THE

POPULAR EDUCATOR:

A COMPLETE ENCYCLOPÆDIA

OF

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THE

POPULAR EDUCATOR.

HISTORIC SKETCHES.—XXXIX.

THE KNIGHTS TEMPLARS, OR RED CROSS KNIGHTS.

On the borders of the debateable land where the jurisdictions of the Queen and of the Lord Mayor of London conflict and conjoin, is a stately monument, rich in historic interest and in memories of bygone men. Hidden away under the block of buildings which form the south side of Fleet Street, one does not notice, without seeking for them, the colleges of the Inner and Middle Temple, which constitute the monument alluded to. It is from the river, from Waterloo or Blackfriars Bridge, or better still from the Surrey shore, that one sees

> "Those bricky towers,
> The which on Thames' broad, aged back do ride,
> Where now the studious lawyers have their bowers,
> There whilome wont the Templar knights to bide,
> Till they decayed through pride."

Within those "bricky towers" do now study and work the apprentices, barristers, and serjeants of the law who are members of the two societies of the Temple; there are collected some of the brightest minds which the Universities of the kingdom have trained, some of the wittiest heads that ever Nature looked upon and smiled, some of the most intellectual, polished, and learned men that are owned by the three kingdoms. They call themselves Templars, they worship in common in the Temple Church, and they preserve the devices and traditions of an order of knights whose name they bear, and in whose seats they sit. How is this? Was it always so? Certainly not. The lines of Edmund Spenser, quoted above, testify as much, and their witness, as we shall see in the course of this sketch, is exactly even with the truth. Let us inquire somewhat into the history of these colleges of law, and see how they came to be colleges at all; let us glean something out of the historic memories which cling around them, and follow the path pointed out by the finger of Time, till it leads us to the epoch when the lawyers dwelt not in the Temple, but armed Christianity stalled her horse and sharpened her sword there.

There was a cry in Christendom that the heathen had entered into the inheritance of God, and had defiled His holy places. Stories the most pitiable were told of what the infidels had done to those who went up to Jerusalem to worship; how that once more the wicked had given the dead bodies of God's servants to be meat for the fowls of the air, and the flesh of His saints to the beasts of the land. A thrill of horror went through men as they listened to the accounts, most likely exaggerated, which were repeated from mouth to mouth, "and the sensation vibrated to the heart of Europe." Swiftly there followed upon this a determination to be up and doing, a stern sentiment founded on religion and soldierly anger prompting men to exact satisfaction at the risk of their lives for the blood of Christ's children which had been shed. This was in the year 1090.

The Saracens (a people often confounded with Turks, from whom they were altogether dissimilar), from Arabia, had conquered Palestine in the year of our Lord 637, driving out the authority of the declining Greek emperors, and establishing the religion and the state system of Mahomet. The Caliphs, or chiefs of the Saracens, had so far respected the religion and social habits of the conquered Christians that they had allowed them to retain about one-fourth of the city of Jerusalem, besides numerous places in the provinces. Among other things which they were permitted to keep was the Church of the Holy Sepulchre, which the Empress Helena, mother of the first Christian Emperor, Constantine, had built over the spot where the Saviour was supposed to have been buried. The Christians experienced at the hands of the Saracens the greatest moderation, though the character and principles of the two religions were essentially different, and in some particulars diametrically opposed. Pilgrims flocked in hundreds and thousands from all parts of Europe, to see the places which had been honoured by the real presence of their Lord. to utter their prayers in the very places where He had prayed, to abase themselves on the very scene of His sufferings, and to adore Him in Jerusalem, "the place where God ought to be worshipped." Though their numbers must have proved inconvenient, one would think, to the Mussulman authorities, and though their enthusiasm was not unlikely to have produced breaches of the peace, we do not hear of their having been interfered with. Occasionally, perhaps, there was a disturbance, but that in all probability was due rather to the imprudence of the Christians than to the tyranny of the Caliph; so the pilgrimages went on, and were accounted by the religious system of the day for righteousness in those who performed them.

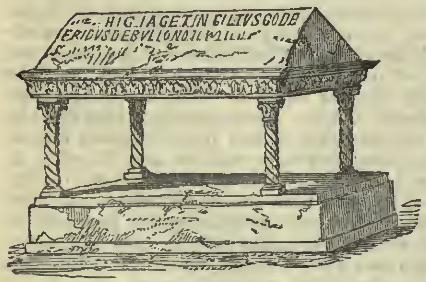
But a change came. In the year 1065, the year before the conquest of England by the Normans, Palestine was wrested from the Saracens by the Turcoman troops, whom they had hired, in the decline of their own vigour, to defend them. The power of the Arabian Caliphs was over; that of the Turkish Sultans or Emirs had taken its place. A very different sort of power the Christians found it. Though professing the same creed as the Saracens, the Turks had none of their moderation. Brutality coupled with fanaticism—these were the principles on which the new rulers proceeded to govern. Forthwith came a wail of misery from the Holy Land; pilgrims were ill-treated, insulted, and put to death. Women (it was customary even for women to go) were outraged; taxes the most offensive were exacted from those pilgrims who had money, and those who had none were driven back with the sword, whilst great numbers perished through the instrumentality of the Turks. A golden fee was required of every one before he could be admitted to the Holy Sepulchre. The Patriarch of Jerusalem was dragged across his church by the hair of his head, and flung into a dungeon, in order that he might be induced to procure the large ransom demanded of him. These and other tales came to Europe, brought by the wayworn and pitiable-looking objects who returned from their pilgrimage with life, and the effect of them was to arouse in the minds of all men the feelings of indignation and pity which have been already referred to—feelings akin to those, though far more ecstatic, which were felt in England when the story of the Indian mutiny came over, or, in a less degree, which were felt when the refusal of Abyssinian Theodore to give up his captives was made known.

Men's minds were ripe for action. They only wanted, as they ever want, some master-mind to take the lead. That master-mind was found in Peter, the Hermit, who marched barefoot through Europe, preaching a holy war, and exhorting Christians not to suffer infidels to crucify the Lord afresh in the persons of His children, and to put Him to an open shame. Pope Urban II. backed the hermit with all his influence, and Christendom roused as one man. "It is the will of God! it is the will of God!" the people shouted on the plains of Auvergne, when Peter stirred up many thousands of them with the burning words of his eloquence. A vast mob, numbering over 500,000, possessed with plenty of enthusiasm but little military knowledge, marched forthwith under the guidance of Peter the Hermit and Walter the Moneyless; but they melted like snow nnder the hardships of the journey and by reason of the divisions which sprang up among them. Before they reached Constantinople, then the capital of the Christian Greek Empire (Constantinople was not taken by the Turks under Mahomet II. till 1453), they became a mere rabble, and went no farther. Other hordes, under military leaders, and in nnmbers 700,000 strong, marched to the Crusades notwithstanding. Princes, barons, knights, esqnires, yeomen, priests, hastened to enrol themselves under the banner of the Cross, and streamed eastward, possessed with the one idea of rescuing the Holy Land from the clutches of infidels, happy if only they might tread the land which had been trod by holiest feet. There were many of these crusades, the most notable being that led by Richard the Lion-hearted in the year 1190.

It is not surprising that such desperate enthusiasm should have sncceeded in doing somewhat. Jerusalem was taken by the Crusaders. The Mussnlmans were driven to the mountains, and a Latin kingdom, based upon the feudal principle (which has been explained in previous sketches), was established in their place.

The dangers surrounding this kingdom were great and perennial. The Turks, commingled now with their Saracen brethren in faith, were ever on the watch to inflict injury on the invaders, and to play the part of the enemy who sowed the tares, if perchance at any time the Christians slept. For a while the conquerors, reinforced by numerons additions from home, held their own, and kept np their communications with the sea; but gradually, as zeal grew faint, these succours became less, and there was considerable difficnlty experienced by the Kings of Jerusalem in protecting their snbjects, let alone visitors. It should be mentioned that the first and most renowned of the Christian Kings of Jerusalem was Godfrey de Bouillon, who mortgaged his Duchy of Bouillon in the Ardennes in 1095 to the Bishop of Liege, to raise the fnnds necessary to enable him to take part in the first Crusade. Following in the track of Peter the Hermit, he reached Palestine after encountering and surmounting difficulties of no ordinary nature; and having been joined by the forces that marched under Robert of Normandy, Bohemond of Tarentum, and other leaders, he was unanimously elected to the supreme command of the Christian hosts in the Holy Land. After a long siege Antioch yielded to the repeated attacks of the Crusaders in 1098, and about a year after Jerusalem was taken by assault, July 15, 1099. The guardianship of the Holy City was vested in Godfrey de Bouillon, who received the title of King of Jerusalem. He did not long enjoy his sovereignty, for in a year and three days after the capture of Jerusalem he died snddenly, having been, it is supposed, poisoned by the Emir of Cæsarea.

Pilgrims continued to journey to the Holy City, receiving as their reward the assurance from the priests of absolution even from the most deadly sins. And certainly they deserved something substantial, for at this time they had not only to bear the enormons expense which a pilgrimage, say from Northampton to the East, cost in those days, but they had to incnr, in addition to this, to say nothing of the risks of climate, etc., the certain hostility of deadly foes, well acqnainted with the country, and whose business in life it was to go abont seeking what Christians they might devonr. The journey from the coast to Jerusalem, no matter at what port the pilgrims disembarked, was full of peril. Numbers of travellers were cut off even in sight of the Holy City, and the King of the place was not able to succour them. Afflicted beyond measure at the sight of so much wrong, anxions to redress, as far as in them lay, the injuries suffered by the pilgrims, nine knights bound themselves by a solemn vow to devote themselves wholly and unrcservedly to the sacred duty of shielding the pilgrims and of punishing their oppressors. A brotherhood of arms was formed under the most solemn circumstances, and vows were taken by the nine in the presence of the Patriarch, to the effect that they would devote themselves to this work; that they would be chaste, poor, and obedient, and do all to the glory of God. They called themselves *The poor Fellow-soldiers of Jesus Christ.*



TOMB OF GODFREY DE BOUILLON AT JERUSALEM.

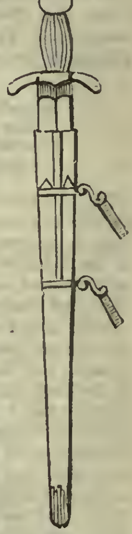
They acted as the police of the Latin King in the matter of Turks, infidels, and heretics; and the idea on which the brotherhood was fonnded, conpled with the reputation their prowess soon acquired, made the service of the Poor Fellow-soldiers very popular in Europe. A humorous writer has thus analysed the motives which induced men to go to the Crusades, showing that "for sake of the party" most men were most moved:—

Religion	1	Because it's the fashion... ...	4
Hatred of Turks	2	Love of bloodshed	5
The wish of my lady-love ...	3	For the sake of the party ...	15

It may have been so with those who joined the brotherhood. Certain it is the number of the order soon exceeded the original number, and some of the "best blood" and the first military talents were to be found among its members. Baldwin II., King of Jerusalem in the year 1118 (nineteen years after the conquest of the place), granted the knights a dwelling-place in the enclosure of the Temple on Mount Moriah, the re-edified Temple of Solomon, and from that time the knights were known as the *Knighthood of the Temple of Solomon.*

Ten years afterwards, the knights having formed themselves into a body of military monks, bonnd by the same rules as monks, and yet soldiers still, obtained recognition from the Pope (Honorius), and were favoured with many honours of an ecclesiastical kind. St. Bernard, Abbot of Clairvaux (anthor, among other things, of the hymn "Jerusalem the Golden"), himself drew up the rules of the order, which are exceedingly curious and sufficiently stringent.

Constant attendance on prayer, self-mortification, complete self-surrender, fasting—these were the principles on which the rules were framed. The twentieth rule prescribed white dresses for the knights. "To all the professed knights, both in winter and summer, we give, if they can be procured, white garments; that those who have cast behind them a dark life, may know that they are to commend themselves to their Creator by a pure and white life. For what is whiteness but perfect chastity, and chastity is the security of the soul, and the health of the body. And nnless every knight shall continue chaste, he shall not come to perpetnal rest, nor see God, as the Apostle Paul witnesseth: Follow after peace with all men, and chastity, without which no man shall see God." Esquires and retainers were to be clothed in black cloth, or, failing that, of brown or some mean colour; "it is granted to none to wear white habits, or to have white mantles, excepting the above-named knights of Christ." Gold or silver was forbidden to be worn on the harness and trappings of the knights—simplicity and unrichness were to be the order of the brotherhood. All money and all gifts were to be in common. There was not to be any communication with the outer world except through tho Master, and sporting of all kinds was strictly forbidden. For the purposes of the brotherhood it was permitted the knights to possess lands and husbandmen, "and the cnstomary services onght to be specially rendered unto you." Rule 66 says, "It is, moreover, exceedingly dangerons to join sisters with yon in your holy profession, for the ancient enemy hath drawn (St. Bernard spake as a monk) many away from the right path to paradise through the society of women." In the last clause of the rules this warning is repeated, with a prohibition:—"Lastly, we hold it dangerous to all religion to gaze too much on the countenance of women; and therefore no brother shall presume to kiss neither widow nor virgin, nor mother nor sister, nor aunt, nor any other woman. Let the knighthood of Christ



SWORD OF GODFREY DE BOUILLON. FROM THE ORIGINAL PRESERVED AT JERUSALEM.

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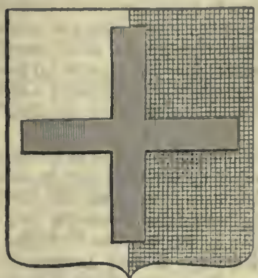
shun feminine kisses, through which men have very often been drawn into danger, so that each, with a pure conscience and secure life, may be able to walk everlastingly in the sight of God."

These rules were confirmed by the Pope, and Hugh de Payens was chosen Master of the Knights. De Payens travelled through Europe, amassing gifts, and getting recruits for the brotherhood. In England he was well received in the year 1128, and there he founded a branch establishment of the knights, under the wardenship of a Prior, who was, on the appointment of sub-priors over other branches in England, called the Grand Prior, and subsequently Master of the Temple, the title of the supreme head in Palestine being at the same time changed into that of Grand Master.

On the spot where "now the studious lawyers have their bowers," the English Templars dwelt, their Master a peer of Parliament. At first, however, they lived in the Old Temple without Holborn Bars, close to the spot where Southampton Buildings now stand; and it was not till many years after the establishment of the order in England that they bought the ground on which they built the New Temple, the site of the present law colleges. Numerous branch depôts in the country sent up men and money to the central body in London, and the Master and knights in London supplied the wants of the order at Jerusalem. In other countries, especially in France, the Templars took deep root, and enormous possessions in land and money were bestowed upon them. The order became very popular, and its numbers increased so that the muster-roll of the knights included the names of many thousands of warriors, picked men from the flower of European chivalry. In the course of a few years they rose into such prominence that kings were glad to court their favour; to the King of Jerusalem they were in the stead of a standing army, and upon them devolved the never-ceasing warfare which was necessary to defend the Latin settlement from destruction.



SHIELD OF A KNIGHT TEMPLAR.

About the year 1146, when the second Crusade was being prepared, the Templars assumed, by permission of the Pope, a red cross, which was worn on the left breast of their mantles, and which obtained for them the name of Red Friars, or Red Cross Knights. They also obtained, at the same period, large additional benefices. Their work was not all rose-water, however; far from it—they had rough and constant employment against enemies both to race and religion, men embittered by years of mutual injury, by fanaticism, by every strong impulse. At times they conquered, at others they fell—even their Grand Master on one occasion being taken and kept in prison till he died. Saladin, the hero of many a romance, a most able warrior and statesman, was the great foe of the Christians; and as under his auspices the Crescent grew, the light of the Cross became pale in Palestine. At one time the whole of the brethren in garrison at Jerusalem having been captured, and offered the alternative of death or the Koran, elected the former, and were beheaded accordingly. By way of reprisal for these things, it often happened that the Knights forgot the Christian quality of mercy, and involved in one common destruction the whole of their captives; indeed, in the end the war between Cross and Crescent became a war to the knife. The Templars were a terror to all but the best of the Turkish soldiers, and rode through their lines in splendid charges, which made the earth quake beneath them.

The Knights Templars had been instituted as a rival order to that of the Knights of St. John of Jerusalem, which was or-organised as a military body about 1099. This order was never at any time of its existence so wealthy and powerful as that of the Templars, and on this account always held a higher position in popular favour. The Templars, on the other hand, were being spoiled by prosperity, and their wealth was now beginning to stir up the envy and desire of the needy. In every country in Europe they had property either in land or money—nine thousand manors in all, besides other riches; and their privileges, obtained both from kings and from the pope, were calculated to arouse the jealousy of the people. Riches, too, in the hands of the "Poor Fellow-soldiers of Jesus Christ," the men who had taken vows of poverty, did not cause their possessors to prosper; the military monks grew less and less chary of going to fight in the Holy Land; and when, in 1187, Saladin re-conquered Jerusalem, and put all the Templars there, together with the other defenders of the place, to the sword, the rest of the fraternity were still less inclined to make an effort to rescue the city, and to re-found the Latin Kingdom in the East. They remained, therefore, at home, living upon their property, jealously preserving the rights granted to them under widely different circumstances, and making themselves obnoxious by their pride and worldliness. The annual income of the order was estimated at £6,000,000.

A society so rich and so powerful could not but have enemies. It began to be whispered that not only did they visibly neglect the obligations of their vows, but secretly they conducted themselves in the most abominable manner; that they worshipped the devil, and dealt in magic, and that one part of the ceremonial on admission to the order was the act of spitting on an image of the Saviour. These and other grave charges were brought against them, but their pride would not allow of their making any reply, till colour having been given to them by the irregularities of some of the brethren, Philip the Fair, of France, who had an eye to confiscations, resolved, in 1296, to proceed against them. As they had no friends, he thought he might safely kick them. After a splendid defence of each one of their posts in Syria, which they lost in succession, overwhelmed by great numbers, after the death in battle of their last notable Grand Master, and after their final expulsion from the Holy Land, their influence diminished with the disgrace that had come upon them.

Philip gave ear to the scandal bruited concerning the Knights. James de Molay, of a noble Burgundian family, was Grand Master. He was an illustrious warrior, who had fought in all the latest battles in Palestine, and had, in conjunction with the Persian King, to whom he at one time allied himself, re-conquered for a while the lost ground in Syria. He had held King Philip at the baptismal font. He was approved an honest man as well as a noble soldier in the sight of all men, and the voice of calumny was not able to speak against him. Yet Philip, having invited him from Cyprus, his stronghold, flung him into prison, and kept him there five years and a half. Meantime information, much of it of an absurd and ridiculous character, was gladly received from any quarter by the King. Pope Clement V., who was wholly under French influence (the Papal Court was then at Avignon), issued bulls ordering inquisition to be made into the conduct of the monks. In France this inquiry was made under torture, and more than a hundred Knights died under the tormentors' hands. Some confessed, under the smart of pain, to foul and unnatural crimes, which they denied afterwards to the death; and upon evidence of this kind, and other evidence quite as unsatisfactory, several hundreds of Templars were burned at slow fires—more than a hundred and ten in Paris on one occasion. France was the only country in which this excessive barbarity was practised, but as in all countries the wealth of the order was a great crime, the fate of the order itself was decided simultaneously everywhere. Their possessions were confiscated throughout Europe, and given, part to the rival order of the Knights of St. John of Jerusalem, part to the princes who had seen them to their end; and the Pope, in 1327, issued a decree abolishing the whole order.

James de Molay, the Grand Master, having endured five years and a half of rigorous confinement, and having probably suffered torture therein, was led out in company with three of his chief officers, on the 18th of March, 1313, to recite in the hearing of the people of Paris the charges he had confessed while under torture. The Bishop of Alba read the confessions, and then called on the prisoners to affirm them. Two of the unhappy Knights, worn out by torture and suffering, assented, but the Grand Master, loaded with chains, called out with a loud voice that for him to affirm an untruth was a crime of which he would not be guilty; and he added, "I do confess my guilt, which consists in having, to my shame and dishonour, suffered myself, through the pain of torture and the fear of death, to give utterance to falsehoods imputing scandalous sins and iniquities to an illustrious order, which hath nobly served the cause of Christianity. I disdain to purchase such a wretched and disgraceful existence by engrafting another lie upon the original falsehood." Guy, the Grand Preceptor, having said something to the same effect, Philip became enraged, and that same evening, at dusk, the two unfortunate Knights, the last Grand Master, and the last Grand Preceptor, were taken to a spot outside Paris, and slowly roasted to death.

Fuller says, "The chief cause of the ruin of the Templars was their extraordinary wealth. As Naboth's vineyard was the chiefest ground of his blasphemy, and as in England Sir John Cornwall, Lord Fanhope, said merrily, not he, but his stately house at Ampthill, in Bedfordshire, was guilty of high treason, so certainly their wealth was the principal cause of their overthrow."

In England, while much of the property of the Knights was seized by the King (Edward III.), a large portion, including the Temple in London, was given to the Knights of St. John of Jerusalem, who let it to the lawyers, and continued to do so down to the time of the suppression of monasteries in 1539, when the Knights of St. John, in common with all other conventual institutions in England, ceased to exist. The property of the Knights was resumed by the Crown, and various noblemen enjoyed the grant of the Temple in London, until the reign of James I. That monarch granted it to the executive members of the two law societies which had flourished there since the downfall of the Templar Knights, and they still hold it by virtue of King James's grant, on condition of paying a quit rent of ten pounds a year.

Chronological Table of the Crusades and Principal Events in the History of the Orders of the Knights Templars and Knights of St. John of Jerusalem.

Crusades suggested by Peter the Hermit, and sanctioned by Pope Urban II.	1094
First Crusade under Godfrey de Bouillon and others (*temp.* William II.)	1096
Jerusalem taken . July 15,	1099
Latin Principalities of Jerusalem, Antioch, and Edessa founded	1099
Military Order of the Knights of St. John of Jerusalem founded	1099
Order of Knights Templars founded by Baldwin II. of Jerusalem	1118
Templars establish themselves in England	1128
Edessa conquered by the Saracens	1144
Fresh Crusade preached by St. Bernard of Clairvaux	1146
Second Crusade under Conrad II. of Germany and Louis VII. of France (*temp.* Stephen), unsuccessful	1147
Jerusalem taken by the Saracens under Saladin	1187
Third Crusade commenced by Frederick Barbarossa, Emperor of Germany	1189
Carried on by Richard I. of England and Philip II. of France	1190
Fourth Crusade under Henry V. of Germany (*temp.* Richard I.)	1195
Fifth Crusade under Baldwin of Flanders, who stopped at Constantinople instead of going to the Holy Land (*temp.* John)	1204
Jerusalem taken by the Turks	1217
Sixth Crusade under Frederick II. of Germany (*temp.* Henry III.)	1228
Jerusalem again taken by the Turks	1239
The Temple Church built	1240
Seventh Crusade under Louis IX. of France (*temp.* Henry III.), unsuccessful	1249
Eighth and last Crusade commenced by Louis IX. of France (*temp.* Henry III.)	1270
Carried on by Prince Edward, afterwards Edward I. of England	1271
Christian Troops finally withdrawn from the Holy Land	1291
Knights of St. John retire to Cyprus	1291
Rhodes occupied by Knights of St. John	1310
Order of Templars suppressed in France	1312
Grand Master, James de Molay, burned in Paris	1314
Templars suppressed in England . . . . about	1340
Rhodes taken by Solyman II.	1522
Knights of St. John retire to Sicily	1522
Malta given to the Knights of St. John by Charles V. of Germany	1530
Order of Knights of St. John finally suppressed in England	1539
Malta taken by Bonaparte	1798
Malta taken by the British	1800
From this time the Knights of St. John have ceased to hold any territory.	

Christian Kings of Jerusalem.

Godfrey de Bouillon	1099	Amaury	1162	Amaury de Lusignan	1197
Baldwin I. (brother of Godfrey)	1100	Baldwin IV.	1173	Jeanne de Brienne	1210
Baldwin II.	1118	Sibyl	1185	Frederick II. of Germany	1229
Fulk of Anjou	1131	Baldwin V.	1185	This King was expelled by the Turks	1239
Baldwin III.	1144	Guy de Lusignan	1186		
		Henry de Champagne	1192		

READINGS IN FRENCH.—XIII.

JACOPO.

SECTION V.

Au plus fort de la mêlée un Russe parvient(*a*) à quelques pas de Napoléon;[1] il l'ajuste, le coup part(*b*); mais un soldat s'est précipité[2] devant l'Empereur. Il tombe frappé de la balle[3] qui devait atteindre le grand capitaine. Napoléon a tout vu(*c*); il donne l'ordre d'enlever le soldat[4] et de le porter aux ambulances. Après la bataille, il courut s'informer[5] lui-même de ce qu'il était devenu. Le soldat n'était[6] que blessé. Lorsque l'Empereur parut(*d*), il sembla avoir oublié sa blessure;[7] il leva sur lui des yeux brillant d'un éclat extraordinaire. Napoléon l'examine plus attentivement;[8] un souvenir confus lui rappelle les traits de cet homme. Tout à coup il remarque dans la main du soldat les débris d'une boîte d'ébène[9] que la balle, en le frappant, a fracassée(*e*). Nul doute, c'est Jacopo! c'est le fils du pêcheur.[10] C'était lui, en effet, lui qui n'avait osé, jusqu'à ce jour,[11] pénétrer jusqu'auprès de celui qui, enfant, avait été son bienfaiteur; lui qui, ayant pris du service(*f*) dans l'armée française, avait au moins voulu[12] combattre pour ce Napoléon qu'il aimait tant. Toujours il portait sur son cœur[13] la boîte que Napoléon lui avait donnée; c'est elle qui avait amorti[14] le coup du soldat russe; c'est elle qui lui avait sauvé la vie. Napoléon, comme vous le pensez bien, n'en resta (*g*) pas là avec Jacopo. Il le plaça dans sa garde[15] et pourvut(*h*) à son avancement. Ses bienfaits s'étendirent sur toute la famille,[16] et le nom de l'Empereur fut béni.

Plus tard, nous retrouverons encore Jacopo. Quand la fortune se lassa[17] enfin des faveurs qu'elle avait accumulées sur la tête du conquérant, que, précipité du haut de son trône, elle l'eut jeté sur le rocher de Sainte-Hélène,[18] une barque cotoya longtemps les rivages de cette île,[19] tandis qu'un vaisseau[20] stationnait en pleine(*i*) mer à quelque distance. C'était Jacopo qui avait résolu de délivrer le prisonnier. Tous ses efforts échouèrent[21] contre la surveillance des Anglais. Désespéré, Jacopo alla s'établir à Sainte-Hélène;[22] il parvint(*j*) à obtenir l'autorisation de servir l'illustre captif. Il assista à son agonie, à sa mort, et jusqu'en 1840, il n'a pas quitté son tombeau. Lorsque enfin est arrivée l'éclatante réparation faite aux mânes du grand homme, Jacopo a pu accompagner ses cendres;[23] il faisait partie du cortège. Aujourd'hui, vous pouvez voir dans la chapelle des Invalides un vieillard[24] qui, chaque jour, vient s'agenouiller au pied du tombeau qui contient les dépouilles mortelles de l'Empereur. C'est Jacopo.

COLLOQUIAL EXERCISE.

1. Qu'arriva-t-il au plus fort de la mêlée?
2. Comment Napoléon fut-il sauvé?
3. Le soldat fut-il atteint?
4. Qu'ordonna alors Napoléon?
5. Où alla-t-il après la bataille?
6. Le soldat était-il mort?
7. Que fit-il en voyant l'Empereur?
8. Que fit Napoléon?
9. Que remarqua-t-il dans la main du soldat?
10. Quel était cet homme?
11. Pourquoi Napoléon ne l'avait-il pas vu plus tôt?
12. Pourquoi avait-il pris du service?
13. Que portait-il toujours sur son cœur?
14. Comment la boîte lui avait-elle sauvé la vie?
15. Que fit Napoléon pour son ancien ami?
16. Borna-t-il là ses bienfaits?
17. Quand retrouverons-nous Jacopo?
18. Où la fortune avait-elle jeté Napoléon?
19. Que fit long-temps une barque?
20. Où voyait-on un vaisseau?
21. Jacopo réussit-il dans ses efforts?
22. Où alla-t-il s'établir?
23. Où revint-il en 1840?
24. Que voit-on aujourd'hui dans la chapelle des Invalides?

