get more than £100 a year is pretty equal to that of those who get less, and that the contribution of each of these moieties to the pnblic revenne is also nearly the same in amount. There is no doubt that those who have the higher rate of income are on the whole better able to pay taxes than those whose earnings are less, because, in the former case, the margin of possible saving over necessary expenditure is greater.

When the claims of the State are exceptionally great, it has been the custom for Governments to raise part of its means by way of loan, thus pledging the resources of the future on behalf of the needs of the present. Of course there can be no defence for loans contracted in order to meet ordinary expenditure, for such a practice is sheer recklessness and waste—a wilful imposition of burdens on posterity. But, on the other hand, there is no need to defend the raising of a loan for productive purposes—as, for example, a road, a railway, a canal, or similarly advantageous public works—when the use of any of these is so considerable that the toll, or rent paid for the convenience which they supply, is snfficient to meet the annual interest on the capital which has been borrowed. Nor, again, can any one object, assuming that other resources fail, that the State, in time of great danger, and when every exertion must be made in order to save the community from ruin, raises any funds which it can to meet the emergency. When everything is in peril, a necessity arises which is importunate; and all that a wise administration can do is to make the necessary charge as little burdensome as possible.

There have been certain economists—as, for example, Dr. Chalmers—who have argued that a Government ought always to raise what it needs for the pnblic service, however great the emergency, by a tax or contribution. And the reason they allege is, that as the loan must—provided it be raised at home—be taken ont of the existing resources of the community, to raise it by way of loan is to cripple the State with a donble payment, the first when the loan is contracted, the second when the interest is paid npon it.

But if my reader will bear in mind what has been said above, and what I affirm is the fundamental canon in taxation—that all taxes are paid out of what can be saved—he will see the answer to this opinion of Dr. Chalmers. Let us suppose that the urgency of the crisis in which the community is placed is such as to donble the necessary expenditnre of the State. In the year 1870 it was stated, and perhaps with truth, that the daily cost of the war to the French nation was six times the charge of the ordinary machinery of Government in times of peace. Now it is certain that there are persons in a community who could have their taxation increased sixfold and yet exist, because these persons find, or are supposed to be likely to find, the huge sums needed for military purposes. But it is quite as certain that there are hosts of people who contribute regularly to the public revenue, to whom even a double taxation might be ruin or starvation, who could not increase their qnota in any notable degree to the revenne of the State. An attempt, then, to raise an extraordinary war expenditure by taxation would be to introduce a graduated property or income tax, under which an increasing quantity would be taken from those whose means are sufficient to supply a considerable margin over their absolute necessities and those of their families.

There are two ways in which a loan can be contracted. Either a borrowing Government may vary the rate of interest which it is willing to pay for a fixed sum, according to the state of the market, or it may vary the amount of principal which it will acknowledge as its debt, while it fixes the rate of interest. For instance, it may borrow £100 at 5 per cent.; or it may give 3 per cent., and, receiving £60 from its subscribers, credit them with a debt to the extent of £100 stock. In the beginning of our debt we adopted the former course. Bnt during the long administration of Walpole, a number of these debts were consolidated into one fund, the rate of interest at that time being so low, that the minister was able to offer the public creditor the option either of being paid off, or of accepting the lower rate of interest. After this time the latter custom was adopted; and it is said that of the whole public debt, not more than two-thirds has been actually received in cash, *i.e.*, that every £100 of onr public obligations represents no more than £66 13s. 4d. paid to the exchequer.