NOTES.

(*a*) From *parvenir.*
(*b*) From *partir.*
(*c*) From *voir.*
(*d*) From *paraître.*
(*e*) Fracassée, *shattered.*
(*f*) Pris du service, *enlisted.*
(*g*) N'en resta pas là, *did not confine his gratitude to this.*
(*h*) From *pourvoir.*
(*i*) Pleine, *open.*
(*j*) From *parvenir.*

L'ÂNON.

Oh! quand je serai(*a*) grand(*b*), que je m'amuserai![1]
Quel plaisir d'être libre et d'agir à sa tête!
J'irai, je viendrai, je (*c*)courrai;[2]
Je veux voir du pays et je voyagerai;
Tous mes jours seront jours de fête

Au lieu de rester là, tristement attaché
Et réduit à brouter dans cette étroite sphère.
Ainsi que mon père et ma mère,[3]
J'irai fièrement au marché;
Mes paniers sur mon dos, agitant ma sonnette:
Chacun m'admirera.—"Voyez-vous?"(*d*) dira-t-on,
"Comme il a l'oreille bien(*e*) faite![4]
Quel jarret ferme(*f*), et quel air de raison!
C'est une créature, en vérité, parfaite;
Le voilà maintenant âne, et non plus ânon . . . .
Quel bonheur d'être grand! Tout devient(*g*) jouissance;[5]
On est quelqu'un, on peut hausser le ton;[6]
Ce qu'on dit a de l'importance,
Et l'on n'est plus traité comme un petit garçon."[7]

Ainsi dans sa pauvre cervelle,
Raisonnait un jeune grison,[8]
Tout en broutant l'herbe nouvelle.[9]
Le jour qu'il désirait à la fin arriva.
Il devint grand, mais il trouva
Qu'il n'avait pas bien fait son compte.[10]
Lorsqu'il sentit les paniers sur son dos:
"Oh! oh," dit-il, "voici de lourds fardeaux:[11]
Mon allure avec eux ne sera pas très-prompte."[12]
À peine achevait-il ce mot,
Qu'un coup de fouet le force[13] à partir au grand trot.
Il vit bien qu'il fallait[14] renoncer à l'espoir
De n'agir qu'à son gré du matin jusqu'au soir,
De se complaire(*h*) en son allure,
Et de dire *Je veux* à toute la nature.
Grands, petits, pensa-t-il ont chacun leur devoir.[15]
J'en ai douté dans[16] mon enfance,
Mais je vois trop, que tout de bon(*i*)
Le courage et la patience
Sont utiles[17] à l'âne, encore plus qu'à l'ânon.

Moi, mes amis, je crois en somme(*j*)
Que ce baudet avait raison,(*k*)
Et que ce qu'il pensait peut[18] s'appliquer à l'homme.

JUSSIEU.

COLLOQUIAL EXERCISES.

1. L'ânon désirait-il être grand?
2. Que pensait-il faire?
3. De quelle manière espérait-il aller au marché?
4. Que croyait-il qu'on dirait de lui?
5. Comment raisonnait-il du bonheur d'être grand?
6. Que peut-on faire alors?
7. De quelle manière est-on traité alors?
8. Qui raisonnait ainsi en lui-même?
9. Que faisait-il en ce temps-là?
10. Que trouva-t-il quand il fut devenu grand?
11. Que dit-il en sentant les paniers sur son dos?
12. Que dit-il aussi de son allure?
13. Qu'arriva-t-il lorsqu'il achevait ce mot?
14. Que vit-il alors?
15. Quelles furent ses pensées?
16. Que dit-il de ses doutes d'autrefois?
17. Que dit-il à l'égard du courage et de la patience?
18. Quelle morale l'auteur tire-t-il de cette fable?

NOTES.

(*a*) Quand je serai, *when I am.*
(*b*) Grand, *grown up.*
(*c*) From *courir.*
(*d*) From *voir.*
(*e*) Bien faite, *well-shaped.*
(*f*) Quel jarret ferme, *what a firm step.*
(*g*) From *devenir.*
(*h*) Se complaire, *to admire himself.*
(*i*) Tout de bon, *in good earnest.*
(*j*) En somme, *finally.*
(*k*) Avait raison, *was right.*

KEY TO EXERCISES IN LESSONS IN FRENCH.

EXERCISE 177 (Vol. III., page 29).

1. Have you been long at variance? 2. I have been on bad terms with him more than a month. 3. Is your friend still alive? 4. No, Sir, he has been dead ten years. 5. Is your correspondent on his way to Paris? 6. I believe that he must have arrived. 7. Is not that young man late? 8. Yes, Sir; he never comes in time. 9. Do those engravings belong to you or to your bookseller? 10. They are mine; I have just bought them. 11. Are you not afraid of being in the way here? 12. We are on too good terms with our host to fear that. 13. Whose turn (*or* place) is it to fetch the books? 14. It is my turn (*or* place) to fetch them. 15. Does it behove you (*Is it your duty*) to punish him when he deserves it? 16. It is my place to punish him, for I am as a father to him. 17. Do not those houses belong to our landlord? 18. They do not belong to him. 19. They belong to our correspondent. 20. Whose letters are these? 21. They are not mine, they are my cousin's. 22. That watch belongs to him. 23. Are you not on the eve of starting for London? 24. We are on the eve of embarking for Cadiz. 25. We have long been in open rupture.

EXERCISE 178 (Vol. III., page 29).

1. Êtes-vous en état de le payer? 2. Je ne suis pas à même de le payer; je n'ai pas reçu mon argent. 3. Êtes-vous bien avec votre libraire? 4. Je ne suis pas bien avec lui. 5. Je suis brouillé avec lui. 6. Combien de temps y a-t-il que vous êtes brouillé avec lui? 7. Il y a plus d'un mois. 8. N'êtes-vous pas à même de satisfaire la demande de mon ami (*or* à la demande de mon ami)? 9. Je suis à même de la satisfaire (*or* d'y satisfaire). 10. Êtes-vous en chemin pour Naples? 11. Non, Monsieur; je suis en chemin pour Rome. 12. Votre médecin n'est-il pas à la veille de partir pour Montpellier? 13. Il est à la veille de partir pour Paris. 14. Est-ce que je suis de trop ici? 15. Non, Monsieur; vous n'êtes pas de trop. 16. À qui est-ce à parler? 17. C'est à moi à parler et à lire. 18. Est-ce à moi de lui faire des excuses? 19. C'est à votre frère de lui faire des excuses. 20. Est-ce à vous de punir cet enfant? 21. C'est à moi de le punir. 22. Lui tenez-vous lieu de père? 23. Je lui tiens lieu de père. 24. Cet habit est-il à vous? 25. Non, Monsieur; il n'est pas à moi; il est à mon frère. 26. Êtes-vous brouillé avec lui? 27. Il y a deux mois que nous sommes brouillés. 28. Cette grande maison n'est-elle pas à vous (*ne vous appartient-elle pas*)? 29. Non, Monsieur; elle n'est pas à moi; elle est à ma sœur. 30. Est-ce à votre frère de lui reprocher sa bonté? 31. Ce n'est pas à lui de le faire. 32. À qui est-ce à aller chercher les livres? 33. C'est à moi à les aller chercher. 34. Monsieur y est-il? 35. Non, Monsieur; Monsieur n'y est pas; mais Madame y est.

EXERCISE 179 (Vol. III., page 30).

1. Have you not a repeater? 2. I have a gold watch, with a double case. 3. Does it go better than mine? 4. It does not go well; it loses one hour a day. 5. Has it a second-hand? 6. It is a watch with a second-hand and a gold dial. 7. Does not your clock strike? 8. It no longer strikes, the bell is broken. 9. Why do not those clocks agree? 10. Because one gains and the other loses. 11. Have you not broken the main-spring of your watch? 12. I broke it in winding it up. 13. Is your clock right? 14. Yes, Sir, it is right; I have just had it regulated. 15. Is the striking part of this clock out of order? 16. The striking part is out of order and the bell is cracked. 17. The short hand of my flat watch is broken. 18. The pendulum of your clock is not straight. 19. How much does your clock gain? 20. It gains five minutes a day. 21. The perfection of a clock is not speed but regularity (*lit.* not to go fast, but to go regularly). 22. Does your watch stop often? 23. It stops every morning. 24. Your clock has stopped.

EXERCISE 180 (Vol. III., page 30).

1. Votre montre avance-t-elle, ou retarde-t-elle? 2. Elle ne retarde pas, elle va très bien. 3. Elle retarde de vingt-cinq minutes par jour. 4. Votre pendule avance-t-elle beaucoup? 5. Elle avance d'une heure par semaine. 6. De combien retarde la montre d'or de M. votre fils? 7. Elle retarde de beaucoup; elle retarde d'une heure en vingt-quatre heures. 8. Je l'ai avancée d'une heure. 9. Je la retarderai d'une demi-heure. 10. Votre pendule ne sonne-t-elle pas la demi-heure (*les demies*)? 11. Non, Monsieur; elle ne sonne que les heures. 12. Avez-vous oublié de remonter votre montre à répétition? 13. J'ai oublié de la remonter, et elle s'est arrêtée. 14. Votre montre d'argent est-elle dérangée? 15. Elle est dérangée, il faudra la faire nettoyer. 16. Quelle heure est-il à votre montre? 17. Il est trois heures à ma montre; mais elle avance. 18. De combien avance-t-elle par semaine? 19. Elle avance de plus de cinq minutes par jour. 20. Votre montre est-elle juste? 21. Non, Monsieur; elle n'est pas juste; elle est dérangée. 22. Votre horloge sonne-t-elle juste? 23. Elle ne sonne pas juste; la sonnerie en est dérangée. 24. Avez-vous cassé les aiguilles de votre pendule? 25. J'ai cassé la petite aiguille et le cadran. 26. L'horloge a-t-elle sonné trois heures? 27. Elle a sonné midi. 28. Elle s'est arrêtée. 29. S'arrête-t-elle tous les matins? 30. Elle ne s'arrête pas tous les matins; elle s'arrête tous les soirs. 31. Votre montre ne s'accorde pas avec la mienne. 32. N'avez-vous pas cassé le grand ressort de la montre de votre frère? 33. Il l'a cassé en la remontant. 34. La montre de mon frère est juste, il l'a fait nettoyer et régler. 35. La montre de ma sœur est dérangée, elle a besoin d'être nettoyée.

EXERCISE 181 (Vol. III., page 68).

1. Had you not dislocated your arm? 2. I had not dislocated it; I had broken it. 3. If you went to America, would you resign your situation? 4. I should be obliged to resign it. 5. Is it long since your cousin resigned his? 6. He resigned a month ago. 7. Has the enemy seized upon the city? 8. He has seized upon it. 9. Will your son behave better in future? 10. He has behaved very well during his stay in Prussia. 11. Did you expect such treatment from him? 12. I did not expect it. 13. What did you expect? 14. I expected to be treated properly. 15. Why did you laugh at him? 16. Because I could not help it. 17. If you left your inkstand here, would the peasant lay hold of it? 18. He would certainly seize it. 19. Does your partner behave well towards you? 20. He behaves well to everybody. 21. Who has set your sister's wrist? 22. Dr. G. has set it (*for her*). 23. Has not your father dislocated his right arm this morning? 24. He has not dislocated it; he broke it this morning at five.

*

LESSONS IN BOOKKEEPING.—XXV.

(7) JOURNAL. (7)

Date.	Fol.	October, 1881.	Dr. £	Dr. s.	Dr. d.	Cr. £	Cr. s.	Cr. d.
29		Sundries Dr.:						
	5	To Cash				5948	4	7
23	6	Charges	65	17	7			
2	7	Tuelon & Co.	33	10	0			
,,	7	W. Phillips	256	15	6			
,,	7	T. Barker	250	16	6			
23	1	Union Bank	5160	0	0			
4	8	W. Silver & Co.	87	10	0			
22	3	Bills Payable	73	15	0			
29	5	Petty Cash	20	0	0			
28	1	Bills Receivable Dr.	4051	17	6			
		To Sundries:						
26	3	To P. Hutchinson & Co.				1230	7	6
6	8	To J. Roberts				1926	10	0
24	4	To Schofield, Halse, & Co.				600	0	0
,,	8	To R. Sykes				160	0	0
28	2	To R. O'Brien & Co.				135	0	0
18		Sundries Dr.:						
	3	To Bills Payable				1057	7	0
5	8	W. Smith & Co.	675	12	0			
12	4	Schofield, Halse, & Co.	175	10	0			
16	4	Fox, Tennant, & Co.	73	15	0			
18	9	T. Ellis & Sons	132	10	0			
		£	11057	9	1	11057	9	1

(8) JOURNAL. (8)

Date.	Fol.	October, 1881.	Dr. £	Dr. s.	Dr. d.	Cr. £	Cr. s.	Cr. d.
22	9	W. Knight & Co., Dr.	910	5	6			
	9	To Import Goods				910	5	6
22	9	Brokerage Dr.	9	3	4			
	9	To W. Knight & Co.				9	3	4
		£	919	8	10	919	8	10
		November, 1881.						
30	5	Cash Dr.	13892	10	6			
		To Sundries:						
30	1	To Union Bank				2784	0	0
24	1	To Bills Receivable				4822	0	0
22	9	To W. Knight & Co.				910	5	6
14	2	To Three per Cents.				2876	5	0
17	1	To Exchequer Bills				2500	0	0
30		Sundries Dr.:						
	5	To Cash				13892	8	4
19	3	Bills Payable	1892	10	0			
24	1	Union Bank	10100	0	0			
22	9	W. Knight & Co.	9	3	4			
12	3	Insurance	1880	15	0			
30	5	Petty Cash	10	0	0			
		£	27784	18	10	27784	18	10

(9) JOURNAL. (9)

Date.	Fol.	November, 1881.	Dr. £	Dr. s.	Dr. d.	Cr. £	Cr. s.	Cr. d.
1	1	Bills Receivable Dr.	260	0	0			
	3	To T. Brown & Co.				260	0	0
24	9	Import Goods Dr.	234	0	0			
		To Sundries:						
	3	To Insurance				6	13	0
	9	To Brokerage				2	6	9
	6	To Charges				137	3	5
	6	To Commission				4	13	4
	4	To N. Herschell				83	3	6
		Carried forward	494	0	0	494	0	0

*

(9) JOURNAL. (9)

Date.	Fol.	November, 1881.	Dr. £	s.	d.	Cr. £	s.	d.
		Brought forward	494	0	0	494	0	0
30	9	Import Goods Dr.	676	5	6			
		To Sundries:						
	3	To Insurance				22	16	9
	9	To Brokerage				6	16	7
	6	To Charges				59	18	1
	6	To Commission				16	18	0
	4	To J. Henderson				569	16	1
30	3	Insurance Dr.	29	9	9			
		To Sundries:						
	4	To N. Herschell				6	13	0
	4	To J. Henderson				22	16	9
		£	1199	15	3	1199	15	3

(10) JOURNAL. (10)

Date.	Fol.	December, 1881.	Dr. £	s.	d.	Cr. £	s.	d.
31	5	Cash Dr.	7572	7	8			
		To Sundries:						
3	2	To Debentures				397	12	0
2	8	To Dawson & Hancock				1750	0	0
27	1	To Bills Receivable				2096	10	0
10	2	To Ship Victoria				300	0	0
26	1	To Exchequer Bills				1797	12	6
30	1	To Union Bank				469	0	0
26	9	To T. Ellis & Sons				132	10	0
,,	4	To Fox, Tennant, & Co.				73	15	0
28	2	To Richard O'Brien & Co.				438	17	0
31	8	To Interest				116	11	2
31		Sundries Dr.:						
	5	To Cash				7572	13	6
31	1	Union Bank	5283	0	0			
19	3	Bills Payable	900	0	0			
24	5	A. Lloyd	116	11	0			
26	4	S. Morley	960	15	0			
27	3	T. Brown & Co.	260	0	0			
,,	3	P. Hutchinson & Co.	32	7	6			
30	5	Petty Cash	20	0	0			
31	8	Interest Dr.	18	10	0			
	4	To Schofield, Halse, & Co.				18	10	0
		£	15163	11	2	15163	11	2

(11) JOURNAL. (11)

Date.	Fol.	December, 1881.	Dr. £	s.	d.	Cr. £	s.	d.
31	9	Balance Account Dr.	26861	4	8			
		To Sundries:						
	1	To Union Bank				23274	0	0
	2	To Ship Victoria				3000	0	0
	4	To J. Henderson				9	18	11
	5	To Cash				0	13	9
	8	To J. Roberts				576	12	0
31		Sundries Dr.:						
	9	To Balance Account				26861	4	8
	3	Bills Payable	1151	2	0			
	4	N. Herschell	153	8	6			
	4	Schofield, Halse, & Co.	149	0	0			
	8	R. Sykes	97	0	0			
	1	Stock Account for Real Worth	25310	14	2			
31		Sundries Dr.:						
	9	To Profit and Loss				1760	1	4
	1	Exchequer Bills	500	0	0			
	2	Three per Cents.	322	10	0			
	2	Ship Victoria	475	3	0			
	2	Adventure in Scotch Linen	91	6	0			
	6	Commission	175	5	10			
	8	Interest	195	16	6			
31	9	Profit and Loss Dr.	1760	1	4			
		To Sundries:						
	5	To Petty Cash				87	10	0
	1	To Stock Account for Net Gain				1672	11	4
		£	57242	12	0	57242	12	0

*

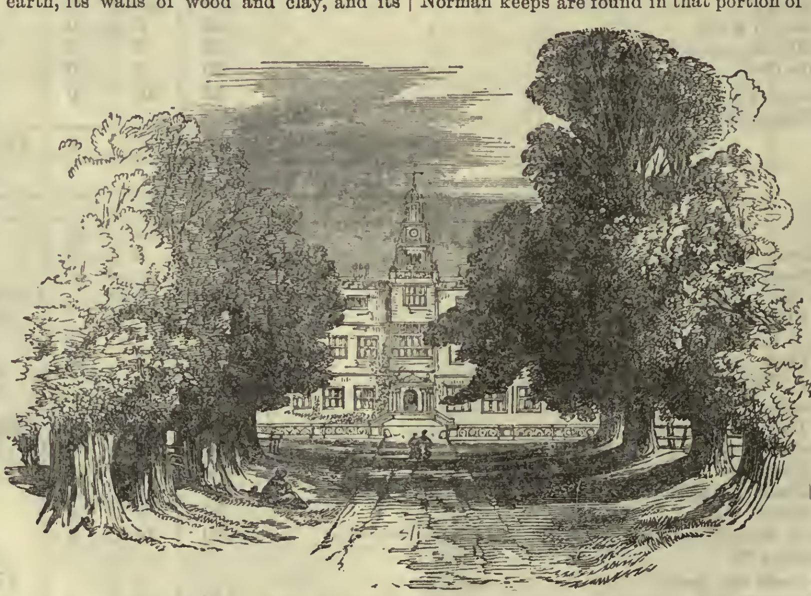
LESSONS IN ARCHITECTURE.—XIX.

DOMESTIC ARCHITECTURE IN ENGLAND.—I.

THE history of domestic architectnre in our own country illustrates in a very striking manner the rise of civilisation and the extinction of barbarism. We have not to travel back more than a few hnndred years to find domestic comfort a thing entirely unknown, and the abodes of princes entirely destitute of conveniences which are now considered necessary in the house of every peasant. Our Saxon forefathers lived in the rudest possible style. The homes even of kings and lords consisted simply of one large apartment or "hall," in which all the details of domestic life were carried on by themselves and their immediate attendants. Privacy was a thing entirely unknown. After the pursuits of the day—the chase or the fight—they assembled around one common board, taking place according to their rank in the honsehold; and in the selfsame apartment all members of the household afterwards disposed themselves for sleep. It was only occasionally that one end of the common hall was separated from the rest by a screen, affording a rude retiring chamber for the lord and lady of the house, with a few privileged attendants.

HADDON HALL (TUDOR STYLE, FIFTEENTH CENTURY).

Almost the only out-offices attached to the hall were the sheds or pens for the cattle and the swine. The dogs, more cherished, were allowed a place in a corner of the hall itself; and another corner was frequently occupied by the store of provisions. Sometimes, however, the latter would be placed in receptacles or cellars dug ont under the hall. Its flooring was of earth, its walls of wood and clay, and its roof of thatch. For the admission of light, openings were left in the sides, and closed by wickerwork when night came on; for warmth, a log-fire was lighted in the centre of the apartment, and the smoke escaped by holes in the roof.



HATFIELD HOUSE (ELIZABETHAN STYLE, SIXTEENTH CENTURY).

Such were the rnde habitations of the higher classes of onr ancestors before and even for some time after the Norman conquest. Domestic architecture, it will be seen, had as yet no existence in the land. The high civilisation of the Romans, who had been in the conntry nearly fonr hundred years, had failed to leave any permanent impress on the barbarons tribes which either inhabited or ravaged these islands in the following centnries. The Roman towns which had been fonnded in Britain, with their commodious buildings and stately villas, were razed and destroyed on the departnre of the people who erected them. No existing models were in the land to tempt the aspirations of Saxon or Danish rulers to anything better than the practices of the barbaric North; nor, indeed, could they have found opportunity, amidst their constant warfare, for the cnlture of the arts of peace.

The Norman Conquest introduced little essential improvement. The residences of the great became imposing, from the necessity that they should be constructed for pnrposes of defence and security. *Castles* arose in all parts of the conntry; but they were built for warlike and not for domestic uses. So far as domestic arrangements are concerned, they conld boast of little accommodation snperior to that of the Saxon common hall. The abode of the residents was within the principal tower or keep, and this was usnally divided into floors, each consisting of a single apartment. On the basement were the cellars and the dungeons; above, the entrance-hall, where stores were often kept; over that, the common hall, where the inmates cooked, feasted, and, for the most part, slept together; while the uppermost story was the dormitory of the lord and his guests. The door to this uncomfortable residence was on the second floor, and entered by stairs, which were raised and lowered at will, so that the edifice was inaccessible except to the inmates; the walls were pierced with bnt few openings to admit light, as these tended to weaken them against an enemy; and the roof was surronnded by a high crenellated parapet, from which defenders of the castle could fight against assailants below.

In keeps of larger dimensions, the floors were sometimes divided by a partition, and the additional apartments thus gained were used as conncil-chamber, chapel, etc.; but in no case was there anything approaching the modern idea of private apartments. Examples of these Norman keeps are found in that portion of the Tower of London known as the White Tower, and in the castles of Rochester, Colchester, etc.

The comparative immnnity of the clergy from the strifes and the dangers which compelled the nobles to regard their homes merely as warlike posts and fortifications, led to the development of a more convenient plan of residence in monastic establishments. The chief distinguishing characteristic of these places, as far as domestic arrangement is concerned, was exhibited in the addition of apartments and out-offices for the storage of provisions, cooking, etc.; and it is to this sonrce that we must look for the germ of the nnmerons and commodious offices which became attached to the mansions of the nobility at a much later date. In some few castles of the twelfth century we find indications of the separation of the culinary apartments from the common hall by partitions at one end; but these examples were exceptions to the general rule, and it was not nntil the thirteenth century that this degree of convenience became generally provided.

In convenience of domestic arrangement, the *castles* of the lords progressed more slowly than the *manor-houses* dispersed through the country. The former were strongholds which at once overawed and protected the towns; the latter were the centres of rural occupation. Both belonged to the same proprietors, for the lord of a castle would possess perhaps several manor-houses in various parts of his estates, as the residences of his overseers, and the granaries for his produce. Built at places less exposed than the towns to attack, these houses could often be erected with a greater regard to utility than to defence; and hence their arrangements in process of time became so far superior to those of the castle keeps, that the occupants of the latter would leave them, when they could, to sojourn for a time at a manor-house in the country. Thus becoming accustomed to greater domestic convenience, they desired, on their return, to introduce similar arrangements, as far as possible, within the castle walls; and in the thirteenth century, when a greater degree of peace and order began to prevail, we find that the nobles often erected buildings on the manor-house plan within the castle enclosure. Besides this, they occasionally fortified the manor-houses after the castle manner, to adapt them to a more frequent and permanent residence than they could otherwise have made in them. The manor-houses, however, were still destitute of arrangements in accordance with our modern ideas of comfort and propriety. Their chief advantage over the castles was in the possession, by gradual development, of offices suited to the general range of domestic affairs. The addition of private apartments even for the chief members of the household was still almost unknown, as it was not yet required by the tastes and habits of a comparatively barbarous age.

From this sketch of the abodes of the higher classes down to the close of the thirteenth century, an idea may be formed as to what was the condition of the lower. In the towns the citizens inhabited rude tenements of a single storey, built of wood and clay. In the country the people dwelt in sheds scarcely fit for the beasts of the field. And although six centuries have elapsed since the period of which we have been writing, the latter remark is still true of the condition of the rural population in many parts of the country.

OSBORNE HOUSE (RURAL ITALIAN STYLE).

But we must confine ourselves in the present paper to the dwellings of the nobility and gentry, reserving the houses of the general population for consideration in another article.

Coming to the fourteenth century, we find a great advance in the general arrangements of the houses of the great. The erection of more commodious residences within the castle walls continued throughout this period. The disposition to combine convenience with strength was rapidly on the increase, and the growing submission of the barons to the authority of the laws favoured the arts of peace. But Architecture, as a science, found its chief scope in ecclesiastical buildings, and there was yet no foundation of settled style in the homes of the nobility. A great improvement in the accommodation was made by the addition to the presence-chambers of withdrawing apartments for the heads of the household, and it now, for the first time, became the practice to partition some of these apartments as bed-chambers. But the large hall was still put to its former uses, serving for the general meal-room of the residents, most of whom still slept upon its floor at night. The common hall was regarded as the most important part of the edifice. Its dimensions were imposing, its timber roof so highly ornamented in many cases, as to excite admiration at the present day. A splendid specimen of these ancient edifices exists in the Great Hall at Westminster; and another good example, attached to the house of a merchant prince at a later date than that now before us, is found in Crosby Hall, in the City of London.

EXAMPLE OF THE PALLADIAN STYLE.

Among the minor improvements of the time must be mentioned the substitution of glazed windows for the open lattice throughout the various chambers, and the addition of hearths or fire-places to these as well as the larger apartments. There was no attempt yet at regularity of ground-plan, but the common hall usually occupied the centre of the domestic buildings, the private apartments being placed at one end, and the kitchen and offices at the other.

In the fifteenth century we reach a transitional period, in which both comfort and elegance began to be studied in domestic edifices. The wealth of the country was rapidly on the increase through its rising commerce, and the invention of gunpowder rendered castles and fortified houses comparatively useless. The buildings of the fifteenth century, therefore, were characterised by a refinement previously unknown. The old manor-houses were transformed into mansions, and the castles, when not allowed to fall into ruin, became stately abodes. The exteriors were often handsomely embellished; the castellations, which had formerly a warlike use, now became a mere ornament; and the growing taste for privacy and comfort led to the gradual formation of a convenient plan for a wide range of apartments. We give an illustration of a portion of Haddon Hall, in Derbyshire, as one of the finest examples of the Tudor period, which embraces the latter part of the fifteenth and a portion of the sixteenth centuries. The general style is supposed to have been suggested by the Perpendicular Gothic, which was now in vogue in church architecture, and to this it will be found to bear many traces of resemblance.

At the beginning of the sixteenth century, ecclesiastical architecture was dying out, and vigorous attention began to be bestowed on the domestic architecture of the country. The middle of the century brings us to the Elizabethan age, when the nation had a long period of comparative repose, and was rapidly accumulating wealth. The power of the nobles had been greatly limited, and they no longer surrounded themselves by troops of retainers, who were sheltered and fed within castle and manor-house walls. In the reigns immediately preceding, these attendants had been gradually dispersed to engage themselves in peaceful arts, to the great advantage of the country. The residences of the nobility were now occupied entirely by themselves and their domestics; and, as a consequence of this progressive change, we find a total revolution in the domestic manners of the time, which produced a corresponding effect in domestic architecture. The large common hall, hitherto the most important feature in the abodes of the great, had fallen into insignificance as regards its actual uses. Additional chambers and private apartments were added, and English architects, some of whom had studied in Italy, devoted themselves to the convenient and harmonious arrangement of the whole. In Hatfield House, Hertfordshire, we have one of the finest examples of the style of the Elizabethan age, and its façade, or front, approached by a fine avenue of trees, forms one of our illustrations. Many other specimens of the substantial and commodious architecture of the period exist in various parts of the country, among which we may mention Longleat, Wilts, remodelled early in the present century by Sir Jeffrey Wyatt; Burleigh House; Charlton House, near Blackheath; and a part of Hampton Court.

The architecture of the Elizabethan age has been considered an attempt to combine the Italian style with the Tudor Gothic. The numerous perpendicular windows, the galleries and corridors, the ornamental gables or level balustrades which took the place of them, and the twisted chimney-shafts, are among its more conspicuous features; but its immense superiority over the building of preceding ages was shown chiefly in its commodious internal arrangements, which for the first time made the abode of a gentleman replete with comfort and convenience.

The interior of the mansion having now been entirely remodelled, its exterior shortly underwent another change, in the gradual adoption throughout England of the Italian style, by which the Tudor and Elizabethan were finally superseded. The Italian style was a revival of classic architecture, to which the works of Palladio were mainly instrumental, and hence it is frequently called the Palladian school. The term Cinque Cento is also applied to it, from its revival in Italy after the year 1500—*cinque*, fifth, being used as an abbreviation of fifteenth century. It was introduced into this country by Inigo Jones, and it soon became the fashion to adopt it. The peculiar features of this style were the range of classic columns used as a portico, and sometimes on each face of the edifice, which was square in form, and often surmounted by a cupola. In interior arrangements a change was made by allotting the ground floor, in large establishments, chiefly to the domestic offices, the dwelling-rooms and principal apartments being placed on the floor above, and over these the bed-chambers. A central saloon, the height of the entire building, took the place of the hall of former times, and was surrounded by the other apartments.

With various adaptations of this style to English taste, it continued in vogue throughout the seventeenth and eighteenth centuries. In the hands of many architects it lost its fairness of proportion, and many of the square and ugly brick buildings of the last century can boast little in common with the Italian plan. In the present century Palladianism has declined, and a disposition has been shown to revert to old English forms in their best examples, and even to escape entirely from the thraldom of precedent, either in external or internal arrangement.

Italian architecture, however, in one or other of its forms and adaptations, still prevails to a considerable extent, although the purely classic system of Palladio has lost favour. The great club-houses in Pall-mall have all more or less of the style known as the *Palatial Italian;* and Bridgewater House, Piccadilly, the residence of the Earl of Ellesmere, is considered to be perhaps the most perfect example of this style in England. The *Rural Italian*, very similar in its details, but without the same uniformity of elevation—is also greatly in favour, and is especially adapted to picturesque situations. In this style the marine residence of Her Majesty at Osborne House was erected by the choice of the late Prince Consort, and an idea of its effect will be gathered from our illustration of a portion of that building.

MECHANICS.—XV.

THE INCLINED PLANE—THE WEDGE—THE SCREW.

THE mechanical powers are nsually said to be six in nnmber:—the lever, the wheel and axle, the pnlley, the inclined plane, the wedge, and the screw. On examination, it will be found that any machine whatever consists of various combinations or modifications of these. If, however, we look more closely, we shall find that these six may really be redneed to three—namely, the lever, the pulley, and the inclined plane.

These, then, are the three fundamental mechanical powers; the wheel and axle being, as we saw in our last lesson, a succession of levers coming into play one after another; and the wedge and the screw, as we shall soon find, merely modifications of the inclined plane. To this, then, we must now tnrn our attention, and see how the inclined plane may be used as a mechanical power, and what is the advantage gained by its use.

A horizontal plane is one that has an even surface, like a portion of the surface of a lake on a calm day, every part being at the same level. If this plane be now tilted or lifted at one end, so as to make an angle with the horizon, it is called an inclined plane, and the angle which it makes with the level snrface is called its angle of inclination. Hence we speak of a plane inclined at an angle of 30, or any other number of degrees. There is also another way of speaking of the inclination, as, for instance, when we say a road has an ascent of one foot in twelve, meaning that for every twelve feet of length measnred along its surface there is a vertical rise of one foot. These modes of expressing the same fact may be nsed indiscriminately.

Now we can easily see that some advantage is gained by the use of the inclined plane. If a drayman wishes to raise a heavy barrel into his dray, he does not attempt to lift it vertically, for he knows he could not do it; but he lays a ladder or plank sloping from the gronnd up to the dray, and rolls the barrel up this incline. So in the railway which has been formed over Mont Cenis, the trains go along a series of zigzags, which are really a succession of inclined planes, and thus the monntain chain is crossed. A driver, too, in driving a heavy load up a steep incline, will frequently cross from side to side of the road, as he goes up a less steep incline, and thus spares the horses.

How comes it, then, that this advantage is gained, and what proportion does the load bear to the power that raises it? We will try and solve these questions. Let A C represent a plane inclined at the angle C A B; W is a weight resting on the plane and fastened to a cord which passes over the pnlley D, and is kept stretched by a power, P. The cord we will first suppose to be parallel to the surface of the plane, and the power therefore acts in this direction. Friction has, in practice, a great inflnence in a case like this; as, however, we shall speak abont that shortly,

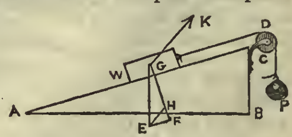


Fig. 77.

we will neglect it now, and suppose that the plane is perfectly smooth, and that the weight is just kept in its position by the action of P. We found in our third lesson that, if we draw a line, G E, downwards from G, the centre of gravity of W, and make it of such a length as to represent the weight of W, and then through E draw E F parallel to G D, and just long enough to meet the line G F, which is perpendicular to the surface of the plane, that then E F represents in magnitude the power P. We have, in fact, a triangle of forces, the three sides of which represent the three forces which act on the weight and keep it at rest. But the angles of the triangle E F G are equal to those of the triangle C B A. This is easily seen, for the angle E F G is equal to C B A, each being a right angle. G E F is also equal to A C B; for, if we continue E F till it meets B C, we shall have a parallelogram, and these will be opposite angles, and so must be equal; the third angles are equal too, since G F and E G are perpendicular to A C and A B. The angles of one triangle are equal, then, to those of the other, and therefore the sides of the triangle E F G bear the same proportion to one another that those of C B A do. Of this you can satisfy yourself by actual measurement, and you will find the rule always hold good. The proper mode of proving it you will learn from Euclid.

The three sides of A B C represent, then, the three forces which act on W; A C representing the weight, B C the power, and A B the resistance of the plane, or the part of the weight which is supported by it. Hence we see that if the incline be 1 foot in 20, a man in rolling a weight up will only have to support $\frac{1}{20}$ of it.

We can easily arrive at this result in another way. Suppose a person wants to lift a weight of 200 pounds to a height of one foot, he will have to exert a force of that amount if he lift it straight up, and will then move it through just one foot. But if, instead of this, he moves it up this incline, when he has passed over one foot in length of its surface, he will only have raised it $\frac{1}{20}$ of a foot, and will have to move it over the whole twenty feet of the plane in order to raise it the one foot. That is, he will have to move it twenty times the space he would if he lifted it direct, and will therefore sustain only $\frac{1}{20}$ of the weight at any moment. Still, he must sustain this portion twenty times as long. This supplies us with another illustration of the law of virtual velocities which we explained in the last lesson.

The general rule for the gain in the inclined plane when the power acts in a direction parallel to it, may be stated as follows:—

The power bears the same ratio to the weight it will sustain that the perpendicular elevation of the plane does to the length of its surface.

If the power, instead of acting along the plane, acts at an angle to it, whether it be parallel with the base or in any other direction, as G K, we have merely to draw E H parallel to the line of action of the force, instead of parallel to the plane, and, as before, we shall obtain a triangle of forces, the three sides of which represent the three forces, and thus we can calculate the power required to support the weight.

If we have two inclined planes meeting back to back, like the letter V inverted, and a weight resting on each, the weights being connected by a cord which passes over a fixed pulley at the summit, we can see from this principle that there will be equilibrium when the weights bear the same proportion to each other as the lengths of the inclines on which they rest: for it is clear that, the steeper the plane, the less is the portion of the resistance borne by it. If, for example, one incline is 15 inches long, and the other 21 inches, a weight of 5 pounds on the former will balance one of 7 pounds on the latter. For, supposing the vertical height of the summit to be 6 inches, the portion of the force of 5 pounds which acts downwards, and tends to raise the other, is $\frac{6}{15}$ of 5 pounds, which equals 2 pounds; while the portion of the other which acts downwards is $\frac{6}{21}$ of 7 pounds, which is also equal to 2 pounds.

This system of two inclines is often used in mining districts, a train of loaded trucks running down from the pit's mouth to the staith, being made to drag a train of empty ones up the incline. Many familiar instances of the use of the inclined plane are met with every day, though they often escape notice, unless we are specially looking for them. For example, our knives, scissors, bradawls, chisels, needles, and nearly all cutting and piercing tools, act on this principle.

THE WEDGE.

We pass on now to notice the wedge, which essentially consists of two inclined planes of small inclination placed with their bases one against the other.

Sometimes one side only of the wedge is sloping, and it is then simply a movable inclined plane. In using this, it is so placed that it can only be moved in the direction of the length, and the weight to be raised is likewise prevented from moving in any direction except vertically. If pressure be applied to the head of the wedge, the weight will be raised. The gain is the same here as in the inclined plane.

Fig. 78.

The wedge, however, usually consists of a triangular prism of steel, or some very hard substance, and is used as shown in Fig. 78. The point is inserted into a crack or opening, and the wedge is then driven, not by a constant pressure, but by a series of blows from a hammer, or some similar instrument. It is usual to consider the wedge as kept at rest by three forces—first, a pressure acting on the head of the wedge, and forcing it vertically downwards, as at P; secondly, the mutual resistance of it, and the obstacle which acts at right angles to the surface of the wedge, as at R R; and thirdly, the force which opposes the motion, and acts at right angles to the direction in which the object would move, as at C.

As, however, the resistance to be overcome varies very much from moment to moment, both in direction and intensity, and as the force is usually supplied by impact or blows, and not by pressure, such calculations afford very little help towards determining the real gain.

The other mechanical powers are usually employed in sustaining or raising a weight, or offering a continuous resistance; a continuous force is therefore used with them. In the wedge, the resistance to which it is applied is usually one which, when once overcome, is not again called into play. In splitting timber, for instance, when the wedge is driven in, the particles of timber are forced apart, their cohesion is overcome, and they do not join again. So in dividing large stones, when once a crack has been made through them, no continued application of force is needed to keep them from re-uniting. When continuous force is required, the wedge having been driven forward is kept from slipping back by friction.

As, then, we cannot calculate the force generated by a blow, we must be content with the general statement that the smaller the angle of the wedge the greater is the power gained.

THE SCREW.

This is the last of the mechanical powers, and, like the wedge, acts on the principle of the inclined plane. If we stretch a cord so as to represent the slope of an inclined plane, and then, holding a ruler, or some cylindrical body, vertically, we roll up the cord upon it, we shall have a screw, the spiral line traced out by the cord being called its thread. It is easy to see that the thread has at every point the same inclination as the inclined plane, and that a particle in travelling up the screw will pass over the same distance as if it moved up the plane.

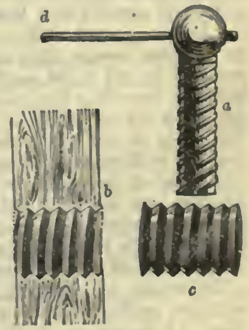


Fig. 79.

A screw, then, is a cylinder with a spiral ridge raised upon it; this ridge is sometimes made with a square edge (Fig. 79 *a*), and then has more strength; but usually it is sharp, as seen in a common screw, and this way of making it reduces friction.

To use the screw, it is necessary to have a hollow cylinder with a groove cut on the inside of it (Fig. 79 *b*), so that the thread of the screw (Fig. 79 *c*) exactly fits into it, and the screw will rise or fall according to which way it is turned. This hollow cylinder is called the nut or female screw.

It is evident that, if we are to gain any power, the nut must not be allowed to turn together with the screw; and hence we have different modes of using the screw, according as the screw itself or the nut is fixed. When used to fasten the beams of a house together, or to strain the wire of a fence, the screw is prevented from rotating, and the nut turned by a wrench; the screw is thus drawn forward, and the required strain applied. In a carpenter's vice, on the other hand, the nut is fixed, and the pressure applied by turning the screw. The gain is in each case just the same, the difference being merely one of convenience in applying it.

Now we shall easily be able to see the amount of power gained. If a particle be placed at the point of a screw and prevented from turning with it, it will, after one revolution of the screw, have been raised through a distance equal to that between two threads of the screw, while any point in the circumference of the screw will have passed through a space equal to that circumference. If, then, the power be applied at the surface of the screw, it will bear the same proportion to the resistance that the distance between two threads of the screw does to its circumference.

In practice, however, the power is nearly always applied at the extremity of a lever, as at *d* in Fig. 79 *a*, so that it becomes a combination of the lever and inclined plane. In a thumb-screw the flattened part acts as a lever, and when a screw is driven by a screwdriver we usually grasp it at the broadest part, and thus gain a leverage. More commonly, however, a long lever is put through the head of the screw.

In all such cases we can easily ascertain the gain from the fundamental principle of virtual velocities. Hence, we have the following rule:—Measure the circumference of the circle described by the power, and divide this by the distance between two threads of the screw; the result will be the mechanical gain.

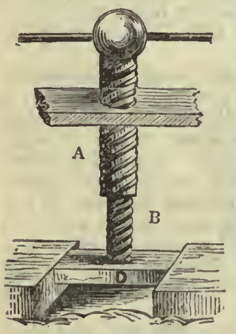


Fig. 80.

Thus, if the power describe a circle whose circumference is 10 feet, and the distance between two threads be $\frac{1}{4}$ inch, we have a gain of 10 feet divided by $\frac{1}{4}$ inch, or 480. There is, however, a difficulty here. We cannot easily measure the actual space through which the power passes, nor can we calculate it with absolute accuracy. It is, however, usually near enough if we take the circumference as $3\frac{1}{7}$ times the diameter. The fraction is more exactly 3·14159, but you may always use $3\frac{1}{7}$ without being far wrong. Thus, if the radius of a circle be 2 feet 6 inches, its diameter is 5 feet, and its circumference $3\frac{1}{7}$ times 5 feet, or about 15 feet $8\frac{1}{2}$ inches. We see then, now, how to work a question like the following:—In the screw of a bookbinder's press there are 3 threads to an inch, and a force of 10 pounds is applied to a lever 14 inches long. What force are the books pressed with? The gain is $14 \times 2 \times 3\frac{1}{7}$ divided by $\frac{1}{3}$, which equals 264; and as the power is 10 pounds, the pressure is 264×10, or 2,640 pounds. The real pressure is, however, less than this, as a portion of the power (sometimes set down at a third) is employed in overcoming friction. Still, this is not altogether lost, for it prevents the screw turning back when the pressure is removed. We have clearly two ways of increasing our gain in the screw, we can either lengthen our lever or make our threads closer; but we soon reach a practical limit to either of these, as the lever becomes inconveniently long, or else the threads so narrow that they are stripped off by the pressure.

To obviate this difficulty, an arrangement—known, after the inventor, as Hunter's screw—was planned. Fig. 80 represents this. A hollow screw, A, of rather large diameter, is cut and made to work through a strong fixed nut; another screw, B, of smaller diameter is fixed to the upper board of the press, a female screw being cut in the interior of the first, into which this may work. Supposing now that both screws have the same number of threads in a foot, the board will not move at all when the upper screw is turned, for the fixed screw will enter the hollow of it exactly the same distance as it is depressed. But if the upper one has, say 24 threads in a foot, and the other 25, the one will have moved downwards $\frac{1}{24}$ of a foot while the other will have risen $\frac{1}{25}$ only, and the board will be depressed by the difference between the two, which is $\frac{1}{600}$ of a foot. It is obvious that we may diminish as much as we like the difference between the two threads, without at all decreasing their strength, and the more nearly they are alike, the greater power we gain.

There is a modification of the screw, or rather a combination of it with the wheel and axle, which is frequently used. It is known as the endless screw, and is represented in Fig. 81. A thread is cut upon an axle, which is turned by a winch, and the teeth of the wheel catch in the thread of the screw and are thus pressed forward as the winch is turned, each revolution advancing the wheel one tooth. Hence the winch must be turned as many times as there are teeth in the wheel in order to raise the weight a distance equal to the circumference of the axle; and since, in the ordinary wheel and axle, the power is to the weight as the radius of the wheel is to that of the axle, so here, the gain is expressed by the length of the arm to which the power is applied, multiplied by the number of teeth in the wheel, and divided by the radius of the axle.

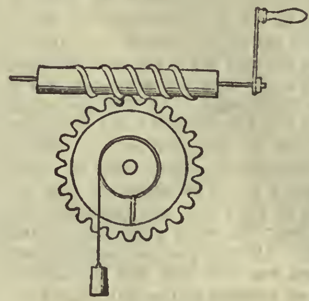


Fig. 81.

In all these cases it has been supposed that the screw has only one thread. Occasionally it has two, and then the gain is only one-half.

We must now give a few more examples for practice, and also the answers to those in our last lesson.

EXAMPLES.

1. An ascent is 120 yards long, and rises in this length 10 feet: what power is required to sustain a weight of 7,236 pounds on it?
2. A road rises 1 foot in 25: what strain is required to sustain a wagon, weighing 1 ton, on the incline?
3. A wedge is 11 inches long and 2 inches thick: what resistance will a pressure of 112 pounds on its head overcome?
4. A screw has four threads in the inch: what force must be applied to a lever 1 foot long to press with a force of 3,000 pounds?
5. The lever of a screw is 2 feet 6 inches long, and is moved with a force of 6 pounds. Required the pressure, there being three threads to the inch.
6. In Hunter's screw, if one have 10 and the other 11 threads in a foot, and the lever is 1 foot 9 inches long, what is the gain?
7. An endless screw is driven by a 12-inch crank. The axle is 2 inches in radius, and the wheel has 45 teeth. What weight will a power of 8 ounces sustain?

ANSWERS TO QUESTIONS IN LESSON XIV.

1. He must press with a force of 74 pounds.
2. Six feet from the heavier boy, as there the moments about the fulcrum will be equal, for $6 \times 72 = 8 \times 54$.
3. 2,700 pounds.
4. He must have a force of $16\frac{16}{27}$ pounds. The gain is $\frac{18 \times 60 \times 54}{6 \times 8 \times 4\frac{1}{2}} = 270$; and two tons divided by this give $16\frac{16}{27}$ pound.
5. A little over 69 pounds.
6. I must pull with a force of 98 pounds through a space of 4 feet.
7. 155 pounds. The middle rope sustains 20 pounds of the weight.
8. The front man will bear $\frac{5}{8}$ of the weight, or $93\frac{3}{4}$ pounds, the other $56\frac{1}{4}$ pounds.

LESSONS IN GERMAN.—XLV.

SECTION XCV.—IDIOMATIC PHRASES (*continued*).

Werth (worth), like its equivalent in our language, is used in designating the value of things; as:—Dieses Pferd ist dreihundert Gulden werth, this horse is worth three hundred florins. When, however, the amount of one's wealth is referred to, some phrase like the following is employed:—Er hat ein Vermögen von zehn Tausend Gulden; or, Er hat zehn Tausend Gulden im Vermögen, he is worth ten thousand florins.

1. Auskommen (a coming *or* getting out), with haben, forms the phrase, Ein Auskommen haben, "to have a competency *or* subsistence;" as:—In diesem Lande hat der Arbeiter ein gutes Auskommen, während er in den meisten Ländern Europa's nur ein nothdürftiges hat, in this country the labourer has a good subsistence, while in (the) most countries of Europe he has only a scanty (one).

*

2. Unterkommen = coming under, that is, a lodging, a shelter; also, an employment; as:—Wir suchten in irgend einem der vielen Gasthäuser dieser Stadt vergebens ein Unterkommen, we sought in vain, in any one of the many inns of this town, a shelter. Der Fleißige findet überall ein Unterkommen, the industrious finds everywhere employment.

VOCABULARY.

Aus'kommen. (See R. 1 above.)
Eins, one thing.
Erho'lung, *f.* refreshment, recreation.
Fort'gehen, to go away.
Gönnen, to grant, favour, permit.
Hernie'derkommen, to come down.
Kreis, *m.* circle, sphere.
Manchmal, often, frequently, sometimes.
Menschlich, human, founded in human nature.
Nachsicht, *f.* forbearance, indulgence.
Noth'dürftig, scanty, necessitous, needy.
Schein, *m.* shine, light.
Stören, to trouble, disturb.
Trost, *m.* consolation.
Trotz, in defiance, in spite of.
Unmög'lichkeit, *f.* impossibility.
Un'terkommen, to find employment, shelter, etc. (See R. 2, above.)
Verle'ben, to live, pass, spend.
Verzei'hung, *f.* pardon, forgiveness.
Vor'fallen, to happen.
Warnen, to warn of, admonish against.

RÉSUMÉ OF EXAMPLES.

Ein kluger Feldherr gönnt seinen Solda'ten zuwei'len eine Erho'lung.	A judicious general sometimes grants his soldiers (a) recreation.
Einmal hat der Schiffer eine ru'hige, dann wieder eine stür'mische Reise.	At one time the mariner has a quiet (pleasant), then again a stormy voyage.
Er hat kein Vermö'gen dazu, um diesen Aufwand lange Zeit bestrei'ten zu können.	He has no fortune by which (thereto) to be able (for a) long time to afford this expenditure.
Weisheit ist mehr werth, als Reichthum.	Wisdom is more valuable (worth more) than riches.
In der Schweiz hat der Bauer ein bes'seres Aus'kommen, als in dem grö'ßeren Theile Ita'liens	In (the) Switzerland the peasant has a better subsistence than in the greater part of Italy.
Bei Einbruch der Nacht suchte er in einem kleinen Oertchen ein Un'terkommen.	On the approach (invasion) of the night, he sought shelter in a little hamlet (little place).
Der Kaufmann hat dem Capitän' bereits' die Fahrt bezahlt'.	The merchant has already paid the captain (for) the passage.
Mich hat herzlich verlangt', das O'sterlamm mit euch zu essen (Lucas xxii. 15).	I have heartily desired to eat this passover with you (Luke xxii. 15, marginal reading).
Das verlas'sene Kind verlangt' nach seiner Mutter.	The forsaken child longs for (after) its mother.

EXERCISE 184.

1. Es giebt im menschlichen Leben zuweilen trübe Augenblicke. 2. Man muß zuweilen dem Geiste eine Erholung gönnen. 3. Er ist schon manchmal hier gewesen. 4. Schon manchmal habe ich dieses gesagt. 5. Manchmal mißlingt es auch. 6. Es ist jetzt keine Zeit dazu, spazieren zu gehen. 7. Er hat heute noch hinlängliche Zeit dazu, diese Arbeit zu vollenden. 8. Er hat an einem andern Tag mehr Zeit, dich zu besuchen. 9. Dieses Haus ist tausend Thaler werth. 10. Mein Rock ist zehn Thaler werth. 11. Jener Mann besitzt fünf hundert Thaler. 12. Er besitzt zehn tausend Thaler. 13. Diese Familie hat ihr gutes Auskommen. 14. Jener arme Taglöhner hat nur ein nothdürftiges Auskommen. 15. Es kamen so viele politische Flüchtlinge an, daß sie nicht alle unterkommen konnten. 16. Die Soldaten fanden alle in den Scheunen und Ställen der Bauern ein Unterkommen. 17. Gestern habe ich dem Kaufmanne seine Rechnung bezahlt. 18. Er hat dem Schneider den Rock noch nicht bezahlt. 19. Er vergaß dem Schuhmacher die Stiefel zu bezahlen. 20. Der Kranke verlangt ein Glas Wasser. 21. Mich verlangt zu wissen, was an der Sache ist. 22. Mich verlangt eine heitere Stunde im Kreis der lieben Meinen zu verleben. 23. Ich verlange das Buch, das dort liegt. 24. Eins bitte ich dich: sei vorsichtig in der Wahl deiner Freunde. 25. Der Mann bat um Geduld und Nachsicht. 26. Da er ihn um Verzeihung bat, so konnte er nicht länger zürnen. 27. Ich bitte Sie um ein Glas Wein.

EXERCISE 185.

1. My house is worth a thousand francs, but that of my brother fifteen hundred. 2. That banker is worth a thousand pounds more than that sum. 3. Contentment is of greater value than all the riches of the world. 4. We could not anywhere find shelter on our arrival in America, as all the inns were full. 5. Every one who goes to Australia may find employment. 6. Those who have a scanty competency are sometimes the tools of the greatest crimes. 7. My brother bids me to be patient and forbearing. 8. He seeks my forgiveness, and therefore I cannot longer be angry with him. 9. Necessity requires that we should sometimes grant our body relaxation. 10. As he forgot to pay for his coat, the tailor requested him to pay.

SECTION XCVI.—IDIOMATIC PHRASES (*continued*).

Bemühen = to trouble. Sich um Etwas, or für Jemand bemühen, "to give one's self trouble about, to take pains, strive about any thing, or for any one;" as:—Darf ich Sie bemühen, mir das Buch zu reichen? may I trouble you to reach me that book? Du bemühst Dich zu viel um eine so geringe Sache, you trouble yourself too much about so trifling a thing. Ein Freund sollte sich für einen Freund bemühen, a friend should take pains for a friend. Es giebt gewisse gutmüthige Leute, die sich mehr für Andere, als für sich selbst bemühen, there are certain good-natured people who take more pains for others than for themselves.

1. Zeitvertreib (from Zeit, *time*, and vertreiben, *to drive* or *pass away*) signifies "a pastime;" as:—Was ihm Zeitvertreib ist, macht mir Langeweile, what to him is pastime, causes me weariness. Sich die Zeit vertreiben, "to spend, *or* pass one's time;" as:—Wie vertreibt er sich die Zeit? how does he pass his time? Er vertreibt sich dieselbe mit Jagen und Fischen, he spends it (the same) in hunting and fishing.

VOCABULARY.

Ab'wesenheit, *f.* absence.
Ausbruch, *m.* breaking out, eruption.
Bemer'kung, *f.* remark, notice.
Berühmt', famous, renowned, celebrated.
Blatt, *n.* paper, leaf.
Durch'lesen, to read over, peruse.
Etwa, about, nearly, perhaps.
Fechten, to fight.
Grimm, *m.* fury, rage, wrath.
Leb'kuchen, *m.* gingerbread.
Nürnberg, *n.* Nuremberg.
Revolution', *f.* revolution.
Scherzen, to jest, joke, sport.
Verfol'gen, to pursue, persecute.
Verstei'gerung, *f.* auction.
Vor'wagen (sich), to hazard, venture (out).
Vor'stellen, to represent, introduce, personate.
Zeit'vertreib, *m.* (See R. 1, above.)

RÉSUMÉ OF EXAMPLES.