There is one manifest inconvenience in this practice. It is almost impossible to lower the rate of interest. But it is argued, and with great reason, that this very impossibility enables the Government to borrow on the best terms. They who lend to a Government generally lend for a permanent investment. Now, if they foresee that this Government, whenever an opportunity offers itself, will set about lowering their rate of interest by offering them the option of re-payment—as the Government, in the interest of the pnblic, is bonnd to do—they will demand higher terms in order to cover this risk. As it is, they are unlike other mortgagees, for the State reserves its right of paying its debtors off, but does not give them the right of demanding their money at pleasure. And it has been calculated that, notwithstanding the fact that Government has given up the power of lowering its rate of interest, it has on the whole made a better bargain for the pnblic, than it would have made by adopting the other alternative, by raising all its stock at a fixed rate of interest, and so precluding itself from any subseqnent operation, except that of creating a snrplus revenue in order to purchase and extinguish portions of its debt.

TO OUR READERS.

WITH the present volume we bring to a conclusion the course of instruction which we mapped out for ourselves when commencing the first volume of the new and revised edition of THE POPULAR EDUCATOR. How we have carried out the task we then undertook it is for our readers to determine; at the same time we feel that the enormous and daily increasing circulation which the work enjoys is a remarkable testimony to its accuracy and value, and the estimation in which it is held by the public.

But the time has now arrived when it becomes necessary to carry this educational course a step further, and in a *somewhat different* direction. Hitherto we have been engaged in imparting to our readers what may be termed abstract or theoretical knowledge. We have, in fact, endeavoured to give, in the six volumes of THE POPULAR EDUCATOR which we have just brought to a close, a complete circle of Theoretical Education—the education of the mental faculties, the instilling of the knowledge of the laws and principles of things, the knowledge which is useful, not as an end in itself, but as a means to an end. There is another branch of education, which teaches us the practical application of these laws and principles, and the utilisation of this knowledge in the daily affairs of life, to which public attention is at the present time much directed—that which is known as Technical Education, the word "technical" having its derivation from the Greek τεχνικός (*tech'-ni-kos*), "of or belonging to some special τέχνη (*tech'-ne*) or art." To this department of education it is our intention to devote four volumes, bearing the title of THE POPULAR EDUCATOR, TECHNICAL SERIES, which—under the name of THE TECHNICAL EDUCATOR—will form an indispensable supplement to this Work. In these our object will be to provide such a course of practical instruction as may tend to render the artisan or the workman in any branch of handicraft or manufacture more perfect in the practice of his calling, and to aid him to become a skilled workman, thus enabling him, by bringing superior knowledge to bear upon his work, to obtain the highest possible rate of wages at home, and to compete favourably with the skilled workmen of other countries, where Technical Education has received a greater share of attention, and has been further developed than amongst ourselves. THE TECHNICAL EDUCATOR will be an amplification and application, or carrying out into practice, of those lessons which form the substance of the six volumes we have now completed. Thus the reader who has mastered the principles of Mechanics in this Work will find in THE TECHNICAL EDUCATOR a description of the way in which these principles are applied and exemplified in the machinery with which he is engaged. The lessons we have already given in Chemistry will be found reduced to practice in our technical papers on the Chemistry of Agriculture and Trade; our Drawing lessons will find a practical application in a series of papers on Design, as well as those which treat of the special Drawing useful for various trades and handicrafts, and also for military purposes. The papers on the Vegetable, Animal, and Mineral Products used in Trade will form a natural and practical complement to the papers we have given on Botany, Natural History, and Mineralogy. The enormous advance which has been made in the uses and applications of Electricity for Motor, Lighting, and other purposes, will render the series of papers on Electrical Engineering of special interest and value.

Our object is, in fact, to make these supplementary volumes a complete Technical Educator; the practical utility of such a Work cannot be questioned, and we are confident that the reputation which THE POPULAR EDUCATOR has achieved will serve as a guarantee for the uniform excellence and accuracy of THE TECHNICAL EDUCATOR.

THE EDITOR.

NOTE.—The above announcement (with additions necessitated by the advance in Practical Science) appeared when the New and Revised Edition of this Work was first issued. The Editor only desires to explain that every re-issue of THE POPULAR EDUCATOR is immediately followed by the re-issue of THE TECHNICAL EDUCATOR, in serial and volume form.

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