Zum Zeit'vertreib begießt' sie ihre Blumen im Garten.	For pastime she waters her flowers in the garden.
Durch diese Mit'theilungen machte er seinem gepreß'ten Herzen Luft.	Through these communications he gave his oppressed heart vent.
Rußland hat sich nicht vergeb'lich bemüht', die Bewe'gungen in Euro'pa zu unterdrü'cken.	Russia has not striven in vain to suppress the agitation in Europe.
Die Leip'ziger Messe ist eine der bedeu'tendsten in ganz Deutschland.	The Leipsic fair is one of the most important in all Germany.

EXERCISE 186.

1. Bei dem Ausbruche der Revolution in Berlin wurde bis in die Nacht hinein gefochten. 2. Er gab ihm das Buch mit der Bitte, es rein zu halten. 3. Es ist ihm gestern ein Brief zugeschickt worden. 4. Ich zeigte ihm die neuen Gemälde, die ich auf der Versteigerung gekauft hatte. 5. Musik ist sein liebster Zeitvertreib. 6. Er singt, scherzt und lacht zum Zeitvertreib, anstatt sich mit ernsten Dingen zu beschäftigen. 7. Ich gehe oft Morgens (Sect. XXXIV. 3), Mittags und Abends spazieren. 8. Sie verfolgten den Feind bis an (Sect. LVII. Note) die Grenzen des Landes. 9. Bis an diese Stelle hatte sie das Buch durchgelesen. 10. Bis an diesen Ort wagten sie sich vor, aber weiter nicht. 11. Er bemühte sich vergebens, die Frage zu lösen. 12. Sie bemühten sich um die Gunst ihres Herrn. 13. Er bemüht sich Reichthümer zu erwerben. 14. Ich bin etwa fünf Jahre hier (in dieser Stadt). 15. Ich bin seit einer halben Stunde hier (in dem Zimmer). 16. Ist Jemand während meiner Abwesenheit hier gewesen? 17. Herr N. war hier und wollte Sie sprechen. 18. Ein Berliner Blatt macht uns folgende interessante Mittheilung. 19. Die Nürnberger (§ 11, Note) Leokuchen sind durch ganz Deutschland berühmt. 20. Das Heidelberger Faß ist wegen seiner Größe bekannt. 21. Ich empfehle mich Ihnen, mein Herr. 22. Empfehlen Sie mich Ihrer Familie. 23. Er empfahl sich der Gesellschaft. 24. Da der alte Jäger seinem Grimm nicht anders Luft zu machen wußte, so schlug er seine Hunde.

EXERCISE 187.

1. My friend sent me a book, with the request to peruse it. 2. I have perused your book as far as the second chapter. 3. A

parcel was sent to me yesterday. 4. Study is my most agreeable pastime. 5. In the morning I study, and in the evening I teach my scholars. 6. We need not trouble ourselves on account of our friend: he does not need our assistance. 7. During the absence of our teacher we played instead of learning. 8. How long have you been in London? 9. I have been nearly threc years here. 10. Was my brother here during my absence? 11. No, he was not here. 12. May I trouble you to write me this letter? 13. A diligent boy strives to acquire knowledge.

SECTION XCVII.—IDIOMATIC PHRASES (*continued*).

Reißen = to tear, to rend, also, to draw, etc.; hence, an sich reißen, "to draw towards, *or* to one, to usurp, seize upon;" as:—Der Sturm riß ganze Bäume aus der Erde, the storm rent whole trees from the earth. Er hat das Vermögen seines Bruders an sich gerissen, he has usurped the fortune of his brother.

Sich um Etwas reißen = to strive, contend for anything; as:—Die Räuber rissen sich um die Beute, the robbers strove for the booty.

1. Einsprechen (literally, "to speak in") = to inculcate by words, to influence by speaking. Einem Muth, Trost, etc., einsprechen, "to speak courage, consolation, etc., to one," *i.e.*, to encourage, to console, etc.; as:—Der tapfere General besuchte täglich die Schanzen, um den Soldaten Muth und Trost einzusprechen, the valiant general visited the redoubts daily, in order to encourage and console the soldiers.

2. Bei Jemanden einsprechen = to call on one, to give one a call; as:—Ich sprach auf einige Augenblicke bei dem Herrn Pfarrer ein, I called for a few moments on the pastor.

VOCABULARY.

Ab'rufen, to call, call away, recall.
An'fangsgründe, first principles, rudiments, elements.
Behag'lich, pleasing, agreeable, comfortable.
Beson'ders, particularly, especially.
Cigar're, *f.* cigar.
Ein'sprechen. (See R. 1, above.)
Fortschritt, *m.* progress.
Gelas'senheit, *f.* tranquillity.
Greis, *m.* old man.
Haus'geräth, *n.* household furniture.
Herrschaft, *f.* dominion, mastery, domination.
Kugel, *f.* bullet, ball.
Lan'dungsplatz, *m.* landing-place, place of descent.
Reißen, to tear, seize. (See above.)
Un'behaglich, unpleasant, comfortless.
Wiege, *f.* cradle.
Wirthshaus, *n.* inn, public-house.

RÉSUMÉ OF EXAMPLES.

Wer ein Vorrecht hat, sucht auch noch an'dere an sich zu reißen.	He who has one privilege seeks (to seize to himself) to usurp others.
Wollen Sie über Havre reisen?	Will you go (travel) viâ Havre?
Ich habe nichts dage'gen, wenn Sie es vor'ziehen.	I have nothing against it, if you prefer it.
Wir ziehen es vor, zu Hause zu bleiben.	We prefer to stay at home.
Der Flei'ßige macht bes'sere Fort'schritte, als der Faule.	The industrious (man) makes better progress than the idle.
Rußland, Oestreich, und Preußen rissen sich um das un'glückliche Polen.	Russia, Austria, and Prussia contended about (the) unhappy Poland.

EXERCISE 188.

1. Trotz der Mühe, welche sich der Lehrer gab, wollten die Kinder keine rechten Fortschritte machen. 2. Er machte bedeutende Fortschritte in der deutschen Sprache, nachdem er die ersten Anfangsgründe überwunden hatte. 3. Er entbehrt der nöthigsten Bücher. 4. Eine arme Familie entbehrt oft der nothwendigsten Hausgeräthe. 5. Die Gelassenheit dieses Angeklagten beruht auf dem Bewußtsein seiner Unschuld. 6. Der Capitän erzählte uns gestern, daß sich der junge Italiener eine Kugel durch den Kopf geschossen habe. 7. Er schoß dem Bären eine Kugel durch den Kopf. 8. Ich ziehe es vor über Bremen oder Hamburg, anstatt über Havre zu reisen. 9. Ich ziehe das Reiten dem Gehen, und das Fahren dem Reiten vor. 10. Es ist mir in einer warmen Stube behaglicher, als in einer kalten. 11. Es ist ihm am behaglichsten, wenn er nach dem Essen seine Cigarre rauchen kann. 12. Knaben ist es am behaglichsten und auch am gesündesten, wenn sie nach dem Essen eine halbe Stunde spazieren gehen. 13. Ich hatte den ganzen Morgen über ein unbehagliches Gefühl. 14. Die Fürsten Deutschlands haben von Neuem die Herrschaft an sich gerissen. 15. Der Oheim wußte nach und nach das Vermögen seiner Neffen an sich zu reißen. 16. Es ist schon lange her, daß ich ihn gesehen habe. 17. Ist es lange, daß er krank ist? 18. Ja, es sind schon mehr als drei Wochen. 19. Bleibe zu Hause, bis ich zu dir komme; ich werde dich zu einem Spaziergange abholen. 20. Der Tod ruft nicht nur den Greis, sondern auch gar oft den Mann in seinen besten Jahren, den Jüngling und das Kind in der Wiege ab. 21. Da ich wußte, daß mein Freund mit dem Dampfboote ankommen würde, so holte ich ihn von dem Landungsplatze ab. 22. Ich habe diesen Brief heute Morgen von der Post abgeholt. 23. Ich sprach auf meiner Reise in verschiedenen Wirthshäusern ein—aber ich kann keines derselben besonders loben. 24. Ich spreche gewöhnlich bei meinen Freunden ein, wenn ich in die Stadt gehe.

EXERCISE 189.

1. I made better progress in the German language after I had mastered the first rudiments. 2. The uncle seeks to usurp the fortune of his cousins. 3. Is it long since your brother was taken ill? 4. No, it is not more than a few days since. 5. Will you stop at home till I call on you? 6. It is more pleasant to me to take a walk in the country than to sit at home. 7. When I go to town, I generally call on some of my friends. 8. He prefers studying to all other employments. 9. I prefer walking to riding, and riding to driving. 10. During the battle the general rode along the ranks to encourage his soldiers. 11. It is healthful to children when they can take a walk after school. 12. The robbers strove for the booty which they had taken from the citizens.

LESSONS IN ARITHMETIC.—XLVII.

MISCELLANEOUS EXAMPLES (*continued*).

53. A and B rent a field for £60. A puts in 10 horses for $1\frac{1}{2}$ months, 30 oxen for 2 months, and 100 sheep for $3\frac{1}{4}$ months; B puts in 20 horses for 1 month, 40 oxen for $1\frac{1}{2}$ months, and 200 sheep for 4 months. If the food consumed in the same time by a horse, an ox, and a sheep be in the ratio 3 : 2 : 1, find the portion of the rent of the field which each must pay.

54. A fraudulent wine merchant sells as brandy a mixture of brandy and rum at £2 5s. a gallon, which is the proper price of his brandy; that of his rum being a guinea a gallon. If one-third of the mixture be rum, what does he gain per gallon by his dishonesty?

55. A Jew discounts a bill of £180, drawn at 4 months, at 60 per cent. per annum, and insists on giving in part payment 5 dozen of wine which he charges at 4 guineas a dozen, and a picture which he charges at £19. How much ready money does he pay?

If the cost to the Jew of the wine and the picture be only one-fourth of the sum he has charged for them, what is the real interest the Jew has been charging?

56. Any sum of money may be expressed in pounds, twelfths of a pound, and a proper fraction of a twelfth; and 5 per cent. on the same may be immediately obtained by considering the pounds as shillings, and twelfths as pence, and the fraction of a twelfth as the same fraction of a penny. (1.) Explain the reason of this. (2.) Hence find 5 per cent. on £621 13s. 8d. (3.) Deduce $4\frac{3}{4}$ per cent. on the same amount.

57. An American dollar at par of exchange is worth 4s. 6d. of our money. What is the value of 642 dollars when the exchange is 7 per cent. in favour of England?

58. A tax of $7\frac{1}{2}$d. in the pound produces £336,000; if it be increased to $3\frac{3}{8}$ per cent., what is the increase in the revenue?

59. A person lays out £1911 in the purchase of Three per Cent. Consols, so as to gain £150 when the price has increased $6\frac{1}{2}$. Find the price originally paid, allowing $\frac{1}{8}$ per cent. for brokerage. If Consols fall again to the original price, and the money be again invested, determine the increase of income.

60. A legacy of £658 17s. 6d. is to be divided among four persons, so that A shall have one-fifth, B half as much as A, C one-third as much as A, and D the remainder. Find their respective shares.

61. A box 5 feet long, 3 feet broad, and 2 feet 6 inches high, is made of wood 1 inch thick; what is it worth, supposing wood $\frac{1}{2}$ inch thick to cost 9d. a square foot?

62. Determine the value of $\dfrac{\sqrt[3]{6}}{\sqrt[6]{9{\cdot}869604}}$ to 4 places of decimals.

63. A person buys a quantity of goods, and sells them at such a price that he receives for $\frac{4}{5}$ of them sufficient to pay for the whole. What does he gain per cent?

64. A merchant, sending goods by sea, insures them at an amount sufficient to cover the interest to be expected on the venture (10 per cent.) and the cost of insurance (5 per cent.). The whole amount paid to him on a total loss is £504 12s. Find the cost of the goods.

65. The average weight of 69 persons is 11 stone; of 70 persons, 11 stone 1 lb. What is the weight of the 70th?

66. To pay a bill of £300 three months before date, a person sells $3\frac{1}{2}$ per cent. stock at 90. Discount being allowed at 4 per cent. per annum, how much stock must he sell, and what does he gain or lose by paying at once?

67. A shilling weighs 3 dwt. 15 grains, and is $\frac{37}{40}$ fine. What is the value of (1) a pound Troy; (2) a pound avoirdupois of pure silver?

68. A person had two-fifths of a coal mine; he sold three-fourths of his share, and divided the remainder between his two sons, giving four-fifths to the elder and £200 to the latter. Find the value of the mine.

69. By selling tea at 5s. 4d. a pound, a grocer clears one-eighth of his outlay; he then raises the price to 6s. What does he clear per cent. at the latter price?

70. If a pipe of 6 inches bore discharges a certain quantity of water in 4 hours, in what time will 3 pipes of 1, 2, 3 inches bore respectively discharge the same quantity, the water flowing in each case with the same velocity? [N.B. The bores of the pipes are proportional to the squares of their diameters.]

71. A piece of work must be finished in 36 days, and 15 men are set to do it, working 9 hours a day; but after 24 days it is found that only $\frac{3}{5}$ of the work is done. If 3 additional men be then put on, how many hours a day will they have to labour in order to finish the work in time?

72. Seven men had water enough for 13 days, allowing $1\frac{3}{4}$ pints per man daily. After 5 days some water escaped, and one man died, and the water lasted the 13 days. How much was lost?

73. A has twice as much money as B. They play together for a certain stake. At the end of the first game B wins from A one-third of A's money. What fraction of the sum B now has must A win back in the second game, that they may have exactly equal sums?

74. If 5 pumps, each having a length of stroke of 3 feet, working 15 hours a day for 5 days, empty the water out of a mine, what must be the length of stroke of each of the 5 pumps, which, working 10 hours a day for 12 days, would empty the same mine, the strokes of the former set of pumps being performed four times as fast as those of the latter?

75. From 1797 to 1821 cash payments were suspended. Before that time the value of gold was £3 17s. $10\frac{1}{2}$d. per oz.; but in 1815 it rose to £4 13s. 6d. per oz. How much per cent. had the currency depreciated?

76. Two clocks, one gaining 3 min. and the other losing 2 min. a day, are set right at noon. What is the time by the first clock when the second indicates noon a week afterwards?

77. A trader fits out 4 ships in succession to run a blockade: he reckons the total outlay on each ship after the first to be 8 per cent. more than on the one that preceded it. The first and third get into port, and he gains 160 per cent. on their cost, while the second and fourth are taken. What is his gain per cent. on the whole?

78. The price of raw cotton being 5d. a pound, and of cleaned cotton 6d. a pound, how much per cent. in weight must be lost in cleaning, the cost of cleaning being neglected?

79. The regulations respecting Great Exhibition tickets, from the opening, on Thursday, May 1, to Saturday, October 18, were as follows:—Three guinea season tickets alone admit to the opening. £1 was charged on May 2nd and 3rd, and on three exceptional days (not in May, nor shilling days). From May 5th to 17th the charge was 5s., and for the rest of the month 2s. 6d., except one day in each week, when the charge was 5s. After May the charge for admission was 1s. on four days of the week. If of the remaining days 18 were 5s. days, and the rest 2s. 6d. days, estimate the saving, by taking a season ticket, of a person who proposed to be a daily visitor.

80. If 5 per cent. be lost by selling a horse for £38, at what price must three others, which cost each the same as the first, be sold, in order to gain 10 per cent. on the whole?

81. What would be the value of 135·74, if the local value of the digits increased eightfold from right to left?

82. How many plots of ground of $33\frac{3}{4}$ square yards can be cut from a field containing 4 acres, 3 roods, 9 poles, $19\frac{1}{4}$ square yards, whose breadth is 135 yards? and what will be the width of the remaining strip, after the plots are marked off?

83. The discount on a certain sum for one year is £27 10s., and the interest on the same sum for the same time is £28 3s. 9d. Find the rate per cent., and the sum.

84. A person's income is derived from the proceeds of £4550 at a certain rate per cent., and £5420 at 1 per cent. more than the former. His whole income is £453. Determine the rates.

85. One clock gains 4 minutes and another loses 4 minutes in 12 hours. Find the time indicated by each clock, when one appears to have gained $16\frac{1}{2}$ minutes upon the other, supposing them to start together at noon.

86. The gold coinage of one country contains 1 part silver to 11 parts of gold without alloy, that of another 1 part of alloy to 23 parts of gold. It is found that 46 of the first weigh as much as $88\frac{1}{2}$ of the second. The intrinsic value of silver is $\frac{1}{16}$th that of gold. Find the par of exchange.

87. A man insures his life to the extent of 10 per cent. upon his whole income; after deducting this, he pays 8d. in the pound income-tax on the remainder. His net income is £957. Find his gross income.

88. A can do a piece of work in 6 days, which B can destroy in 4. A has worked 10 days, during the last 5 of which B has been destroying; how many days must A now work alone in order to complete his task?

89. A and B lay out equal sums in trade. A gains £100, and B loses so much that his money is now only $\frac{3}{5}$ of A's. But if each gave the other $\frac{1}{2}$ of his present sum, B's loss would be diminished by one-half. What had each at first?

90. On certain goods the import duty is 150 per cent. on their prime cost. The duty is reduced one-half, but the cost of production increases 10 per cent. Determine what would have been the price of goods sold now at £46 4s., allowing 20 per cent. profit in each case.

KEY TO EXERCISES IN LESSONS IN ARITHMETIC.—XLVI.

EXERCISE 64.

1. $\frac{117}{140}$.
2. 24000.
3. 12 stone.
4. £286492500.
5. $33\frac{1}{3}$ per cent.
6. 512.
7. 83148·8.
8. $173\frac{87}{121}$ acres.
9. ·02031.
10. 15 and 180.
11. 914 yds. 1 ft. 9 in. £15681 15s. $4\frac{217}{235}$d.
12. 18 per cent.
13. 8d.
14. £394 0s. $8\frac{1}{2}$d. $\frac{6}{7}$.
15. 114 paper gulden.
16. £375.
17. 352 persons.
18. 7·060002.
19. 139 inches.
20. £1060.
21. $6\frac{1}{4}$ per cent. £574 13s.
22. 2s. 4d.
23. 7 weeks altogether.
24. £20 6s. $0\frac{64}{105}$d.
25. $88\frac{2}{9}$oz. £343 10s.$3\frac{1}{3}$d.
26. £47 5s.
27. 9216.
28. $\frac{19}{50}$; £$22\frac{2}{9}$.
29. 895 and 11277, or 1611 and 6265.
30. The first way is the cheapest. 252 quintals.
31. £38 0s. 5d.
32. $3045\frac{9}{31}$ sequins.
33. The second way is the cheapest. 120 quintals.
34. 2250.
35. 3 per cent. £54330 10s.
36. 16720 tons.
37. 729, 432, 3348, 27 respectively.
38. $301\frac{1}{3}$ cubic yds.; $165\frac{66}{335}$.
39. £20 6s. 3d.
40. 876, 99·54 yards approximately.
41. $\frac{31}{56}$ of £1245 and $\frac{25}{56}$ of £1245 respectively.
42. $885\frac{1}{17}$.
43. $21212\frac{4}{33}$ yards.
44. £52 10s.; £58 6s. 8d. more income.
45. 2·80335 acres.
46. £1 11s. $4\frac{1}{2}$d.
47. 19041 francs 59 cents.
48. 390.
49. 2·97d.
50. In 6 years.
51. The ratio of 3 to 7.
52. £4 4s., £2, £1 16s. respectively.

LESSONS IN BOTANY.—XXXV.

SECTION CVI.—THYMELACEÆ, OR DAPHNADS.

Characteristics: Perianth tubular, 4 or 5-cleft; stamens perigynous, their number equal to the divisions of the perianth, occasionally double or fewer; ovary free, uni-locular; ovules pendent; fruit drupaceous or a nut, ordinarily one-seeded, exalbuminous; stem usually ligneous; leaves simple.

All the species of the genus *Daphne* contain an acrid principle, which gives them a vesicating property. The *Daphne Fortuni* is a very beautiful plant; it was brought from China by Mr. Fortune, some years ago, and is now cultivated in England. This gentleman also introduced the golden-flowered Edgeworthia, or the *Edgeworthia chrysantha* (Fig. 265). It is a very beautiful member of the Daphne tribe, and must not be confounded with the Reptonia, which was originally called Edgeworthia.

SECTION CVII.—LORANTHACEÆ.

Characteristics: Calyx adherent to the ovary; petals free or coherent, epigynous, four, six, or eight, valvate in æstivation or absent; stamens opposite to the petals or to the divisions of the simple perianth; ovary uni-locular; ovule pendent; berry one-seeded; embryo placed at the surface of an abundant fleshy albumen; small dichotomons shrubs, nearly always parasitic; leaves opposite, entire; flowers sometimes diœcious.

Members of this natural family chiefly inhabit the intertropical regions. Their bark contains adhesive material, like birdlime, intermediate in its general natnre between wax and caontchouc.

The mistletoe (*Viscum album*, Fig. 266) is the only species which reprcsents the family in onr land. It is a diœcious plant, with thick fleshy leaves, greenish flowers scarcely apparent, and sessile. The mistlctoe was much reverenced by the ancient Druids, who attribnted to it various mysterious properties. Evcn at this day the inhabitants of Java entertain a snperstitious respect for the *Ficus religiosa*, upon which an individnal of the natural family *Loranthaceæ* grows. They believe that the shades of their ancestors wander under the vaulted canopy formed by these cnrious trees, and are gladdened by a view of the parasites.

imbricate; flowers complete, or polygamous, or diœcious; embryo minute and homogeneous.

The most remarkable species of this class is the *Rafflesia Arnoldi* (Fig. 267), a native of Snmatra, where it grows on the trnnk of a Cissus, and consists of a single flower no less than nine feet in circnmference. Its nectary has a capacity of twelve pints, and its weight is not less than fiftcen pounds. Before its expansion the floral bud appears like a great cabbage; the bracts soon expand, and the perianth becomcs developed. Its fleshy colour and cadaverons odour attract flies and other insects, which are necessary to the process of its fecnndation. This curions member of the vegetable world has been described at length in Vol. I., page 185.

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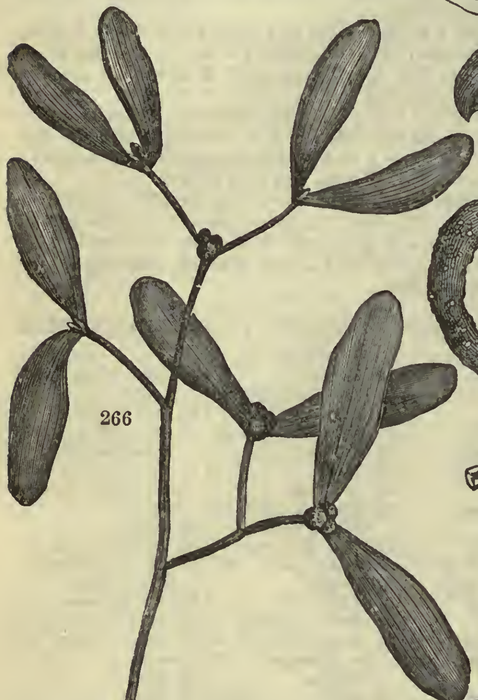

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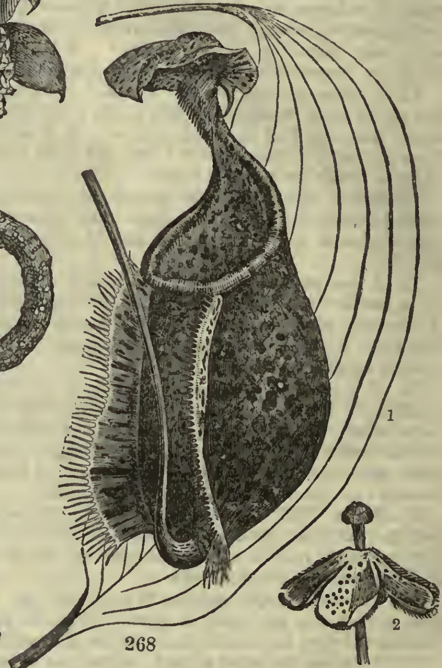

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1

2

3

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265. EDGEWORTHIA CHRYSANTHA. 266. THE MISTLETOE (VISCUM ALBUM). 267. RAFFLESIA ARNOLDI.

268. RAFFLES'S PITCHER-PLANT (NEPENTWES RAFFLESIANA). 1, THE LEAF; 2, THE MALE FLOWER; 3, THE FRUIT.

SECT. CVIII.—HYDNORACEÆ, RAFFLESIACEÆ, CYTINACEÆ, APODANTHACEÆ, AND BALANOPHORACEÆ.

These five natural orders constitute a group of plants which have been collectively termed Rhizogens or Rhizantheæ, from some Greek words which mean "flower-prodncing roots." They are supposed by some botanists to constitute an intermediate class between the Phanerogamia and the Cryptogamia. The following are their leading characteristics:—Plants composed of cellnlar tissue, pervaded by a few vessels; parasites upon the roots or stems of other plants; leaves rednced to mere scales, never green, deprived of stomata and vessels, generally

SECT. CIX.—NEPENTHACEÆ, OR NEPENTHES.

Characteristics: Sub-ligneous plants of tropical Asia and Madagascar; flowers in racemes, diœcious; perianth herbaceons, fonrpartite; stamens sixteen, coherent in a central column; ovary free, fourcelled; capsnle locnlicidal. The *Nepenthes*, type of this family, possesses alternate leaves, the petiole contracted at its base, but further on expanding into a flat limb, bnt its mid-rib is prolonged, and bcars a new foliaceons expansion like a pitcher in form, supplied with a cover attached by a kind of hinge, on which it opens and shnts. The pitcher closed at night is open during the day, and secretes in its interior a fluid, insipid in some species, slightly saccharine in others. The largest and finest species was discovered about thirty years ago at Singapore by Sir Stamford Raffles, and has received the name of *Nepenthes Rafflesiana* (Fig. 268).

LESSONS IN ASTRONOMY.—I.

OBJECTS AND EARLY HISTORY OF THE SCIENCE—EARLY ASTRONOMERS; THALES, HIPPARCHUS, PTOLEMY.

Of all the sciences which arrest the attention and engage the thought of mankind, the science of astronomy is assuredly one of the grandest, most ennobling, and most sublime. Others, though they tend greatly to expand and enrich the mind, chain it down to the earth; but this lifts it up, and carries it away far beyond the boundaries of the finite, till it is almost lost in the illimitable void of space.

Astronomy seems to lift man out of himself, and to place him on a standpoint far removed from the world he inhabits, which it reduces to a mere unit in the glorious whole; and as he beholds the unaltering regularity and unceasing motion of the heavenly bodies by which he is surrounded, and by slow degrees comes to perceive that all their varying and apparently complicated motions resolve themselves into the most beautiful simplicity, and are all governed by a few plain and simple laws, he is led to see fresh proofs of the power and wisdom of Him who by His word called them into being, and launched them forth in space.

By this science the student learns the hard lesson that the evidence of the senses is not always to be depended on; that the apparently immovable earth is in reality in a state of continual motion, both on its own axis and around the sun; and that the real movements of the heavenly bodies are quite different from those which are apparent. He learns, too, that this world, which he has always been accustomed to regard as the largest and most important body in existence, is classed among the orbs of heaven, and even among the smallest of them; that it is, indeed, but a speck in creation, quite invisible from the nearest of those fixed stars which stnd the sky; and thus he is led to feel his own insignificance. And yet when he finds that the motions of all these bodies can be accurately determined, that their sizes and even their weights can be measured, that some of the elements which enter into their composition can be told, and that their distances can be ascertained, though so great that light, with all its speed, takes thousands of years to cross the chasm that separates them from us, he sees something of the immense power with which the human mind has been endowed.

As he advances he finds that the sun and moon, which appear like small bodies performing their journeys round the earth, are in reality worlds, the former of them greatly exceeding in size that on which he lives; that the stars, which he has looked upon as mere points in the sky, are in reality suns, with systems of their own revolving around them—the "centres of life and light to myriads of unseen worlds;" and that these suns, with their attendant worlds, are all revolving in mighty orbits around one common centre, and forming one grand cluster.

The telescope still further extends his view, for by its powerful aid he discovers here and there faint *nebulæ*, or patches of cloudy light, scattered among the stars; and these at length resolve themselves into complete clusters, similar to that which is made up of our sun and all the other stars around us. But here the power of his instrument fails him, and the distances and magnitude of these systems are such as to baffle all computation or thought. Man can only stand on the verge of the infinite, and wonder and adore the glories of Him who filleth all space.

We must therefore come to the study of this science with a mind specially prepared for the reception of its truths, being ready, on the one hand, to receive all truths which shall be shown to be fully supported by careful observations and proof, even though they appear to be sometimes almost contrary to the evidence of the senses; and, on the other hand, to dismiss all those crude notions previously formed in the mind which, upon consideration, are not found to be supported by facts, and which tend, therefore, to hinder and mislead us in our inquiries. The importance of this latter point will be clearly seen when we notice how, in the early ages of astronomy, all true progress was effectually checked by the firm hold which certain preconceived notions had acquired over the human mind; and how, when at last the fact of the earth's motion was discovered, and the complicated and cumbrous systems previously believed in were thus at one stroke swept away, persecution and opposition of every kind were heaped upon the men whose intellect had thus solved the difficulties of ages.

The science of astronomy dates from an antiquity far more remote than any other science, many important discoveries having been made in it at a period anterior to all written history. In the book of Job, which is usually admitted to be the most ancient book in the world, we find reference to Arcturus, Orion, and the Pleiades, showing that, even at this early period, names had been given to some of the constellations and stars.

We can easily understand why this should be so. Every one of us, when walking alone on a clear night, when the moon has set, and the whole concave of heaven is studded with innumerable stars, must have felt an anxious desire to know something of the history and motions of those bodies. This desire was felt in the early ages of the world, and in the East, where the science seems to have had its origin, the settled weather, the clearness of the air, and the cloudlessness of the sky, would all render these observations more easy. In those early ages, too, men lived far more in the open air than in the present day. Shepherds, for instance, often watched with their flocks during the whole night, and thus they would have frequent and favourable opportunities for watching and noticing the movements of the stars. This occupation, too, would serve well to beguile the otherwise tedious hours of night, and we find accordingly that shepherds were the first astronomers.

Another reason why the science attracted so much attention was its great practical importance. Men soon noticed the regular changes of the seasons. They would see that at one time winter cold seemed to reign over all, and apparent death held all the vegetable world. Spring then followed, with its fresh leaves and opening flowers, and summer and autumn with their fruits and stores of grain; and they naturally inquired the reason of all these changes. They would notice likewise that during the summer months the sun was absent from them for only a short time, and at noon attained a greater height above the horizon than he did in the winter months, when the night was long and the hours of daylight but few; and they would thus come to connect the changing seasons with the motions of the sun, which were accordingly noted with greater accuracy. In a similar way the changes of the moon, from the first narrow crescent of light to the full round orb, and then back again, would early be remarked.

One other cause for the study of this science is found in man's innate craving for the supernatural, or something beyond himself. The apparent immutability of the heavenly bodies, the purity of their light, the regularity of their motions, and, above all, the mystery which enveloped them, excited his admiration and reverence; and hence we find that they early became objects of worship to the ignorant, and therefore superstitious, people of that time. The study of their motions was therefore usually pursued for some religious or astrological purpose, and the chief astronomers were priests or professional diviners.

We can easily understand why this was the case. It was seen that the succession of the seasons and the alternations of day and night were caused by the motions of the most important of the heavenly bodies, and hence it was supposed that all the rest exerted their influences over other matters that were going on in the world, and that by the careful study of their motions and changes future events in the history of men and nations might easily be predicted. We find, accordingly, that astrologers were consulted before any great or important work was undertaken, and their advice was usually very strictly adhered to.

The question as to what nations first cultivated this science cannot be definitely settled. It seems probable, however, that the earliest systematic observations of the stars were made by the Chaldæans.

The path of the sun among the fixed stars was very early discovered, and these stars were arranged into the twelve constellations, known as the signs of the zodiac, long before the historical era. Many of the other constellations were also named, but some were afterwards altered by the Greeks and Romans; and even in modern days a few additions have been made, as, for instance, the Shield of Sobieski and the Heart of Charles I.

It must not be supposed that any resemblance can be traced between the shape marked out by the stars and the figures they are supposed to represent. The original idea seems to have been merely to map out the sky into convenient portions for examination, and at the same time to immortalise certain real or mythical heroes; but as the system became adopted universally, it has been retained to the present day, and serves as a ready means of distinguishing and registering the stars.

The zodiacal signs are sometimes supposed to have been connected with the rural occupation of the ancients. The cluster of stars among which the sun was passing in spring was called the Ram, because at that time the flocks were sent out into the fields. The Lion, too, has been considered symbolical of the intensity and power of the rays of the summer sun. The Balance tells of the period of equal day and night; the Scorpion of the unhealthiness of autumn; while the Waterbearer and the Fishes betoken the rains and floods of winter.

The names given to these twelve constellations are as follows:—*Aries*, *Taurus*, *Gemini*, *Cancer*, *Leo*, *Virgo*, *Libra*, *Scorpio*, *Sagittarius*, *Capricornus*, *Aquarius*, *Pisces*. Their order may, however, be more easily remembered by the following lines:—

The *Ram*, the *Bull*, the heavenly *Twins*,
And next the *Crab* the *Lion* shines,
  The *Virgin*, and the *Scales*;
The *Scorpion*, *Archer*, and *He-Goat*,
The *Man that bears the Watering Pot*,
  And *Fish* with glittering scales.

Among the most important of the phenomena of the heavens are solar and lunar eclipses, and these of course attracted the attention of early astronomers, and at length the true cause of them was discovered. A careful record also appears to have been kept of them, so that the *Saros*, or Chaldæan Period, was discovered. This is a period of eighteen years and eleven days, or 223 lunar months, at the expiration of which the moon enters again upon its former track in the heavens, and thus the same eclipses are, as it were, repeated.

The wonder and anxiety with which these remarkable events were witnessed can easily be imagined, and when the first astronomer ventured to predict an eclipse, and his prediction was found true, he must have been looked upon as little short of divine. The first instance we have on record in which this was actually done is in the year 610 B.C., when Thales, the father of astronomy among the Greeks, foretold an eclipse of the sun. It seems probable, however, that a similar thing had been previously done by the Chaldæans.

With Thales begins the true history of astronomy. The Greeks were not, however, distinguished by any great proficiency in the natural sciences. We find here and there shrewd guesses and faint gleams of truth; but it is always mixed up with fanciful speculations, instead of being supported by careful observation and reasoning. They seem, for the most part, to have started with certain principles (which had no existence except in their imaginations), as, for instance, that the earth must be in the centre of the universe, and that, since the circle was the perfection of shape, all the motions of the heavenly bodies must be in circles. They then observed the phenomena of the sky, and the apparent motions of the sun and stars, and formed cumbrous and complicated systems to try and reconcile these appearances with their theories.

Hence we find all the involved mysteries of transparent wheels revolving one within the other, and carrying with them the planets and stars, of cycles and epicycles, and of crystal spheres in ceaseless rotation, which the followers of Ptolemy were ever planning and altering. The true law of discovery—which is to make accurate observations first, and afterwards start a theory to explain the appearances—seems to have been quite lost sight of, and hence confusion prevailed.

We must, however, just glance at a few of the names which stand prominently forward in the history of the science. Anaxagoras and Pythagoras were two of the Greek philosophers who succeeded Thales, and they appear to have had much more accurate views than most in their day. The truth of the earth's motion round the sun seems to have been realised by them, though it does not appear to have been received by others, and was opposed by those in power as being impious. The former of the two was indeed sentenced to death on account of his philosophical views; but his sentence was afterwards, through the influence of a friend, commuted into banishment for life.

The next we notice was the greatest of all the ancient astronomers, Hipparchus, who lived in the second century before the Christian era. He gave up all attempts to frame a system for the universe, and occupied himself by carefully watching and recording the motions of the sun and planets. The movements of the sun in particular occupied his persevering attention, and in this way he made a very near approximation to the true length of the year; and the accuracy of his observations is very remarkable when we consider the imperfect nature of the instruments he had to employ. He also observed the irregularities in the rate of the sun's motion, and determined in what part of its course its speed was greatest, and thus ascertained that, if the motion of the sun was uniform, the earth was not situated in the centre of its orbit.

Another thing for which the name of Hipparchus is memorable is a catalogue of fixed stars, which he formed in order that future astronomers might be able to detect any alteration in their position or number. He appears to have been led to undertake this task by the appearance of a new star, and though the work of carefully ascertaining and noting the position of each star was, especially with the imperfect instruments possessed in his time, a work requiring great labour and patience, he persevered, and completed a list which contained 1081 stars. In the progress of this work he made one very important discovery. On comparing the place assigned by him to a star in the constellation *Virgo* with that determined by some distinguished astronomers nearly two hundred years previously, he found a difference of two degrees in its longitude.

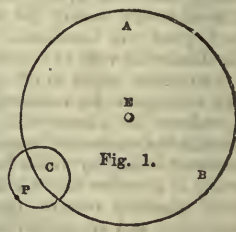


Fig. 1.

He then made similar comparisons, where it was possible, with respect to other stars, and found the same change in their position. It was thus evident that all the stars must have moved forward, or else that the point from which the measurements were taken had moved backwards. This phenomenon is known as the Precession of the Equinoxes, and will be fully explained in its place. The reason of it was discovered by the great Newton.

Another idea for which we are indebted to Hipparchus was that of representing the positions of the stars on an artificial globe, and of marking the position of places on the terrestrial globe by means of lines of latitude and longitude.

Nicias, one of the followers of Hipparchus, is said to have gone even further than his master, and started an hypothesis that the apparent changes in the sky were caused by a daily revolution of the earth. The idea, however, was not supported by any arguments, and was lost sight of for ages.

The only other one of the ancient astronomers we shall refer to in this sketch is Ptolemy, who was a very learned scholar, not only in astronomy, but in mathematics and geography. Having carefully examined the observations of Hipparchus and others, he at length promulgated a system known as the Ptolemaic, which, though since proved to be quite erroneous, accounted so well for all known phenomena that its errors could not, with the instruments then in use, be discovered; and accordingly, it was universally received until the age of Copernicus, and even then it was long before it was entirely given up.

According to this system, the earth was the centre, with the planets revolving round it in the following order:—The Moon, Mercury, Venus, the Sun, Mars, Jupiter, Saturn, and, beyond all, the fixed stars. To account for the apparent irregularities in their motions, he introduced what he termed epicycles, which will be understood by reference to Fig. 1. E represents the earth, and A B C the orbit in which the planet should move; but, instead of this, he supposed that there was a point C moving in this orbit, and that the planet P moved round this point in a small circular orbit or epicycle. The combination of these two motions explained the irregularities. This system was afterwards rendered much more complicated by the alterations introduced by his successors.

LESSONS IN ALGEBRA.—XIV.

SIMPLE EQUATIONS.

151. MOST of the investigations in algebra are carried on by means of *equations*. In the solution of problems, for example, we represent the *unknown quantity*, or *numbers sought*, by a certain letter; and then, in order to ascertain the *value* of this unknown quantity or letter, we form an *algebraic expression* from the conditions of the question, which is *equal* to some given quantity or number.

EXAMPLE.—A drover bought an equal number of sheep and cows for 840 crowns. He paid 2 crowns a-head for the sheep, and 12 crowns a-head for the cows. How many did he buy of each?

Here, let $x =$ the number bought of each;
Then $2x =$ the cost of the sheep in crowns;
And $12x =$ the cost of the cows in crowns.

Hence, $2x + 12x = 840$ by the conditions of the question.
Therefore, $14x = 840$ by addition;
And $x = 60$, the number bought of each.

Here, the last expression is obtained from the preceding one by dividing each member by 14, the co-efficient of $14x$.

It will be perceived, in this example, that the *unknown quantity*, or *number sought*, is represented by the letter x; and from the conditions of the problem, we obtain the quantity $14x$, which is equal to the given quantity 840 crowns. This whole *algebraic* expression, $14x = 840$ crowns, is called an *equation*.

152. *An* EQUATION, *therefore, is a proposition expressing in algebraic characters the equality between one quantity or set of quantities and another, or between different expressions for the same quantity.*

This *equality* is denoted by the sign $=$, which is read "is equal to." Thus $x + a = b + c$, and $5 + 8 = 17 - 4$, are equations, in one of which the sum of x and a is equal to the sum of b and c; and in the other, the sum of 5 and 8 is equal to the difference of 17 and 4.

The quantities on the two sides of the sign $=$ are called *members* of the equation; the several terms on the *left* constituting the *first* member, and those on the *right* the *second* member.

When the unknown quantity is of the *first power*, the proposition is called a *simple equation*, or an equation of the *first degree*.

153. *The reduction of an equation consists in bringing the unknown quantity by itself to one side of the sign of equality, and all the known quantities to the other side, without destroying the equality of the members.*

To effect this, it is evident that one of the members must be as much increased or diminished as the other. If a quantity be added to one, and not to the other, the equality will be destroyed. But the members will remain equal—

(1.) If the same or equal quantities be *added* to each. Ax. 1.

(2.) If the same or equal quantities be *subtracted* from each. Ax. 2.

(3.) If each be *multiplied* by the same or equal quantities. Ax. 3.

(4.) If each be *divided* by the same or equal quantities. Ax. 4.

The *principal* reductions in simple equations are those which are effected by *transposition*, *multiplication*, and *division*.

REDUCTION OF EQUATIONS BY TRANSPOSITION.

In the equation $x - 7 = 9$, the number 7 being connected with the unknown quantity x by the sign $-$, the one is *subtracted* from the other. To reduce the equation, let the 7 be *added* to both sides. It then becomes $x - 7 + 7 = 9 + 7$.

The equality of the members here is preserved, because one is increased as much as the other. But on one side we have -7 and $+7$. As these are equal, and have contrary signs, they *balance each other*, and may be cancelled. The equation will then be $x = 9 + 7$.

Here the value of x is found. It is shown to be equal to $9 + 7$, that is, to 16. The equation is therefore reduced. The unknown quantity is on one side by itself, and all the known quantities on the other side.

In the same manner, if $x - b = a$;
Adding b to both sides, we have $x - b + b = a + b$;
And cancelling as before, we have $x = a + b$. *Ans.*

154. *When known quantities, therefore, are connected with the unknown quantity by the sign + or —, the equation is reduced by* TRANSPOSING *the known quantities to the other side, and prefixing the contrary sign.*

This is called reducing an equation by *addition* or *subtraction*, because it is, in effect, adding or subtracting certain quantities to or from each of the members.

EXAMPLE.—Reduce the equation $x + 3b - m = h - d$.
Here, transposing $+ 3b$, we have $x - m = h - d - 3b$;
And transposing $- m$, $x = h - d - 3b + m$. *Ans.*

155. When several terms on the same side of an equation are *alike*, they must be united in one, by the rules for reduction in addition.

EXAMPLE.—Reduce the equation $x + 5b - 4h = 7b$.
Here, transposing $5b - 4h$, we have $x = 7b - 5b + 4h$;
And uniting $7b - 5b$ in one term, we have $x = 2b + 4h$. *Ans.*

156. The *unknown* quantity must also be transposed, whenever it is on both sides of the equation. It is not material on which side it is finally placed, though it is generally brought to the left-hand side.

EXAMPLE.—Reduce the equation $2x + 2h = h + d + 3x$.
Here, by transposition, we have $2h - h - d = 3x - 2x$;
And by incorporation [Art. 155] $h - d = x$. *Ans.*

157. When the *same term*, with the same sign, is on *opposite sides* of the equation, instead of transposing, we may *expunge* it from each. For this is only subtracting the same quantity from equal quantities.

EXAMPLE.—Reduce the equation $x + 3h + d = b + 3h + 7d$.
Here, by expunging $3h$, we have $x + d = b + 7d$;
And by transposition and incorporation $x = b + 6d$. *Ans.*

158. As *all* the terms of an equation may be transposed, or supposed to be transposed, and it is immaterial which member is written first, it is evident that the *signs of all the terms may be changed*, on both sides, without affecting the equality.

Thus, if we have $x - b = d - a$;
Then by transposition, we have $-d + a = -x + b$.
Or, by changing the places of the members, $-x + b = -d + a$;

159. If all the terms on *one* side of an equation be transposed each member will be equal to 0.

Thus, if $x + b = d$, then it is evident that $x + b - d = 0$.

EXERCISE 25.

1. Reduce $a + 2x - 8 = b - 4 + x + a$.
2. Reduce $y + ab - hm = a + 2y - ab + hm$.
3. Reduce $h + 30 + 7x = 8 - 6h + 6x - d + b$.
4. Reduce $bh + 21 - 4x + d = 12 - 3x + d - 7bh$.
5. Reduce $5x + 10 + a = 25 + 4x + a$.
6. Reduce $5c + 2x + 12 - 3 = x + 20 + 5c$.
7. Reduce $a + b - 3x = 20 + a - 4x + b$.
8. Reduce $x + 3 - 2x - 4 = 34 + 3x - 4 - 5x$.
9. Reduce $4x - 2 + 18 = 5x + 8$.
10. Reduce $24 - 2x = 3x - 8 + 2$.
11. Reduce $3 + 5x - 18 = 6x - 22$.
12. Reduce $10x + 60 + 7x = 28x + 64 - 12x$.
13. Reduce $y - 10 - b = 6 - b$.
14. Reduce $x - 10 + c - 14 - c = 0$.

KEY TO EXERCISES IN LESSONS IN ALGEBRA.

EXERCISE 23.

1. $\frac{xy + dy}{5dr}$.
2. $\frac{ad}{rx}$.
3. $\frac{4dy}{h}$.
4. $\frac{abx + x}{3aby - 3y}$.
5. $\frac{ah - cmy + h - my}{12}$.
6. $\frac{1}{ah - bh}$.
7. $\frac{1}{8}$.
8. $\frac{2xy}{a + b}$.
9. $\frac{4abd + 4cdx}{am}$.
10. $\frac{9ac - 3x}{a}$.

EXERCISE 24.

1. $\frac{c}{x - y}$.
2. $\frac{2x + 3b}{10 - y}$.
3. $\frac{3x + 11}{3ax}$.
4. $\frac{a + 1 - x}{2cd^2}$.
5. $\frac{ab + b^2}{ax}$.
6. $\frac{4x + 2mx}{3aby}$.
7. $\frac{a^2 - b^2}{12}$.
8. $\frac{x + y}{b}$.
9. 1.
10. $3cx$.
11. $\frac{4cxy}{ab}$.
12. $\frac{27xm}{x - y}$.
13. $\frac{6amx + 6mx}{a^2 - ay}$.
14. $\frac{4ax + 6c + 2d}{2x^2 + xy + bx}$.
15. $\frac{c^2y}{a^2x}$.
16. $\frac{6x^2 - x - 1}{x^2 - x - 6}$.
17. $\frac{y^3 + 2y}{y^2 - 3y + 2}$.
18. $\frac{a^2 - b^2}{a^2 - c^2}$.
19. $\frac{x^3 + ax^2}{a^3}$.
20. $\frac{m^2}{n^2}$.
21. $\frac{a}{a - 1}$.
22. $\frac{xy}{x - b}$.
23. $\frac{x^4 - b^4}{ax^2 - a^2}$.
24. $\frac{a^2(x^2 - a^2)}{x^4 + a^2x^2 - a^4 + a^2}$.
25. $\frac{x^2 + a^2}{x + 2a}$.
26. $\frac{5x^2 + 4x - 2}{x}$.

LESSONS IN LATIN.—XXXVI.

DEVIATIONS IN THE SECOND CONJUGATION.

MANY verbs of the second conjugation are without supines; such are, horreo, *I am stiff;* paveo, *I fear;* floreo, *I flourish.*

1. *Perfect*, -UI; *Supine*, -TUM.

i. Arceo, arcere, arcui (no supine), *to keep off, restrain.* Artus or arctus, the passive participle of arceo, is used as an adjective in the sense of *restrained, close, tight;* connected with artus, -ūs, *a joint.* The compounds of arceo, in which the *a* passes into *e*, are formed like moneo; as, coerceo, coercere, coercui, coercitum, *to hold together, hold in, keep back.*

ii. Doceo, docere, docui, doctum (with 2 acc.), *to teach.*

iii. Miscere, misceri, miscui, mixtum or mistum (with dat.), *to mix.*

iv. Teneo, tenere, tenui (tentum in compounds), *to hold.*

v. Torreo, torrere, torrui, tostum, *to dry, parch, toast.*

The student may here advantageously stop a moment, in order to compare his Latin with his English. Obviously in horreo (horridus), we have our *horrid;* in floreo, our *flower;* in coerceo, our *coerce* and *coercion;* in moneo, our *monition, monitor,* and *admonition;* in doceo, our *doctor;* in misceo, our *mix;* in teneo, our *tenet;* and in torreo, our *torrid* and our *toast:* to such an extent do the Latin and the English agree. These facts lie on the surface. An acquaintance with philology would disclose other facts. Thus, our *teach* is the same word as the Latin docere; and the two are found in the Greek *didaskein;* thus, *teach*, doce, dasc, have a common origin and a common import.

2. *Perfect in* -UI; *Supine in* -UM.

Only one verb. Censeo, censere, censui, censum, *to give an opinion, estimate, take the census, to judge.*

Thus are the compounds formed: recenseo, *I go over, investigate, revise,* has recensītum as well as recensum; percensere, *to go through, recount,* has no supine.

3. *Perfect in* -EVI; *Supine in* -ETUM.

i. Deleo, delere, delevi, deletum, *to destroy.*

ii. Flere, *to weep.*

iii. Nere, *to spin.*

iv. Complere (and other compounds of the obsolete plere), *to fill.*

v. Aboleo (from the obsolete oleo, *I grow*), *to abolish,* forms in the supine abolĭtum. This verb does not occur until after the Augustan age.

vi. Cieo, ciere, civi, cĭtum, *to arouse,* slightly differs from the model. Cio, cire, cīvi, cītum (never cĭtum), follows the fourth conjugation. The compounds of the above follow the forms of the simple verbs, as, concieo, -iēre (rare), -īvi, -ĭtum; concio, -ire, -itum; excieo, -iēre, -īvi, -ĭtum; excio, -ire, -ivi, -ītum; percieo, -iēre (rare), -īvi, -ĭtum; percio, -ire, -īvi, -ītum; accieo, -iēre, -ivi, -ĭtum; and accio, accire, accivi, accītum. Cieo means *to stir up;* concieo, *to arouse;* excieo, *to call forth;* percieo, *to arouse thoroughly;* accieo, *to fetch;* and accio, *to call to, send for.*

Aboleo is in signification somewhat curious. Its root, *oleo* (olo), means *to grow;* hence, adoleo, *to flourish in growth;* and adolescens, *a young man, age during the period of growth.* By the force of the prefix ab, *from,* the verb aboleo denotes *to be checked in growth,* then *to grow down,* and so *to perish* or *to destroy.*

I have said above that the word does not belong to the Augustan age. This is as much as to say that the word is not of the purest Latin source. Three ages may be distinguished in Roman literature, the pre-Augustan, the Augustan, the post-Augustan: the first comprising the writers who lived before the age of the first Roman emperor, namely, Augustus (B.C. 63—A.D. 14); the second, those who lived during that age; and the third, those who lived after that age. In the second class stand Cæsar, Cicero, Virgil, Sallust, Livy, and Horace. Undoubtedly these are very great names. But why should Lucretius be made light of, because he lived before, or Tacitus, because he lived after the days of Augustus? And is Cornelius Nepos, on the ground that he flourished in the middle of the period, preferable to Suetonius, because he wrote when the period had run out? In truth, the distinction is to some extent arbitrary, as well as indefinite, and it has been made to pass for more than it is worth. These remarks, however, are made to explain what is meant by the Augustan age, rather than to question its propriety or disparage its worth. Beyond a question, during that age lived and wrote Roman authors whose style is the model. But, because they are excellent, it by no means ensues that other good writers are not of authority. However, this classification is far better than that which it has superseded, and which divided the Roman writers into those of the iron, those of the brazen, those of the silver, and those of the golden age. Having taken a little refreshment in a topic of general interest, we must now resume our verbal studies.

4. *Perfect in* -I; *Supine in* -TUM.

The short vowel of the stem is lengthened in the perfect:—

i. Căveo, căvēre, cāvi, cautum, *to guard against* (ab. aliquo).

ii. Făveo, făvere, fāvi, fautum (rare), *to be favourable, to favour* (takes the dative).

iii. Fŏveo, fŏvere, fōvi, fōtum, *to warm, cherish, nurse.*

iv. Mŏveo, mŏvere, mōvi, mōtum, *to move.*

v. Vŏveo, vŏvere, vōvi, vōtum, *to vow.*

The ensuing have no supine:—

vi. Ferveo, fervēre, fervi, *to be hot, boil.*

vii. Păveo, pavēre, pāvi, *to dread* (expavescere is more common).

viii. Conniveo, connivēre, *to close the eyes, wink.*

VOCABULARY.

Admiscēre, *to mix with, mingle.*
Agere gratias, *to give thanks.*
Allobroges, -um, *the Allobroges, a people of Gaul.*
Amplexor, 1, *I embrace.*
Ascensus, -ūs, m., *a going up, ascent.*
Clades, -is, f., *slaughter.*
Dedĭco, 1, *I dedicate, consecrate.*
Deprehendo, -di, -sum, 3, *I take hold of.*
Distinēre, *to keep apart, occupy.*
Excludo, -si, -sum, 3, *I shut out.*
Gallina, -æ, f., *a hen.*
Gravitas,-ātis,f., *weight, earnestness.*
Horno, adv., *this season.*
Implico, 1, *I enfold, implicate.*
Pons, -tis, m., *a bridge.*
Publice, *publicly, at the public expense.*
Pullus, -i., m., *a young animal.*
Quominus—eofacilior, *the less—the more easy.*
Removēre, *to remove.*
Respīro, 1, *I breathe.*
Sedo, 1, *I still.*
Sustinēre, *to uphold, support* (E. R. *sustain*).
Testis, -is, c. (common, that is, either masculine or feminine), *a witness.*
Uva, -æ, f., *a grape.*
Vigiliæ, -arum, *a watch.*

EXERCISE 133.—LATIN-ENGLISH.

1. Ciceronem Minerva omnes artes edocuit. 2. Gravitas modestiæ mista maxime admirābĭlis est. 3. Tot, tantisque negotiis distentus sum, ut mihi non liceat libĕre respirare. 4. Nescisne quot labores, quot pericula, quot miserias milites in itinĕre sustinuĕrint? 5. Si virtus te a malis cupiditatibus arcŭerit, vita tua beāta erit. 6. Cicero per legatos cuncta doctus, prætoribus imperavit, ut in ponte Allobrŏges deprehenderent. 7. Ne animi se admisceant hominum vitiis. 8. Bonis facilis ascensus est in cœlum. 9. Quo minus animi se admiscuerint atque implicaverint hominum vitiis atque erroribus, eo facilior illis ascensus in cœlum erit. 10. Simplex animi natura est, nec habet in se quicquam admixtum. 11. Vescimur uvis sole tostis. 12. Horno multas uvas torruimus. 13. Cato Carthaginem delendam esse censuit. 14. Quinto quoque anno tota Sicilia censa est. 15. Duæ urbes potentissimæ, Carthago et Numantia, a Scipione sunt deletæ. 16. Græcorum Romanorumque gloriam nulla unquam oblivio delēvit, nec unquam delēbit. 17. Deus bonis omnibus mundum implevit, mali nihil admiscuit.

EXERCISE 134.—ENGLISH-LATIN.

1. Cicero was instructed in all arts by Minerva. 2. The citizens have vowed six temples (to be built) at the public expense. 3. They have consecrated a temple to Venus. 4. The mother cherishes her infant. 5. The mother always will cherish her children. 6. The wives cherished their husbands. 7. The slaughter of the troops raised great weeping in the city. 8. I know not what labours thou hast sustained. 9. You know not what labours I have sustained. 10. Thy father has kept thee away from vice. 11. Give thanks to thy father because he kept thee away from evil. 12. Let not your mind mix itself with (dat.) the cares of this life. 13. I have cherished great love in thy breast. 14. Great love towards thee has been cherished in my breast. 15. Who moved (*caused*) this war? 16. The generals of the enemy moved this war. 17. Thy excited mind will never be stilled. 18. Blot out those words. 19. He has blotted out the history of his reign. 20. Evil deeds are not easily blotted out. 21. Thy father gave it as his opinion that wickedness should be blotted out.

CONSTRUCTION OF "DOCEO," *I teach.*

Doceo has in the active voice two accusatives, or a double object, one of the person, the other of the thing. In the passive voice the latter may be retained, and thus we have the anomaly of an object in the passive voice. In English, *to teach* may have the same construction, as—

Active: I teach the young Latin.

Passive: The young are taught Latin by me.

Examples in Latin.

"Pejor magister te ista docuit, non ego."—*Plautus.*

*

Lit. Trans. :—" Worse master thee those things taught, not I.
Id. Trans. :—" A worse master taught thee those things, not I."
" Is reliqua frustra docetur."—*Quintilian.*
Lit. Trans. :—" He the rest in vain is taught."
Id. Trans :—" He is taught (*attempted to be taught*) the rest in vain."

Docere may have an ablative with *de*; for example—

" Præmittit ad Boios, qui de suo adventu doceant."—*Cæsar.*
Lit. Trans. :—" He sends before him to the Boii, who of his coming should teach."
Id. Trans. :—" He sends before him to the Boii persons to inform them of his approach."

The instrument or object on which a person receives instruction is put in the ablative case.

VOCABULARY.

Causa, -æ, f., *a cause.*
Græca lingua, -æ, f., *the Greek language.*
Grammatica, -æ., f., *grammar.*
Judex, -icis, *a judge.*
Latina lingua, -æ, *the Latin.*
Musica, -æ, f., *music.*

EXERCISE 135.—LATIN-ENGLISH.

1. Doce me quo modo ea effugere possim. 2. Non literas accepi quæ me docerent quid ageres. 3. Fratris causam te docui. 4. Causam rei docendus est judex. 5. De injuriis Augusti docet judices pater ejus. 6. Docebit avunculus de itinere tuo. 7. Studiosos discendi docere est æqnum et jucundum. 8. Invideo magistro tuo qui te tantâ mercede nihil sapere docuit. 9. Mnltos discipnlos linguam Latinam doceo. 10. Græce loqui docendns sum. 11. Filiam meam docuit fidibus. 12. Doceant eum equo, armisque. 13. Mene docebis Græcam linguam? 14. Musicam doce hos meos filios. 15. Literas te libens docebo.

EXERCISE 136.—ENGLISH-LATIN.

1. Teach me how I may do yon good. 2. They will teach thy daughter grammar. 3. I have taught my wife to speak Latin. 4. They teach me (to play) on the lyre. 5. He has been taught Latin. 6. Teach them to speak Greek. 7. I have been taught many things by my father. 8. They are taught music by my sister. 9. I know not what I shall teach you concerning the event of the war. 10. The boys must be tanght Latin. 11. I have been taught to speak Greek (*Græce loqui*). 12. Many pnpils have been taught Latin by me.

VOCABULARY.

Arripio (ad and rapio), 3, *I seize.*
Corrosus, pass. part. from corrodo (cum and rodo), 3, *I gnaw.*
Devoro (de and voro), 1, *I devour.*
Exoro (ex and oro), 1, *I entreat earnestly* (ex gives the force of *success*).
Irretitus,-a,-um, *caught* (pass. part. from irretio, 4, *I catch in a net*; root, rete, *a net*).
Laqueus, -i, m., *a snare, trap.*
Musculus, -i, m., diminutive of mus, muris, m., *a mouse.*
Plaga, -æ, in the plural, *the meshes of a net.*
Quo facto, *which being done* (instance of the ablative absolute).
Soleo, 2, *I am accustomed.*

Mus et Milvius.

Milvius[1] laqneis[3] irretitus[2] musculum[5] exoravit,[4] ut[6] ipsum,[8] corrosis[10] plagis,[9] liberaret.[7] Quo[1] facto,[2] milvius[4] liberatus[3] murem[8] arripuit[5] et[6] devoravit.[7] Hæc[1] fabula[2] ostendit,[3] qnam[4] gratiam[5] mali[6] pro[9] beneficiis[10] reddere[8] soleant.[7]

This is another of Esop's fables, which will afford you some practice in translating Latin into English as well as in parsing.

KEY TO EXERCISES IN LESSONS IN LATIN.—XXXV.

EXERCISE 129.—LATIN-ENGLISH.

1. Who comes? 2. The door creaked. 3. The leader violently abused the soldiers. 4. The whole city resounded with the voices of citizens exulting on account of the victory gained over the enemies. 5. Come, let us go to lie down. 6. The Romans by their arms completely subdued many tribes and nations. 7. We are taught by the authority and command of the laws to possess regulated desires, and to restrain all passions. 8. Great springs of water gushed forth from the fountain. 9. The wise men of the Indians devote themselves to the flames. 10. The wise men of the Indians are burnt without a groan. 11. The wise men of the Indians, when they have devoted themselves to the flames, are burned without a groan. 12. Cicero applied himself to (*studied under*) Molon the philosopher. 13. The wise man endeavours to unfold the involved idea of his mind. 14. When you have laid open the history of the times, you will find many examples both of virtues and vices. 15. When the city was taken, every place on all sides sounded with the lamentations of women and children. 16. We are frightened when it has thundered in calm weather. 17. We strive after what is forbidden. 18. Augustus forbad the poems of Virgil to be burned. 19. Augustus forbad the poems of Virgil to be burned in opposition to the modesty of his (Virgil's) will.

EXERCISE 130.—ENGLISH-LATIN.

1. Forium cardines crepuerunt. 2. Mater filium innocentem increpuit. 3. Milites per totam noctem excubuêre. 4. Nautæ hostium classem domabunt. 5. Ad Ciceronem me applicabo. 6. Veto te ad Aristotelem te applicare. 7. Nitĕmur in vetitum. 8. Tota domus hominum gemitibus ægrorum sonuit. 9. Urbs armis sonat. 10. Jupiter nutu cæteros Deos domat. 11. Passim gemitus ploratusque sonant. 12. Leonem perdomui.

EXERCISE 131.—LATIN-ENGLISH.

1. I fear that I have revived your regret and grief by my letter. 2. You are about to revive the past misfortunes of the republic by your wicked deeds. 3. There is no doubt that you will revive the past misfortunes of the republic by your wicked deeds. 4. Tantălus, touching the top of the water, is represented by the poets as tortured by thirst. 5. Do you not know how much that talkative man has tortured me by chattering? 6. Caius Marius, when he was flogged, at the first forbad that he should be bound, and no one before Marius is said to have been flogged unbound. 7. Husbandmen carry the corn, when cut down, into barns. 8. Unless you have restrained your desires, in vain will you endeavour to live happily. 9. Who knows not how much Cicero aided his country? 10. Not only fortune but your industry also has assisted you in your undertaking. 11. If fortune lends our soldiers any aid, we do not doubt that we shall gain a splendid victory over the enemies. 12. The army advanced by long marches to assist the blockaded citizens. 13. Do not sup before you have washed your hands. 14. As you are about to wash your body, fetch pure water from the running stream.

EXERCISE 132.—ENGLISH-LATIN.

1. Pueri, expergiscimini, lavate, et quum lavissetis ad negotium se applicate. 2. Hæ mulieres me garriendo enecuerunt. 3. Non dubito quin hæ mulieres te garriendo enecuerint. 4. Hæ puellæ garrulæ me garrulitate enecabunt. 5. Vetabo filium garrire. 6. Lavistine manus? 7. Age! bene manus prius lava quam accumbes. 8. Nolunt pedes lavare. 9. Patris verbum filium adjuvat. 10. Naves veninut urbem obsidione cinctam adjūtum. 11. Non est dubium quin ducis exercitus nostri brevi urbem adjuvaturus sit. 12. Secuistine pollicem? 13. Crus secui. 14. Dolorem meum refricuisti. 15. Nolens refricui dolorem tuum. 16. Fortuna fortem juvat. 17. Servus alligatur. 18. Pater vetat filium alligari.

LESSONS IN FRENCH.—LII.

§ 13.—PROPER NAMES.

(1.) Proper names, when not used figuratively, are invariable, even when preceded by the plural article, les (*) :—

L'Espagne s'honore d'avoir produit les deux *Sénèque*. RAYNOUARD.	*Spain prides herself on having given birth to the two Senecas.*
Les *Locke*, les *Montesquieu*, les *J. J. Rousseau*, en se levant en Europe, appelèrent les peuples modernes à la *liberté*. CHATEAUBRIAND.	*Locke, Montesquieu, J. J. Rousseau, as they arose in Europe, called upon modern nations to claim their liberty.*

(2.) When proper names are used figuratively, they take the form of the plural :—

La France a eu ses *Césars* et ses *Pompées*. NOEL ET CHAPSAL.	*France has had its Cæsars and its Pompeys.*

That is,—generals like Pompey and Cæsar.

Un coup d'œil de Louis enfantait des *Corneilles*. DELILLE.	*A glance of Louis produced Corneilles.*

That is,—poets like Corneille.

§ 14.—THE ARTICLE.

(1.) The article is a word prefixed to a noun, or to a word used substantively, to determine the extent of its signification.

(2.) There are in French three sorts of articles, viz., definite, indefinite, and partitive.

(3.) The definite article is **le** (*the*), for the masculine singular; **la** for the feminine singular; and **les** for the plural, both genders.

(4.) The indefinite article is **un** (*a* or *an*) for the masculine, and **une** for the feminine.

(5.) The partitive article is **du** (*some, any*) with a masculine noun singular; **de la** with a feminine noun singular; and

* Often used by the French before the names of celebrated individuals.

*

des with any noun plural. Before an adjective this article is de for both genders and numbers.

(6.) The definite article is subject to two kinds of changes: *elision* [§ 143] and *contraction.*

(7.) Elision is the suppression of the letters *e*, *a*, which are replaced by an apostrophe ['] before a vowel, or an *h* mute [*see* Sect. 2 (2), § 143 (1)]: thus,

l'esprit, *the mind,*	instead of	le esprit.
l'amitié, *the friendship,*	„	la amitié.
l'homme, *the man,*	„	le homme.
l'humanité, *humanity,*	„	la humanité.

(8.) Contraction is the union of the article le, les, with one of the prepositions à, de. Thus, we say by contraction:—

au livre, *to the book,*	instead of	à le livre.
aux fruits, *to the fruits,*	„	à les fruits.
du livre, *of the book,*	„	de le livre.
des fruits, *of the fruits,*	„	de les fruits.

(9.) The contractions *au, du* are not used before masculine words commencing with a vowel, or an *h* mute, nor before feminine words:—

à l'homme,	*to the man.*
à l'ami,	*to the friend.*
de l'homme,	*of the man.*
de l'ami,	*of the friend.*
à la femme,	*to the woman.*
de l'orange,	*of the orange.*

(10.) The indefinite article must agree in gender with its noun; and when preceded by the preposition de, the *e* of the latter is elided:—

Masculine.		*Feminine.*	
un homme,	*a man.*	une femme,	*a woman.*
d'un homme,	*of* or *from a man.*	d'une femme,	*of* or *from a woman.*
à un homme,	*at* or *to a man.*	à une femme,	*at* or *to a woman.*

(11.) The partitive article is used before nouns taken in a partitive sense [§ 78 (1)], and must be expressed and repeated before every such noun, whether *some* or *any* is expressed or understood:—

du pain, m.	*bread, some bread.*
de l'argent, m.	*money, some money.*
de la viande, f.	*meat, some meat.*
de l'argenterie, f.	*silver-plate, some silver-plate.*
des livres, m.	*books, some books.*

The partitive article before an adjective:—

de bon pain,	*some good bread.*
de bonne viande,	*some good meat.*
de bons livres,	*good books.*
d'aimables sœurs,	*amiable sisters.*
d'étranges évènements,	*strange events.*

Résumé of the above Observations.

le, before a masculine word, la, before a feminine word,	*commencing with a consonant,*	*the.*
l', before a word of either gender,	*commencing with a vowel or h mute,*	
les, for the plural, *in all cases.*		
du, before a masculine word, de la, before a feminine word,	*commencing with a consonant,*	*of the.* *from the.*
de l', before a word of either gender,	*commencing with a vowel or h mute,*	
des, for the plural, *in all cases.*		
au, before a masculine word, à la, before a feminine word,	*commencing with a consonant,*	*at* or *to the.*
à l', before a word of either gender,	*commencing with a vowel or h mute,*	
aux, for the plural, *in all cases.*		
un, before a masculine noun, une, before a feminine noun,	*a, an.*	
d'un, before a masculine noun, d'une, before a feminine noun,	*of* or *from a, an.*	
à un, before a masculine noun, à une, before a feminine noun,	*at* or *to a, an.*	

Le père et *la* mère sont *au* désespoir. B. DE ST. PIERRE.	*The father and mother are in despair.*
*L'*amitié dans nos cœurs verse *un* bonheur paisible. DEMOUSTIER.	*Friendship pours a peaceful happiness into our hearts.*
*L'*honneur *aux* grands cœurs est plus cher que *la* vie. CORNEILLE.	*Honour is dearer than life to noble hearts.*
Les filles et *les* garçons chantèrent en chœur. B. DE ST. PIERRE.	*The boys and girls sang in chorus.*
Sur *les* rives *du* Gange ou voit fleurir *l'*ébène. DELILLE.	*On the banks of the Ganges we see the ebony in bloom.*
La violette se cache timidement *au* milieu *des* filles *de l'*ombre. DELEUZE.	*The violet conceals herself timidly in the midst of the daughters of the shade.*
Le remords se réveille *au* cri *de la* nature. DE BELLOY.	*Remorse is aroused by the cry of nature.*
La moitié *des* humains vit aux dépens *de l'*autre. DESTOUCHES.	*One half of mankind lives at the expense of the other.*

KEY TO EXERCISES IN LESSONS IN FRENCH.

EXERCISE 182 (Vol. III., page 69).

1. Le Dr. L. ne s'est-il pas démis de sa place? 2. Il ne s'en est pas démis. 3. Il s'en démettrait, s'il allait eu Allemagne. 4. Êtes-vous obligé de vous démettre de votre place? 5. Je ne suis pas obligé de m'en démettre. 6. M. votre cousin s'est-il démis le bras? 7. Il ne s'est pas démis le bras, mais l'épaule. 8. Qui la lui a remise? 9. Le Dr. F. la lui a remise. 10. Mme votre mère ne s'est-elle pas démis le poignet? 11. Elle ne s'est pas démis le poignet; elle s'est cassé le bras. 12. L'ennemi s'est-il emparé de la ville? 13. L'ennemi s'est emparé de la ville. 14. Quelqu'un ne s'emparera-t-il pas de votre chapeau (*or* ne s'emparera-t-on pas de votre chapeau), si vous le laissez ici? 15. Quelqu'un s'en emparera (*On s'en emparera*). 16. Comment votre fils s'est-il comporté ce matin? 17. Il s'est très bien comporté (*comporté très bien*). 18. Il se comporte toujours comme il faut. 19. Ne vous inquiétez-vous pas inutilement? 20. Je ne m'inquiète pas du tout. 21. Vous attendiez-vous à un tel traitement de la part de votre fils? 22. Je ne m'attendais pas à un tel traitement de sa part. 23. Cette demoiselle se comporte-t-elle bien euvers sa mère? 24. Elle se comporte bien envers tout le monde. 25. Vous comporterez-vous mieux à l'avenir? 26. Nous nous comporterons bien. 27. Vous êtes-vous cassé le doigt? 28. Je me suis cassé le pouce. 29. Pouviez-vous vous empêcher de dormir? 30. Nous ne pouvions nous empêcher de sourire. 31. Mes sœurs ne pouvaient s'empêcher de rire. 32. Pourquoi vous inquiétez-vous? 33. Parce que mon fils ne se comporte pas bien. 34. M. votre père s'attendait-il à être bien traité? 35. Il s'attendait à être traité comme il faut.

EXERCISE 183 (Vol. III., page 69).

1. What shall I bring you from London? 2. Bring us what you can, no matter what. 3. Have you told him to bring velvet? 4. I have told him to bring some, no matter of what quality. 5. Provided some one comes, no matter who. 6. What matters it to me whether Arnaud approves or condemns me? 7. Does he grant you your request? 8. He refuses; what does it matter? 9. Is he satisfied with the efforts which you have made? 10. He is not satisfied with them; what matters it? 11. He would not receive us; I care little about it (*it is of little consequence to me*). 12. What matter the complaints and murmurs of authors, if the public laugh at them? 13. What matters it that a vile blood be shed at random? 14. That concerns you; does it not? 15. That does not concern me. 16. That concerns (*touches*) me alone. 17. You have told them that these affairs did not concern them; have you not? 18. You are angry with me; are you not? No matter. 19. With whom are you angry? 20. We are angry with nobody. 21. We have no grudge against you. 22. You will be angry with me; will you not? 23. Have you a design against the life of your friend? 24. I have no design against his life.

EXERCISE 184 (Vol. III., page 69).

1. Par quel chemin M. votre frère viendra-t-il? 2. Qu'importe par quel chemin? pourvu qu'il vienne demain. 3. Écrira-t-il à M. votre frère? 4. Il ne lui écrira pas; mais n'importe. 5. Ne voulez-vous pas me prêter un livre? 6. Quel livre désirez-vous? 7. N'importe lequel. 8. Vous apporterai-je de la soie, de Paris? 9. Apportez-moi ce que vous pourrez, n'importe quoi. 10. Est-ce que cela regarde M. votre frère (*Cela regarde-t-il M. votre frère*)? 11. Cela ne le regarde pas, mais cela me regarde. 12. Refuse-t-il de nous écrire? 13. Il refuse d'écrire; mais qu'importe? 14. Apportez-moi un livre, n'importe lequel. 15. M. votre frère viendra, n'est-ce pas? 16. A-t-il voulu recevoir M. votre frère? 17. Il a refusé de le recevoir, mais n'importe. 18. Il est content, n'est-ce pas? 19. Il n'est pas conteut, mais n'importe. 20. Cela vous regarde-t-il? 21. Cela me regarde. 22. Cela regarde mon frère. 23. Je vous ai dit que cela ne regarde personne. 24. Cet homme en veut-il à la vie de votre père? 25. Il n'en veut pas à sa vie; mais il en veut à ses biens. 26. Nous en voulez-vous par rapport à cela? 27. Je ne vous en veux pas par rapport à cela. 28. En voulez-vous à mes amis? 29. Je ne leur en veux pas. 30. Cela vous regarde, n'est-ce pas? 31. Cela me regarde. 32. Cela vous regarde-t-il (*Est-ce que cela vous regarde*)? 33. Il fait très chaud ce matin, n'est ce pas?

EXERCISE 185 (Vol. III., page 114).

1. Have you collected many people at your house? 2. Very few people came. 3. At what hour will they serve the dinner to-day? 4. It will be served as soon as all our company is come. 5. Has the captain all his crew on board? 6. No, Sir, he has sent some men on shore. 7. Do your people rise early? 8. Every day I must awake all my people (*servants*). 9. The Russians lost three times more men than the Swedes. 10. Where is your mother? 11. She is in the drawing-room; there is company with her. 12. Everybody can travel as I do. 13. So goes the world. 14. She waits to leave the world until the world has left her. 15. Are your people back from the country? 16. We expect our people to-day. 17. Is there here a society of men of letters? 18. No, Sir; there is only a society of lawyers. 19. Do you know those worthy people? 20. I believe they are military men. 21. Such are people in these times (*nowadays*). 22. Like people, like patrons. 23. All my people are sick. 24. We must put up with everybody. 25. What can you have to settle with such people?

EXERCISE 186 (Vol. III., page 115).

1. Y a-t-il beaucoup de monde chez votre frère? 2. Il n'y a pas beaucoup de monde. 3. Ce jeune homme médit-il de tout le monde? 4. Il ne médit de personne. 5. Avez-vous amené beaucoup de monde avec vous? 6. Nous n'avons amené que peu de monde. 7. Y a-t-il du monde avec M^me^ votre mère? 8. Il n'y a pas de monde avec elle. 9. Qui vous a dit cela? 10. Tout le monde le dit. 11. Le monde est-il venu? 12. Le monde n'est pas encore venu. 13. M^me^ votre mère a-t-elle congédié deux domestiques? 14. Elle a congédié tout son monde. 15. Connaissez-vous ces gens? 16. Je les connais très bien; ce sont de fort braves gens. 17. Quand il voyage, il loge toujours chez de bonnes gens. 18. Y a-t-il de sottes gens ici? 19. Il y a de sottes gens partout. 20. Éveillez-vous vos gens (*votre monde*) tous les matins? 21. Oui, Monsieur; il faut que je les éveille tous les jours. 22. Qu'est-ce que M. votre frère peut avoir à démêler avec ces gens? 23. Ce sont les meilleures gens du monde. 24. Y avait-il beaucoup de monde à l'église ce matin? 25. Il n'y avait pas beaucoup de monde. 26. Vos gens sont-ils malades? 27. Oui, Monsieur, tous mes gens sont malades. 28. Il y a ici une société de gens de lettres (*savants*). 29. Il y a à Paris plusieurs sociétés de gens de robe. 30. Quels braves gens! 31. Quelles bonnes gens! 32. Attendez-vous vos gens aujourd'hui? 33. Nous les attendons ce soir. 34. Ainsi va le monde. 35. Votre capitaine a-t-il tous ses gens? 36. Il a tout son monde à bord.

EXERCISE 187 (Vol. III., page 115).

1. Is it a new coat that your son wears? 2. It is a new coat, the cloth (*of it*) is very fine. 3. Are not the sleeves (*of it*) too short? 4. I believe that the sleeves are too short and the skirts too long. 5. Has not the country its advantages? 6. I like the country; I know its advantages. 7. Paris has its pleasures. 8. I like Paris; I know its pleasures. 9. Does that surgeon understand medicine? 10. He knows nothing at all about it. 11. Are you expert in medicine? 12. I do not understand it. 13. I do not know it. 14. I understand nothing about it. 15. Have you succeeded in making yourself understood? 16. We have not (*succeeded in it*). 17. My neighbour is a worthy man, and I agree very well with him. 18. Imposing silence on certain people is a greater miracle than making the dumb speak. 19. Do you know from what country that man is? 20. He conceals (*is silent about it*) his country and birth (*parentage*). 21. Through the power of reason she acquired the art of speaking and of being silent. 22. Will you hold your tongue, impertinent woman, you always come and mix your impertinences in everything. 23. He who is silent consents. (*Silence gives consent*).

EXERCISE 188 (Vol. III., page 115).

1. Avez-vous un très beau jardin? 2. Nous en avons un très grand, mais la terre n'en est pas bonne. 3. L'habit de votre frère est-il neuf? 4. Il a un habit neuf, mais les manches en sont trop courtes. 5. Les basques n'en sont-elles pas trop longues? 6. Non, Monsieur, les basques en sont trop courtes. 7. N'avez-vous pas entendu ce prédicateur? 8. Il y avait tant de bruit que je n'ai pu l'entendre. 9. La campagne n'a-t-elle pas ses plaisirs? 10. La campagne a ses agréments. 11. M. votre frère n'aime-t-il pas la ville? 12. Il aime la campagne, il en connaît les agréments. 13. Qu'est-ce que votre frère entend par là? 14. Il entend ce qu'il dit. 15. M. votre père s'entend-il aux affaires (*au commerce*)? 16. Mon père ne s'entend pas aux affaires. 17. Ce jeune homme entend-il bien l'anglais? 18. Il entend très bien le français et l'anglais. 19. Vous entendez-vous avec votre associé? 20. Mon associé est un honnête homme; je m'entends très bien avec lui. 21. Ce jeune homme tait-il son âge? 22. Il tait son âge et son pays. 23. M. votre père s'entend-il à la médicine? 24. Il ne s'y entend pas. 25. Il ne l'entend pas. 26. Taisez-vous mon enfant. 27. Dites à cet enfant de se taire. 28. Qui se tait consent. 29. Ne voulez-vous pas vous taire? 30. Que lui avez-vous donné à entendre? 31. Nous lui avons donné à entendre que l'étude a ses charmes. 32. L'avez-vous fait taire? 33. Oui, Monsieur, nous l'avons fait taire. 34. Dites-lui de se taire. 35. Je lui ai déjà dit de se taire. 36. Taisons-nous.

GEOMETRICAL PERSPECTIVE.—XIII.

AT the foot of the enunciations of several of the problems, we have proposed a scale of some definite number of feet to the inch. Beginners, no doubt, will have found this convenient in assisting them to determine the size of the drawing they may be about to make. We hope by this time they clearly understand that upon the scale depends not only the arrangement and proportions of the parts of the drawing throughout its construction, but also its requisite size upon the paper, to allow sufficient room to ensure a clear representation of all minor details. Therefore it matters little whether the scale is half an inch or one inch to the foot, so long as it is sufficiently large to admit of all that we wish to introduce. Most of the figures attached to our problems are upon a very small scale, for the purpose of economising space; but we advise our pupils to make their drawings from these figures on a larger scale. We have drawn Fig. 61 in the proportion of 3 feet to an inch; a scale of a foot to 1 inch would be better for copying it. This brings us to a difficulty which is not unfrequently a stumbling-block to many young students in geometrical drawing. We will make use of Problem XXXVII. and its Fig. 61 to assist us in explaining it. It will be seen that in the statement of the problem there are but *two* measurements named; all the rest are referred to the scale of 3 feet to the inch, from which the parts must be measured. The difficulty we allude to is—How are the proportions of the other parts to be obtained upon an increased scale? First, the scale of 3 feet to the inch must be made, and also another and corresponding scale of 1 foot to the inch; the parts of the Fig. 61 may be measured by the scale of 3 feet to the inch, and the *same figures* applied to the 1 inch scale for the drawing in hand. If these simple directions for making a drawing upon increased proportions are exactly followed, it will save much time and space in giving the stated measurements of every part of our subjects; and as we have drawn them to a scale, the additional trouble of making a scale to work from will be but trifling. We propose now to apply the rules and conditions of Problems XXXV. and XXXVI. The first relates to additional picture-planes; the second to the use of the diagonal in perspective representation.

PROBLEM XXXVII. (Fig. 61).—*Draw the perspective view of a pedestal, as shown in the plan and elevation* A *and* B. *The height of the eye to be at two-thirds of the height of the pedestal. Nearest angle, 1 foot within the picture, and 2 feet to the right of the eye; one side is inclined to the picture-plane, at an angle of 35°; other conditions at pleasure. Scale, 3 feet to an inch.*

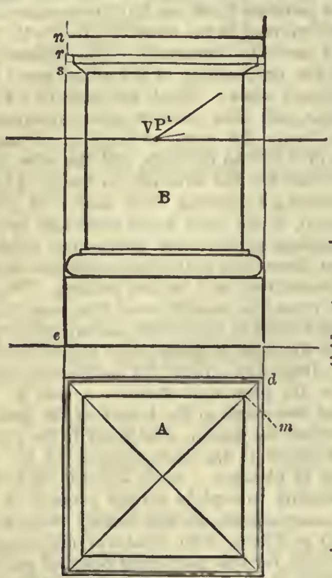
As there is no necessity to explain all the process of construction from the commencement, we will merely refer to the leading lines and their positions, with whatever additional instruction may be necessary for this particular class of subjects. *a b* two feet to the right of the eye; *b c* one foot within; *e* O the retiring diagonal line, O its VP and DO its distance-point. Let the line of contact be drawn from *e*, the point of contact of the diagonal line, because all the heights of the parts of the pedestal must be measured upon it and drawn towards its VP; that is, they are to be taken from the elevation, B, on the line *e n*, where all the lines of the mouldings are produced for this purpose, and then transferred to the line of contact, *e n*, of the perspective view. It will be noticed that the horizontal projections of the mouldings beyond each other are brought down by perpendicular lines to the plan, A; these must be taken from the plan, commencing at the outer angle, *d*, along the diagonal line, and repeated upon the PP thus:—Draw a line from DO through W to the PP in *d*, make *d m* equal to *d m* of the plan, and rule from *m* back again to DO; from where this line cuts the diagonal, draw a perpendicular; this will give the near angle of the faces of the pedestal. Let this be considered as a rule, *that all the various projections of mouldings, of whatever kind, are brought down to the diagonal of the plan, and treated as we have shown by the construction from m.* The upper PP must be drawn through *n* on the line of contact, and all the points of measurement that have to be made upon it, together with all the lines to be drawn from these points, must be produced and carried out precisely in the same way as when they are arranged upon and taken from the PP of the base.

Our next consideration, which is also an important one will be the use of *half-distance points*. It not unfrequently occurs that the lengths of the lines representing the object are so great that we are unable, from want of sufficient room on

*

the paper, to mark them on the PP for the purpose of cutting them off their respective vanishing-lines, guided by their true distance-point. When such is the case, we have recourse to the use of *half-distance points.* Our pupils are aware how a distance-point is found for any given vanishing-point. *If the space on the* HL *between the* VP *and its* DVP *be bisected, the middle point thus found will be the half-distance point.* To explain and illustrate the construction and application of this very useful principle in perspective, we have employed only a single line.

PROBLEM XXXVIII. (Fig. 62).—On reference to the figure, it will be seen that *c d* is the perspective view of a line at an angle of 35° with the PP, the real length of which is *a b*, from which lines are drawn in the usual way to the DVP, to determine *c d* on the vanishing-line. Find the half-distance point by the bisection explained above, mark it ½ DVP, and draw from it a line through *c* to *n;* take *half the length* of the given line to be represented, and set it off from *n* to *f*, rule from *f* to ½ DVP. It will be seen that the two lines from *n* and *f* pass through the same points *c* and *d* to the ½ DVP, which were originally found by the two lines from *a* and *b* to the DVP. Suppose it were necessary to represent a line double, or of a greater length than *a b;* in this instance we will take double the length to show the advantage of



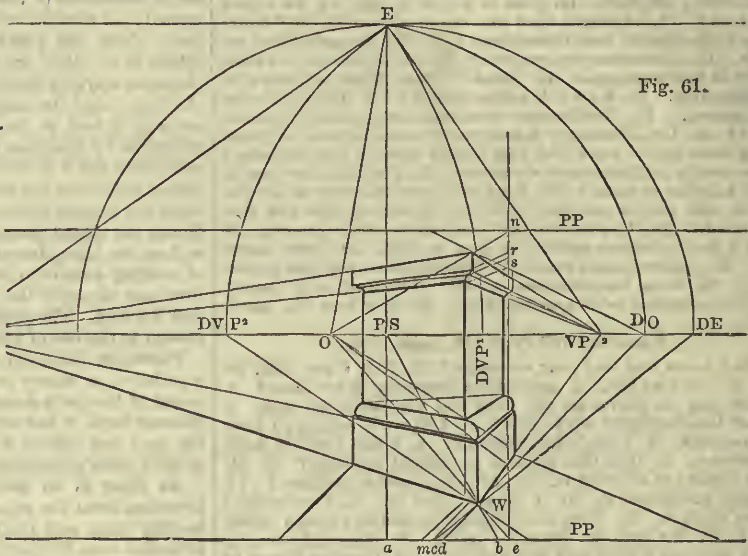


Fig. 61.

this principle of construction. Make *f m* equal to *f n*, and rule from *m* to the ½ DVP, it will cut the vanishing line in *e; c e* will then be the perspective length of a line equal to twice *a b*. Our pupils will see that it is impossible, from want of space, to double the length of *a b* on the PP, and so carry a line from the extreme to the DVP; had there been sufficient room to mark the full length, *x* would have been the line to the DVP to determine the length of *c e*. As we shall have occasion to avail ourselves of the *half-distance point* in some of our future questions, we advise our pupils to exercise themselves in this problem, employing various lengths of lines at various angles.

PROBLEM XXXIX. (Fig. 63).—*The interior of a room in parallel perspective; the retiring portion in view is* 16 *feet long*, 19 *feet wide, and* 12 *feet high. Distance of the eye from the picture-plane* 12 *feet, and its height from the ground* 4 *feet. At the further end are folding doors* 10 *feet high, and* 4 *feet wide ; also a single door at the side, the height and width of which are the same. The door* A *is at an angle of* 32° *with the connecting wall, the door* B *at an angle of* 67°, *and* C *at an angle of* 40° *with its wall, and* 5 *feet from the further corner of the room.* In this case the PS will be the VP for the retiring walls on both sides ; the width of the room is marked off from *a* to *b* on the PP and ruled to the PS; the height is *a d* and *b f;* the depth to be represented, viz., 16 feet, is set off from *a* to *c*, and a line from *c* to DE will cut off the length of the room in the point *n* on the line from *a* to PS; from this point *n* a perpendicular line is to be drawn to represent the corner of the room, to meet the lines from *d* and *f* to the PS; from this perpendicular draw lines across (that is, parallel with the HL) to meet the corresponding retiring lines of the opposite retiring wall; thus will be determined the further end upon which are fixed the folding doors A and B. How to find their vanishing-points and cut off their widths, we trust it will not be necessary to repeat, but merely remark that VP^1 is the VP for the door A, VP^3 for the door B, and VP^4 for C. To ascertain the vanishing-point for the retiring thickness of a door, it will be found by drawing a line from E to the HL at a right angle with the line of its VP; for example, VP^2 is the VP for the retiring thickness of the door A. With regard to drawing the true position of the door at the side, there may be a difficulty not yet explained. Here is a case, which frequently occurs, of a line or plane *at an angle or inclination with something else than the picture-plane.* In the case before us, a door is stated to be at *a given angle with its wall,* whilst at the same time the wall is at *a right angle* with the PP. The difficulty is how to find the VP for the door. The proposition states that it is at an angle of 40° with its own wall. The difficulty will not be great if we know the angle to the PP of the intermediate plane to which the given object is inclined; because, if the wall D (see Fig. 64) upon which the door swings is at a right angle with the wall F, and C, the door, is at an angle of 40° with D, therefore C will be at an angle of 50° with F; but F is parallel with the PP, therefore the door C will be at an angle of 50° with the PP. Consequently, we shall find the VP of the door (Fig. 63) by drawing a line from E at 50° with the PP, producing VP^4. To find its distance from the corner of the room at *n*, mark the point *e* 5 feet from *c*, rule from *e* to DE, and where this line cuts the line from *a* to PS will be found the position of that side of the doorway upon which the door swings: the heights of the doors are set off from *o*.

PROBLEM XL. (Fig. 65).—*A box* 6 *feet long*, 3 *feet wide, and* 1 *foot* 6 *inches high, inclined to the picture at an angle of* 37°. *The lid is open and thrown back at an angle of* 45° *with the perpendicular. Thickness of wood,* 2 *inches. Depth of lid,* 6 *inches. Distance of the eye from the picture-plane,* 6 *feet, and its height from the ground* 2 *feet* 6 *inches. The nearest angle to touch the picture-plane. Scale,* ⅜ *inch to the foot.*

If the lid is at an angle of 45° with the perpendicular, it will be at the same angle with the horizon; therefore, as VP^2 is the VP for the end of the box, the angle of inclination must be made from DVP^2. To cut off the retiring length of the lid, the line of contact must be drawn from *c n* to *b*, and then from DVP^3 draw a line through the corner of the box joining the lid to *a;* make *a b* equal to the width of the box, and rule from *b* back again to the DVP^3. For the depth of the lid draw from DVP^4 to *n* on the line of contact; make *n c* equal to the depth 6 inches, and draw back again as before. As the other parts of the construction are the same which have been repeatedly explained in previous problems, we leave the remainder as an exercise for practice.

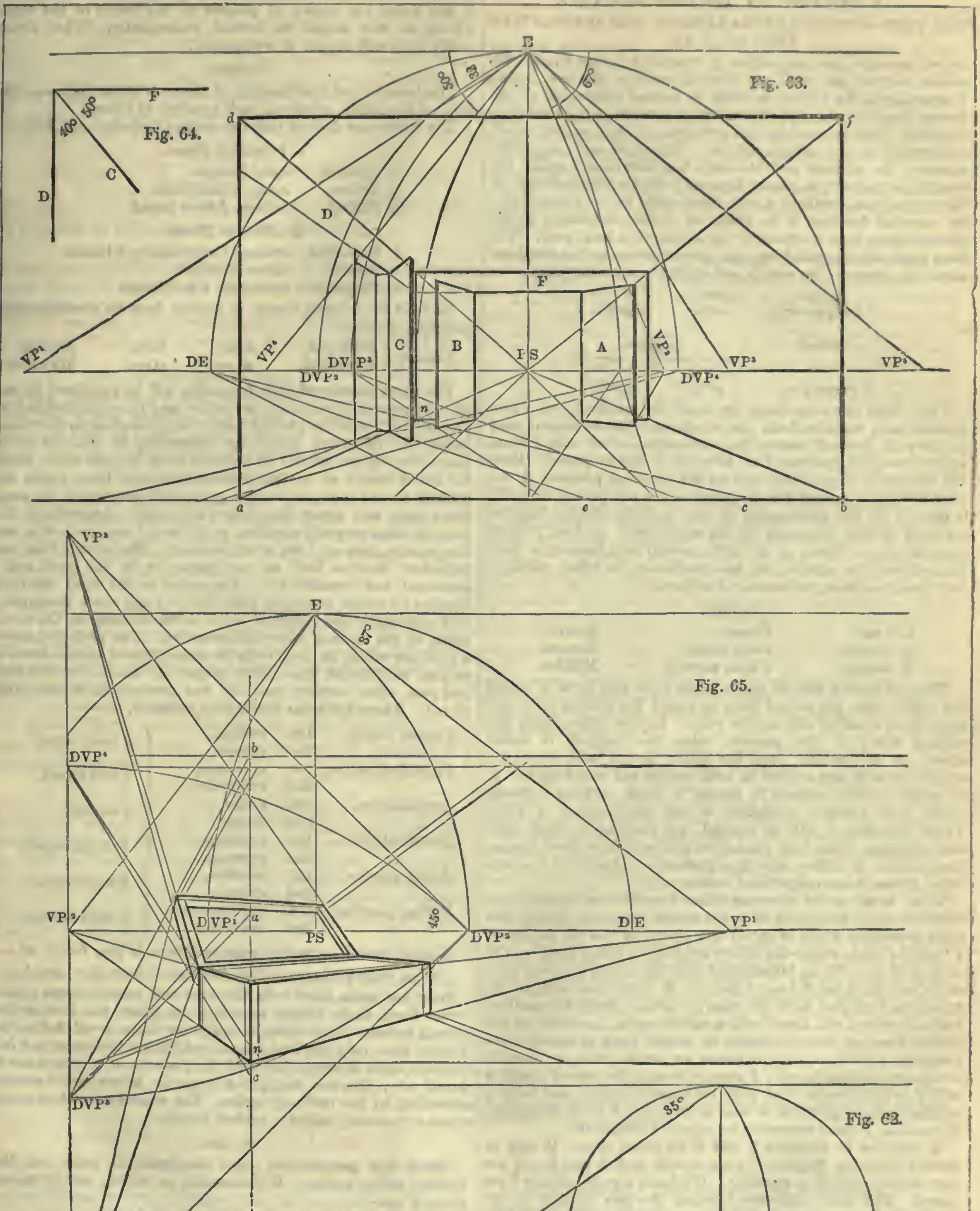


Fig. 64.

Fig. 63.

Fig. 65.

Fig. 62.

LESSONS IN GREEK.—XXIII.

THE VERB—GENERAL EXPLANATIONS—THE SUBSTANTIVE VERB ειμι, I AM.

If we examine the proposition ὁ στρατιωτης εστιν αγαθος, *the soldier is good*, we shall see that it consists of three parts: ὁ στρατιωτης, *the soldier*, is what is termed the *subject* of the proposition; that is, it is that of which something is asserted or declared. Αγαθος, *good*, is the *attribute*, or that quality which is asserted of the subject *soldier*. The word εστιν, *is*, which connects the subject and attribute together (hence called the *copula*), is the *verb*, so named because it is the principal *word* in the proposition—without a verb there could be no proposition: its essential function is to affirm or declare something of the subject; thus, here it affirms of the *soldier* that he is *good*. The term *predicate* is applied by some grammarians to the attribute alone, by others to the copula and attribute together, thus:—

Subject.	*Copula.*	*Predicate.*
ὁ στρατιωτης	εστιν	αγαθος.

or

Subject.	*Predicate.*	
	Verb.	*Attribute.*
ὁ στρατιωτης	εστιν	αγαθος.

Very often the verb forms by itself the predicate of a proposition, and contains both the copula and the attribute; that is, the verb by itself makes the affirmation: thus λυω, *I loose*, where *loosing* is predicated or affirmed of the subject *I*. Here the subject is a pronoun, and as the personal pronoun is not used in Greek, except for emphasis, since the person intended is marked by the termination of the verb, the subject may be involved in and expressed by the word itself, as λυω, *I loose*. Accordingly, in Greek as in Latin, a verb may contain in itself the subject, the copula, and the predicate; in other words, it may comprise both predicate and subject.

VOICES.

1. λυω,	*I loose,*	Active.
2. λυομαι,	*I am loosed,*	Passive.
3. λυομαι,	*I loose myself,*	Middle.

Here we have a verb in three forms; the first form is called the *active voice*, the second form is called the *passive voice*, the third form is called the *middle voice*. In the active voice, the subject acts; in the passive voice, the subject is acted upon; in the middle voice, the action comes back upon the subject, that is, the subject is both acting and acted upon. It is called *middle* because it stands in sense midway between active and passive, partaking of the signification of both. These varieties, it will be noticed, are varieties in both form and meaning. Thus λυω, the active, differs in form from λυομαι, the middle. It differs also in signification; for while λυω signifies *I loose*, λυομαι signifies *I loose myself*.

Verbs in the active voice are either *transitive* or *intransitive*: they are called transitive when the action passes on to and acts upon something which is called the *object*, as λυω τον ανθρωπον, *I loose the man*, where the object ανθρωπον is acted upon by the subject of λυω. In an intransitive verb the action does not pass on to an object, as θαλλω, *I bloom*. It is obvious that an intransitive verb can have no passive voice. Some intransitive verbs, however, are found with a middle voice, inasmuch as the middle does not always denote an action done to oneself (like τυπτομαι, *I strike myself*), but also an action done *for* oneself, as παρασκευαζομαι δειπνον, *I prepare a meal for myself*; and it is in this latter sense that some intransitive verbs may have a middle voice—*e.g.*, verbs in -ευω, as βουλευω, *I am a counsellor*; βουλευομαι, *I am a counsellor for myself, I deliberate*.

In relation to numbers 2 and 3, as given above, it may be noticed that the English *I loose myself* and *I am loosed* are very nearly related in meaning. If I loose myself, clearly I am loosed. The chief difference between the two is, that in the former the action is restricted to one person, namely, the subject; while, in the latter, it extends to a second person—the person, that is, by whom the subject is wrought upon. The difference, in consequence, is rather in the person than the act. Accordingly, the form remains the same, being in both cases λυομαι. In other words, λυομαι may have a reflex (or middle) import, as *I loose myself*, or a passive import, as *I am loosed*. Strictly speaking, there is but one form in the present tense. Grammarians differ as to the name which they give to that form, some calling it middle, others a passive voice. Very few, if any verbs, are known to possess all the tenses of the three voices, as they might be formed analogically. What forms really exist will appear as we proceed.

TENSES.

The *tense* is that modification of the verb which indicates the time of the action, whether, past, present, or future.

The tenses are divided into two classes, *principal* and *historic*.

i. *Principal Tenses.*

1. Present, λυω, *I loose.*
2. Future, λυσω, *I shall loose.*
3. Perfect, λελυκα, *I have loosed.*

ii. *Historic Tenses.*

1. Imperfect, ελυον, *I was loosing*, I loosed.
2. Aorist, ελυσα, *I loosed.*
3. Pluperfect, ελελυκειν, *I had loosed.*

Each of the historic tenses is formed from its corresponding principal, thus:—

Tenses,	Principal,	λυω,	λυσω,	λελυκα.
	Historical,	ελυον,	ελυσα,	ελελυκειν.

The exact manner of their formation will be explained by and by. At present observe that an action may be considered as now proceeding, hence the present tense; as proceeding in past time, hence the imperfect tense; as proceeding in time to come, hence the future tense; as actually done in past time, hence the aorist tense; as having proceeded in past time, hence the perfect tense; and as having proceeded previously to some other past act, hence the pluperfect tense. Accordingly the present tense properly signifies, as in λυω, *I am loosening*; and the passive, λυομαι, *I am being loosened*. Mark, also, that the imperfect denotes both an act going on in the past, and a continual and repeated act. The aorist, as the word signifies, denotes an action as simply past, without any exact limitation and so is called the indefinite (such is the meaning of the term) tense, or the tense of historical narrative. The perfect denotes a past act which, in itself or in its consequences, comes down to or near the present time. The pluperfect denotes an act done and past, when another past act was proceeding, or was completed. There are some *double form of tenses*, as:—

Perfect active,	1st.	τετυφα,	*I have struck.*
	2nd.	τετυπα,	
Pluperfect active,	1st.	ετετυφειν,	*I had struck.*
	2nd.	ετετυπειν,	
Aorist active,	1st.	ετυψα,	*I struck.*
	2nd.	ετυπον,	
Aorist middle,	1st.	ετυψαμην,	*I struck myself.*
	2nd.	ετυπομην,	
Aorist passive,	1st.	ετυφθην,	*I was struck.*
	2nd.	ετυπην,	
Future passive,	1st.	τυφθησομαι,	*I shall be struck.*
	2nd.	τυπησομαι,	

A third future, or perfect passive future, is also found, as:—

Third future passive, τετυψομαι, *I shall have been struck.*

Only few verbs have both the first and second forms: most verbs form their tenses according to either the first or the second forms. Pure verbs, or verbs having a vowel before the final ω, have only the first forms, and the student must not fall into the error of supposing that all these forms of τυπτω are in actual use; they are simply the forms the tenses would assume according to the ordinary rules. The second perfect is sometimes erroneously called a perfect middle.

MOODS.

Mood is a grammatical term employed to point out the manner of an action. If I describe an act as simply taking place, I use—

(1.) *The Indicative*, as λυω, *I loose*,

so called because it merely indicates or declares the act; this is the mood of independence and reality.

If I describe an act as dependent on some other act, as dependent on a conjunction or a verb, I employ

(2.) *The Subjunctive*, as λυω, *I may loosen.*

This is the mood of dependence, or of conception; so called because it implies dependence on another act expressed or understood; that is, an act really performed or conceived of in the mind.

(3.) The *optative* mood, λυοιμι, has two leading uses:—(*a*) It expresses a simple wish, as λυοιμι, *may I loose* (hence its name, derived from opto, *I wish*). (*b*) In dependent sentences, it acts as a subjunctive to an historic tense in the principal sentence. In other words, when the act expressed in the principal sentence is in an historic tense, the place of the subjunctive in the dependent sentence is supplied by the optative, as:—

Principal.	*Subjunctive.*	
τουτο ποιω ἱνα	λυω,	*I do this that I may loose.*
Historic.	*Optative.*	
But, τουτο εποιουν ἱνα	λυοιμι,	*I did this that I might loose.*

If I express an act in the way of command, I use

(4.) *The Imperative*, as λυε, *loose thou.*

These four moods are called *finite*, that is, definite or limited, because they all express the act under certain limitations or modifications.

But if I express an act indefinitely, or in its abstract form, disconnected, that is, with person or number, I then employ the mood termed

(5.) *The Infinitive*, as λυειν, *to loose.*

Another modification of the verb is found in

(6.) *The Verbal Adjective*, λυτεος, *one who must be loosed*, which resembles the Latin participle passive in -dus, as amandus, *he must be loved;* and accordingly, has a passive force.

THE PARTICIPLE.

Participles are so called because they partake of the qualities of the verb and the adjective; as expressive of the quality of the verb they denote action, as expressive of the quality of the adjective, they denote modification: for example, βουλευων ανηρ, a counselling man, that is, *a counsellor.*

PERSONS.

In Greek, as in English, there are three persons: 1st, the speaker, *I;* 2nd, the person spoken to, *thou;* 3rd, the person spoken of, *he.* The persons in Greek are in general indicated by personal-endings, that is, changes in the termination of the verb; for example:

1st Person.	*2nd Person.*	*3rd Person.*
λυ-ω, I loose;	λυ-εις, thou loos*est;*	λυ-ει, he loos*es.*

In the English terminations, *-est*, *-es*, we have an example of these person-endings.

NUMBERS.

As in nouns so in verbs, the Greek has three numbers, the *singular*, the *plural*, and the *dual*. The singular number denotes one single object; the plural denotes more objects than one; and the dual denotes precisely two objects. The dual, however, is seldom used, unless it is required to specify the number two. For the first person of the dual there is in most of the tenses no special form; its place is supplied by the form of the first person plural.

CONJUGATIONS.

The term *conjugation* denotes peculiarities of formation in number, person, tense, mood, and voice. These peculiarities in Greek have been brought under two heads, and so two conjugations have arisen: these are, the *first conjugation*, consisting of verbs of which the first person singular ends in ω (this class comprehends the great bulk of the Greek verbs); and the *second conjugation*, comprising the verbs of which the first person singular ends in μι: for example:—

First conjugation, λυ-ω, *I loose.*
Second conjugation, ιστη-μι, *I place.*

Most grammarians subdivide these two classes, making five conjugations of verbs in ω, distinguished from each other by the letter which precedes the ω (called the *characteristic letter*), and four of verbs in μι, distinguished by the vowel which precedes the μι.

PREFIXES, SUFFIXES, AND STEMS.

In order to represent the two ideas—namely, existence (or affirmation) and attribute—which enter into the signification of the verb, three essential elements are employed: first, the stem; second, the suffix or inflections; and, third, the prefix or augment; for example:—

Augment.	*Stem.*	*Inflexion.*
ε-	λυ-	-σα.

I have loosed.

The stem is variable. Thus we have the stem or root of the verb; the stem of the verb may in most verbs be found by cutting off ω, the personal-ending; thus, λυω, λυ-.

Besides the stem of the verb, there is the tense-stem, thus, ελυσα: the first aorist, by dropping the personal-ending α, gives ελυσ, the tense-stem of the first aorist active; of this form, ελυσ, the ε is the augment or prefix, the force of which is to denote past time.

Of the form ελυσα, the σα is the inflection or suffix of the first aorist; and of the σα, the α is the ending of the first person singular.

KEY TO EXERCISES IN LESSONS IN GREEK.—XXII.

RECAPITULATORY EXERCISES FROM THE CLASSICS.

1. Anacharsis used to say that it was better to have one friend of value than many friends of no value. 2. Hanno, the elder, brought over from Libya a large force into Sicily, 50,000 infantry, 6,000 cavalry, and 60 elephants. 3. They relate that the Chinese live as long as 300 years, and there is a story that the Chaldeans live beyond 100 years. 4. Arganthonius, the king of the Tartessians, is said to have lived more than 150 years. 5. Plato died in the first year of the 108th Olympiad, in the 81st year of his life. 6. A certain Demetrius used to say to Nero, "You threaten me with death, but nature threatens you." 7. A witling being in difficulties, sold his books, and wrote home to his father, saying, "Rejoice with me, father, for my books are now supporting me." 8. Anacharsis, the Scythian, being asked by some one what is at enmity to men, said, "Themselves to themselves." 9. A witling who was selling his house, used to carry about a stone as a specimen of it. 10. Being a judge, ever make the same decision touching the same circumstances, doing nothing for the purpose of favour. 11. Have a care for your own soul. 12. Be willing to please all. 13. Above all things reverence yourself. 14. It is the easiest thing of all to deceive oneself. 15. My good friend, be not ignorant of yourself. 16. Iphicrates was the son of a currier, though very distinguished; he used to say to a man of noble birth, "My family starts with myself, but your family ends in yourself." 17. Thales, being asked what was most common, answered, "Hope; for they who have nothing else, have that." 18. As the habit of each is, such is his life. 19. The Nile bears itself from the Ethiopic mountains until it empties itself into the sea, after twelve hundred stadia. 20. Twice five are ten. 21. Thence he marches two stations five parasangs to the river Saros, the breadth of which is three plethra.

EXTRACTS FROM THE NEW TESTAMENT.

1. But Jesus said, "Make the men sit down." And there was much grass in the place. So the men sat down, in number about five thousand. 2. Many of those who heard the word believed, and the number of the men became about five thousand. 3. And I saw and heard the voice of many angels round the throne, and the beasts and the elders, and the number of them was ten thousand times ten thousand and thousands of thousands, saying with a loud voice, Worthy is the Lamb that was slain to receive power, and wealth, and wisdom, and strength, and honour, and glory, and blessing. 4. Let him that hath understanding count the number of the beast, for it is the number of a man, and his number is six hundred threescore and six. 5. But John endeavoured to prevent him, saying, I have need to be baptized of thee, and dost thou come to me? 6. Bear one another's burdens, and thus fulfil the law of Christ. 7. For this is our boasting, the witness of our conscience, that in simplicity and sincerity of heart, not in fleshly wisdom, but in the grace of God, we have dealt with the world, but more abundantly with you. 8. If there be any consolation in Christ, if any comfort of love, if any fellowship of the Spirit, if any bowels and mercies, fulfil ye my joy, that ye be likeminded, have the same love, being of one accord, of one mind. Let nothing be done through strife or vainglory, but in honesty of mind let each esteem others better than himself. Let not every man look on his own, but also on the things of others.

LESSONS IN BOTANY.—XXXVI.

SECTION CX.—PAPAYACEÆ, OR PAPAYADS.

Characteristics: Flowers diœcious; calyx very small, five-dentated; petals hypogynous, five—joined into a funnel-shaped corolla in the staminiferous flowers, remaining free in those bearing pistils merely; stamens ten; ovary uni-locular or five-celled; placentæ parietal; berry pulpy; seed albuminous; trees of tropical America with a milky juice.

The papaw-tree, or *Carica papaya* (Fig. 269), is a tree with cylindrical trunk, simple, and bearing at its summit a terminal tuft of palmi-lobed leaves. This tree has been known to grow twenty feet in the space of three years. Its staminiferous flowers are in long multi-floral racemes. Its pistils are almost sessile. Fruit about the size of a little melon, a delicious article of food, either in its raw state or cooked. The milky juice of the stem and leaves contains a fibrinous matter, which has the singular property, that on pouring a few drops of it into water, and steeping in this water for the space of a few minutes raw meat, the latter becomes remarkably tender. The same result is obtained by enveloping the meat in leaves of the tree, or even by suspending it from the tree; but in any case the meat must be eaten immediately after cooking, otherwise it rapidly spoils.

SECTION CXI.—BEGONIACEÆ, OR BEGONIADS.

Characteristics: This natural order contains four genera, the chief of which is the genus *Begonia*, from which the order takes its name. The plants belonging to this order inhabit tropical regions. They have alternate stipulate leaves and monœcious flowers; perianth petaloid, the tube adherent to the ovary; stamens numerous; ovary inferior, tri-locular, multi-ovular; capsule triangular, loculicidal, three-valvular; embryo exalbuminous. These plants contain oxalic acid, the presence of which, in conjunction with stipules and the nature of the perianth, causes them to approach the *Rumex* tribe, in which genus of the natural order *Polygonaceæ* the sorrel and water-dock are included. Numerous species are cultivated in the hot-houses of Europe, of which the scarlet begonia (Fig. 270) is the most magnificent.

SECTION CXII.—EUPHORBIACEÆ, OR SPURGEWORTS.

Characteristics: Flowers diclinous and generally without calyx or corolla, but sometimes with one or both; ovary usually three-celled; uni- or bi-ovulate; carpels joined with a central styliferous axis; fruit capsular, with dry or fleshy epicarp separating in valves; seeds pendent; embryo dicotyledonous, straight, in the axis of a fleshy albumen.

The greater number of this family contain a milky, acrid, and poisonous juice, which often holds dissolved, in addition to other principles, a peculiar elastic substance, and occasionally colouring matter. The seeds are oily, the root is sometimes feculent. The *Euphorbiæ*, the type of this natural order, present an aspect of great variety; certain members possess a fleshy stem angular and spiny, very much resembling cactuses; others have normal leaves and stems. Many of the African, Arabian, and Indian species furnish an exudation, which, when thickened by the sun, becomes the commercial euphorbium. The manchineel (*Hippomane Mancinella*, Fig. 271) is a fine tree of intertropical America, celebrated for its peculiarly poisonous qualties. If accounts are to be trusted, it is certain death for an individual to sleep under a tree of this species; and even rain which touches the skin after having fallen upon the leaves of this tree raises a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269. THE PAPAW-TREE (CARICA PAPAYA)—1, BLOSSOM; 2, FRUIT. 270. SCARLET BEGONIA (BEGONIA COCCINEA). 271. MANCHINEEL (HIPPOMANE MANCINELLA).

272. THE CASTOR-OIL PLANT (RICINUS COMMUNIS). 273. THE COMMON HOP (HUMULUS LUPULUS).

blister. The manchineel tree also bears tempting-looking fruit, from which an agreeable odour is exhaled, but even a small portion, if eaten, is certain death.

Castor oil is expressed from the seeds of one of the *Euphorbiaceæ*, the *Ricinus communis*, or castor-oil plant (Fig. 272).

The genus *Manihot* contains two important species, both especial objects of cultivation in many parts of America on account of their feculent root. The *Manihot Aipi*, or sweet cassava, is eaten by the natives after being roasted in hot cinders; animals eat it raw. The *Manihot utilissima*, or bitter cassava, contains in its root a juice charged with prussic acid, or a material which readily produces this acid by decomposition. Nevertheless, the natives where the tree grows derive an abundance of nutritive matter from this vegetable, much of which is exported under the name of tapioca.

SECTION CXIII.—CANNABINACEÆ, OR HEMPWORTS.

Characteristics: Flowers diœcious; perianth of staminiferous flowers calyciform, perianth of the pistilliferous flowers reduced to a bract; ovary uni-locular, one or two-styled; ovule single, pendent, curved; fruit a small nut or achænium; seed exalbuminous, bent back; stem herbaceous; leaves stipuled, opposite, or occasionally the superior ones alternate.

The genera *Cannabis* and *Humulus* compose this small family. Hemp (*Cannabis sativa*), a native of Persia, has leaves palmate or dentate in segments. The individual on which the staminiferous flowers grow has a more withered aspect and sooner dries up than the other, to which the appellation *female hemp* is commonly applied. The male individual is that from which the substance hemp is obtained. The common hop (*Humulus Lupulus*, Fig. 273), is a well-known plant, having a climbing angular stem and cordate, lobed leaves. Its achænium and its bracted calyx are studded with glands containing a bitter aromatic substance, slightly narcotic in quality, and on which the virtues of the hop depend. It is termed by chemists *humuline*.

The counties of England in which the hop is chiefly cultivated are Kent, Surrey, and Sussex. It is also grown in smaller quantities in Worcestershire and Nottinghamshire. Pillows stuffed with the hop-blossom are sometimes used to procure sleep.

LESSONS IN ITALIAN.—X.

THE ARTICLE—NOUNS DECLINED WITH AND WITHOUT THE ARTICLE.

THERE are three articles in the Italian language, *il* and *lo* for the masculine, and *la* for the feminine gender, equivalent to the English definite article *the*.

The article *il* can only be used before those masculine words which begin with a consonant, excepting always *s* impure; *i.e.*, *s* followed by another consonant. The plural is *i*. For example:—

Il giar-dí-no, the garden.	*Il si-gnó-re*, the gentleman.
I giar-dí-ni, the gardens.	*I si-gnó-ri*, the gentlemen.

The article *lo*, without the apostrophe, can only be used before those masculine words which begin with the *s* impure. The plural of *lo* is *gli*. For example:—

Lo spí-ri-to, the spirit.	*Lo stra-niè-re*, the stranger.
Gli spí-ri-ti, the spirits.	*Gli stra-niè-ri*, the strangers.

The only exception to this rule is the very frequent use of the article *lo* after the preposition *per*, for, through, before words not beginning with the *s* impure; as, for example, *per lo món-do*, for the world; *per lo giar-dí-no*, for or through the garden; *per lo pas-sá-to*, for the past.

Many grammarians of great authority have even emphatically proscribed the use of *per il* in the place of *per lo*. As, however, cultivated persons and the best writers have never ceased occasionally to use the combination *per il*, its correctness and allowableness will at once be admitted, for the usage of a language is a safer guide than the caprice of grammarians.

The article *lo* is also used before all masculine words that begin with a vowel; but in such a case the apostrophe must be used thus, *l'*. For example:—

L' án-ge-lo, the angel.	*L' im-piè-go*, the office or employment.
Gli án-ge-li, the angels.	*Gl' im-piè-ghi*, the offices or employments.

The reader will remark that I have placed no apostrophe after *gli*, the plural of *lo*, before *án-ge-li*, while I have used the apostrophe on *gl'* before *im-piè-ghi*. The reason of this is, that the plural *gli* only requires the apostrophe before words commencing with the vowel *i*, and never before words commencing with the vowels *a*, *e*, *o*, and *u*; which is clearly a necessary usage to maintain the squeezed sound of the word *gli* (llyee) in these cases. For, otherwise, *gl' án-ge-li* would be pronounced according to the rules explained in the fifth pronouncing table, gláhn-jai-lee. Even Italians themselves are occasionally liable to commit the fault of placing the apostrophe on the *gl'* before *a*, *e*, *o*, and *u*; but the difference caused in the pronunciation manifestly shows the grossness of this blunder.

The article *la* can only be used before words of the feminine gender which begin with consonants. The plural is *le*. For example:—

La tá-vo-la, the table.	*La má-dre*, the mother.
Le tá-vo-le, the tables.	*Le má-dri*, the mothers.

The article *la* must have the apostrophe *l'* when it comes before words of the feminine gender commencing with a vowel. For example:—

L' a-ni-ma, the soul.	*L' èr-ba*, the herb or grass.
Le á-ni-me, the souls.	*L' èr-be*, the herbs or grasses.

The reader will have observed that I have not placed an apostrophe on the *le* before the plural *a-ni-me*, while the *le* has the apostrophe before the plural *èr-be*. The reason is, that it is a common usage only to place the apostrophe on the plural *le* before words of the feminine gender commencing with the vowel *e*. For example:—

L' es-pe-riè̀n-ze, the experiences; *l' e-re-sí-e*, the heresies. But before feminine words commencing with the other vowels, the *le* is not commonly used with an *apostrophe*. For example; *le á-ni-me*, the souls; *le in-sé-gne*, the banners, signs; *le ô-pe-re*, the works; *le-u-sán-ze*, the usages.

It is obvious that the six words above mentioned, constituting the three articles in the singular and plural, *il*, *lo*, *la*, *i*, *gli*, and *le*, must frequently meet monosyllables, and therefore occasion dissonance. As harmony is a marked characteristic of the language, some means must be found to correct this. This is effected by contractions, in which letters are changed, omitted, or added according to laws dictated by the conveniences of pronunciation, by custom, and by harmony. The monosyllables referred to are *di*, of; *a*, to; *da*, from, by; *con*, with; *per*, for, through; *su*, upon; and the important contractions (to be committed to memory) to which they are subject, when in combination with the articles *il*, *lo*, *la*, *i*, *gli*, and *le*, are the following:—

For	*di il*	write	*dél.*	For	*da i*	write	*dai.*‡	For	*con l'*	write	*cóll'.*
,,	*di i*	,,	*dèi.**	,,	*da lo*	,,	*dál-lo.*	,,	*con gli*	,,	*có-gli.*
,,	*di lo*	,,	*dél-lo.*	,,	*da l'*	,,	*dall'.*	,,	*con la*	,,	*cól-la.*
,,	*di l'*	,,	*déll'.*	,,	*da gli*	,,	*dá-gli.*	,,	*con le*	,,	*cól-le.*
,,	*di gli*	,,	*dé-gli.*	,,	*da la*	,,	*dál-la.*	,,	*su il*	,,	*sul.*
,,	*di la*	,,	*dél-la.*	,,	*da le*	,,	*dál-le.*	,,	*su i*	,,	*sui.*
,,	*di le*	,,	*dél-le.*	,,	*in il*	,,	*nel.*	,,	*su lo*	,,	*súl-lo.*
,,	*a il*	,,	*al.*	,,	*in i*	,,	*nèi.*§	,,	*su l'*	,,	*sull'.*
,,	*a i*	,,	*ai.*†	,,	*in lo*	,,	*nél-lo.*	,,	*su gli*	,,	*sú-gli.*
,,	*a lo*	,,	*al-lo.*	,,	*in l'*	,,	*nell'.*	,,	*su la*	,,	*súl-la.*
,,	*a l'*	,,	*all'.*	,,	*in gli*	,,	*né-gli.*	,,	*su le*	,,	*súl-le.*
,,	*a gli*	,,	*ag-li.*	,,	*in la*	,,	*nél-la.*	,,	*per il*	,,	*pél.*
,,	*a la*	,,	*al-la.*	,,	*con il*	,,	*col.*	,,	*per i*	,,	*péi(pé')*
,,	*a le*	,,	*al-le.*	,,	*con i*	,,	*coi.*	,,	*per gli*	,,	*pé-gli.*
,,	*da il*	,,	*dal.*	,,	*con lo*	,,	*col-lo.*				

The reader will remark that I only give three contractions of the word *per*. For this reason, that *per*, generally speaking, is not contracted with an article commencing with the letter *l*, and in such cases, it is customary to place *per* and such an article separately; as *per lo pas-sá-to*, for the past; *per la cá-sa*, for the house; *per le so-rél-le*, for the sisters.

The letter *s* in the word *cása*, although placed between two vowels, has the sharp, hissing sound, as well as in the words *cô-sa*, thing, and *co-sì*, thus, before commented on.

With regard to the word *con*, with, it may be remarked that,

* It is useful, with regard to pronunciation and orthography, to bear in mind the difference between these three words: *dèi*, of the (pl.); *Dé-i*, gods (the plural of *Dí-o*); and *De-ì*, dey (of the Barbary States).

† It is, for the reasons stated in the previous note, useful to mind the difference between *ái*, to the (pl.), and *á-j*, tutors.

‡ Mind the difference between *dái*, from *or* by the (pl.), and *dá-i*, thou givest.

§ Mind, also, the difference between *nèi*, in the (pl.), and *né-i*, moles (upon the body), patches (on the face).

when it comes in connection with an article commencing with *l*, it is optional to contract it; it being equally correct to say *con lo'* or *cól-lo scét-tro*, with the sceptre; *col* or *con l' in-gán-no*, with the deceit; *con la* or *cól-la si-gno-ra*, with the lady; *con le* or *cól-le brác-cia*, with the arms.

Once for all, being obliged for the greatest part to divide the syllables as they are divided in Italian spelling, I must emphatically warn the reader not to read the combination *cc* (when not followed by *h*) as though the first *c* was a *k* (the Englishman would naturally do so), but to read the whole combination as though it was *ttch*, gliding with great rapidity from one syllable to the other. I must refer, on this point, to my remarks and tables on pronunciation.

Two important prepositions, *tra* and *fra*, between, among, can likewise be contracted with the article, but in a special way, and with modifications which must be stated separately.

If *tra* and *fra* are to be contracted with an article commencing with *l*, the letter *l* must be doubled, *ll*; as, for example, *frál-le mon-tá-gne*, between the mountains; *trál-le dú-e so-rêl-le*, between the two sisters; *frál-lo scrí-gno e la sê-dia*, between the chest and the chair.

Whenever *tra* or *fra* is to be joined to the article *i*, the latter is omitted, and an apostrophe placed in its stead. For example: *fra' cu-gí-ni*, between the cousins; *tra' fra-têl-li*, between the brothers.

The words *tra* and *fra* are never contracted with the article *gli*. For example: *fra gli a-mí-ci*, between the friends; *tra gl' in-fe-li-ci*, between the unfortunate.

When *tra* or *fra* stands before *il*, the letter *i* of the article is commonly not heard in pronunciation, and in writing the apostrophe is used in its place. For example: *fra 'l són-no*, during the sleep; *tra 'l sì e 'l nô*, between yes and no, hesitating.

The so-called indefinite article *uno*, masculine, and *una*, feminine, will be hereafter explained.

In Italian, as in English, the nouns have no terminational alteration in either number; that is to say, all cases are alike. Strictly speaking, therefore, they cannot be said to have any declensions. All changes in Italian nouns denote only a difference in gender or in number. For example: *pás-se-ro*, sparrow, not only denotes the object *sparrow*, but also that it is a male; and *pás-se-re* (female), sparrows, not only denotes the feminine, but the plurality of number. The article in Italian, as in French, Spanish, and English, does not in itself denote the case, but is a word that distinguishes one noun as a determined object from another noun of the same class. It is on this account a fixed principle of the language never to place the article before a noun, when the latter is used in its general and indeterminate signification. The articles *il*, *lo*, and *la*, are in themselves as indeclinable as the noun itself. They only change according to the gender and number of the noun; and when the Italians desire to denote cases, they must, on this account, like the English, place before the articles certain words, which are the substitutes of those inflections by which, in the Greek, Latin, and German languages, the cases are expressed. The English have only two such signs of cases—the words *of* and *to*. The Italians have three: *di*, for the second case, or genitive; *a*, for the third case, or dative; and *da*, for the sixth case, or ablative. These three words, *di*, *a*, and *da*, are used in the singular as well as in the plural, before masculine nouns as well as feminine. In the first case, or nominative, and in the fourth case, or accusative, the Italian noun has, as well as the English, no case sign before it, and both these cases are sufficiently distinguishable by the place which they take before or after the verb, for which reason they require no special distinguishing mark. For example:—

A-les-sán-dro vín-se Dá-rio, Alexander conquered Darius; *Cár-lo per-cuô-te il cá-ne*, Charles strikes the dog; *il prín-ci-pe á-ma-la các-cia*, the prince likes the chase; *Piê-tro lêg-ge le gaz-zêt-te*, Peter reads the newspapers.

I must once for all, and emphatically, warn the reader, because I am obliged, in the case of the double *g* (*gg*), to place the first *g* in one syllable, and the second *g* in the next, not to read (when the *gg* is not followed by *h*) the first *g* like *g* in the English word *get*, to which mistake many readers will be naturally liable; but I must refer, with regard to the pronunciation of the *g* (*gg*), to the lessons on pronunciation.

I shall now subjoin two tables illustrating the declensions of Italian nouns: I. with and without an article; II., with some important words frequently preceding them. These tables are so important that they must be committed to memory. But let me first remark, that it will be sufficient for our present purpose to lay down this fundamental rule with regard to the formation of the plural of Italian nouns:—

All Italian nouns, masculine and feminine, change their final vowel into I *in the plural;* as, *il pá-dre*, the father; *i pá-dri*, the fathers; *il po-ê-ta*, the poet; *i po-ê-ti*, the poets; *il cêr-vo*, the stag; *i cêr-vi*, the stags; *la má-dre*, the mother; *le má-dri*, the mothers; *la má-no*, the hand; *le má-ni*, the hands.

The most important exceptions from this rule are feminine nouns terminating in A, *which form their plural by changing* A *into* E; as, *la so-rêl-la*, the sister; *le so-rêl-le*, the sisters.

I.—NOUNS DECLINED WITH AND WITHOUT AN ARTICLE.

Singular.

Nom.		*lí-bro*	*il lí-bro*, the book.
Gen.	*di*	*lí-bro*	*del lí-bro*, of the book.
Dat.	*a*	*lí-bro*	*al lí-bro*, to the book.
Acc.		*lí-bro*	*il lí-bro*, the book.
Abl.	*da*	*lí-bro*	*dal lí-bro*, from the book.
	in	*lí-bro*	*nel lí-bro*, in the book.
	con	*lí-bro*	*col lí-bro*, with the book.
	per	*lí-bro*	*pel lí-bro*, for the book.
	su	*lí-bro*	*sul lí-bro*, on the book.

Plural.

Nom.		*lí-bri*	*i lí-bri*,* the books.
Gen.	*di*	*lí-bri*	*dei (de') lí-bri*,† of the books.
Dat.	*a*	*lí-bri*	*ai (a') lí-bri*, to the books.
Acc.		*lí-bri*	*i lí-bri*, the books.
Abl.	*da*	*lí-bri*	*dai (da') lí-bri*, from the books.
	in	*lí-bri*	*nei (ne') lí-bri*, in the books.
	con	*lí-bri*	*coi (co') lí-bri*, with the books.
	per	*lí-bri*	*pei (pe') lí-bri*, for the books.
	su	*lí-bri*	*sui (su') lí-bri*, on the books.

Singular.

Nom.		*schióp-po*	*lo schióp-po*, the gun.
Gen.	*di*	*schióp-po*	*dél-lo schióp-po*, of the gun.
Dat.	*a*	*schióp-po*	*ál-lo schióp-po*, to the gun.
Acc.		*schióp-po*	*lo schióp-po*, the gun.
Abl.	*da*	*schióp-po*	*dál-lo schióp-po*, from the gun.
	in	*schióp-po*	*nél-lo schióp-po*, in the gun.
	con	*schióp-po*	*cól-lo schióp-po*, with the gun.
	per	*schióp-po*	*per lo schióp-po*, for the gun.
	su	*schióp-po*	*súl-lo schióp-po*, on the gun.

Plural.

Nom.		*schióp-pi*	*gli schióp-pi*, the guns.
Gen.	*di*	*schióp-pi*	*dé-gli schióp-pi*, of the guns.
Dat.	*a*	*schióp-pi*	*á-gli schióp-pi*, to the guns.
Acc.		*schióp-pi*	*gli schióp-pi*, the guns.
Abl.	*da*	*schióp-pi*	*dá-gli schióp-pi*, from the guns.
	in	*schióp-pi*	*né-gli schióp-pi*, in the guns.
	con	*schióp-pi*	*có-gli schióp-pi*, with the guns.
	per	*schióp-pi*	*pé-gli schióp-pi*, for the guns.
	su	*schióp-pi*	*sú-gli schióp-pi*, on the guns.

Singular.

Nom.		*a-nêl-lo*	*l' a-nêl-lo*, the ring.
Gen.	*d'*	*a-nêl-lo*	*dell' a-nêl-lo*, of the ring.
Dat.	*ad*	*a-nêl-lo*‡	*all' a-nêl-lo*, to the ring.

* Instead of the plurals *i*, *dei*, *ai*, *dai*, some old writers used the plurals *li*, *delli*, *alli*, *dalli*; but this is no longer usual.

† The plurals *dei*, *ai*, *dai*, *nei*, *coi*, *pei*, *sui*, are frequently marked with the apostrophe for the sake of harmony, thus: *de'*, *a'*, *da'*, *ne'*, *co'*, *pe'*, *su'*; especially when coming before several words all of which terminate in *i*. For example, *a ca-gió-ne de' mól-ti suó-i pec-cá-ti*, on account of his many sins.

‡ Harmony, which has had so much influence on the formation and pronunciation of Italian words, frequently requires that to the case-sign *a*, when it comes before a vowel, the letter *d* should be added; as, *ad o-nó-re*, to honour; *ad a-mí-co*, to the friend; for *a onore*, and *a amico*.

The laws of harmony, likewise, frequently require the mark of the apostrophe on the case-sign *di*, when it comes before words commencing with a vowel; as, *cá-po d' ó-pe-ra*, masterpiece; *sé-gno d u-mil-tà*, sign of humility.

The case-sign *da*, on the other hand, is never marked with the apostrophe, but always written in full, in order to avoid the inevitable ambiguity of confounding the case-sign *di* with it whenever it is marked with the apostrophe, and the dissonance of two vowels in this case coming together must be tolerated; because, as I have already remarked, perspicuity is a more urgent law than harmony in these contractions.

Acc.		a-nél-lo	l' a-nél-lo, the ring.
Abl.	da	a-nél-lo	dall' a-nél-lo, from the ring.
	in	a-nél-lo	nell' a-nél-lo, in the ring.
	con	a-nél-lo	coll' a-nél-lo, with the ring.
	per	a-nél-lo	per l' a-nél-lo, for the ring.
	su	a-nél-lo	sull' a-nél-lo, on the ring.

Plural.

Nom.		a-nél-li	gli a-nél-li, the rings.
Gen.	di	a-nél-li	dé-gli a-nél-li, of the rings.
Dat.	ad	a-nél-li	á-gli a-nél-li, to the rings.
Acc.		a-nél-li	gli a-nél-li, the rings.
Abl.	da	a-nél-li	dá-gli a-nél-li, from the rings.
	in	a-nél-li	né-gli a-nél-li, in the rings.
	con	a-nél-li	có-gli a-nél-li, with the rings.
	per	a-nél-li	pé-gli a-nél-li, for the rings.
	su	a-nél-li	sú-gli a-nél-li, on the rings.

Singular.

Nom.		cá-sa	la cá-sa, the house.
Gen.	di	cá-sa	dél-la cá-sa, of the house.
Dat.	a	cá-sa	ál-la cá-sa, to the house.
Acc.		cá-sa	la cá-sa, the house.
Abl.	da	cá-sa	dál-la cá-sa, from the house.
	in	cá-sa	nél-la cá-sa, in the house.
	con	cá-sa	cól-la ca-sa, with the house.
	per	cá-sa	per la cá-sa, for the house.
	su	cá-sa	súl-la cá-sa, on the house.

Plural.

Nom.		cá-se	le cá-se, the houses.
Gen.	di	cá-se	dél-le cá-se, of the houses.
Dat.	a	cá-se	ál-le cá-se, to the houses.
Acc.		cá-se	le cá-se, the houses.
Abl.	da	cá-se	dál-le cá-se, from the houses.
	in	cá-se	nél-le cá-se, in the houses.
	con	cá-se	cól-le cá-se, with the houses.
	per	cá-se	per le cá-se, for the houses.
	su	cá-se	súl-le cá-se, on the houses.

Singular.

Nom.		ár-te	l' ár-te, the art.
Gen.	di	ár-te	dell' ár-te, of the art.
Dat.	ad	ár-te	all' ár-te, to the art.
Acc.		ár-te	l' ár-te, the art.
Abl.	da	ár-te	dall' ár-te, from the art.
	in	ár-te	nell' ár-te, in the art.
	con	ár-te	coll' ár-te, with the art.
	per	ár-te	per l' ár-te, for the art.
	su	ár-te	sull' ár-te, on the art.

Plural.

Nom.		ár-ti	le ár-ti, the arts.
Gen.	di	ár-ti	dél-le ár-ti, of the arts.
Dat.	ad	ár-ti	ál-le ár-ti, to the arts.
Acc.		ár-ti	le ár-ti, the arts.
Abl.	da	ár-ti	dál-le ár-ti, from the arts.
	in	ár-ti	nél-le ár-te, in the arts.
	con	ár-ti	cól-le ár-ti, with the arts.
	per	ár-ti	per le ár-ti, for the arts.
	su	ár-ti	súl-le ár-ti, on the arts.

Singular.

Nom.		Lón-dra, London.	Nom.		Al-bér-to, Albert.
Gen.	di	Lón-dra, of London.	Gen.	di	Al-bér-to, of Albert.
Dat.	a	Lón-dra, to London.	Dat.	ad	Al-bér-to, to Albert.
Acc.		Lón-dra, London.	Acc.		Al-bér-to, Albert.
Abl.	da	Lón-dra, from London.	Abl.	da	Al-bér-to, from Albert.
	in	Lón-dra, in London.		in	Al-bér-to, in Albert.
	con	Lón-dra, with London		con	Al-bér-to, with Albert.
	per	Lón-dra, for London.		per	Al-bér-to, for Albert.

Singular.

Nom.		Vit-tó-ria, Victoria.	Nom.		Gió-ve, Jupiter.
Gen.	di	Vit-tó-ria, of Victoria.	Gen.	di	Gió-ve, of Jupiter.
Dat.	a	Vit-tó-ria, to Victoria.	Dat.	a	Gió-ve, to Jupiter.
Acc.		Vit-tó-ria, Victoria.	Acc.		Gió-ve, Jupiter.
Abl.	da	Vit-tó-ria, from Victoria.	Abl.	da	Gió-ve, from Jupiter.
	in	Vit-tó-ria, in Victoria.		in	Gió-ve, in Jupiter.
	con	Vit-tó-ria, with Victoria.		con	Gió-ve, with Jupiter.
	per	Vit-tó-ria, for Victoria.		per	Gió-ve, for Jupiter.

Nom.		Dí-o, God.	Abl.	da	Dí-o, from God.
Gen.	di	Dí-o, of God.		in	Dí-o, in God.
Dat.	a	Dí-o, to God.		con	Dí-o, with God.
Acc.		Dí-o, God.		per	Dí-o, for God.

It is obvious that proper names of gods, persons, towns, and other localities, require no article in the singular, because their individual signification renders any other more precise determination or distinction by means of the article superfluous.

MECHANICS.—XVI.

STATICAL FORCES.—FRICTION.

WE have now mastered the elementary principles of the simple machines, and are in a position to resolve a compound machine into the elementary ones of which it is made up, and thus to find the benefit derived from its use. Our inquiry now is, what are the forces which most generally act on a body or a system of bodies when in a state of equilibrium?

There are, then, four kinds of forces with which statics deals:— 1. Gravity. 2. Resistance of surface. 3. Tension. 4. Friction.

Gravity is the most universal of these, as it acts constantly and on every substance. All bodies attract each other with a force proportionate to their bulk. If a heavy weight be suspended by a cord over the edge of an almost vertical precipice, and looked at from a short distance by a telescope, we shall find that the cord does not hang perfectly vertical, but is inclined slightly inwards by the attraction of the rock for the weight.

This principle of universal attraction, which was discovered by the great Sir Isaac Newton, is applicable to all bodies whatever. It holds the smallest stone to the ground, and at the same time keeps the planets in their orbits, and thus lies at the basis of the science of astronomy. When a body is raised from the earth and then left free, this attraction causes it to fall. The reason why it falls towards the earth, instead of the earth rising to it, is the immensely superior bulk of the latter. Strictly speaking, they do move towards each other in the exact proportion of their bulk. If a body of equal size with the earth were allowed to fall towards it, they would meet just half way. This force always acts towards the centre of the earth, and its amount is easily ascertained, being simply the weight of the body. When we say that a body weighs eight pounds, we merely mean that that is the force with which the attraction of the earth draws it. This attraction diminishes as we remove farther from the earth's centre; hence, as the diameter is greater at the equator than at the poles, a substance weighs less there than it does as we travel northward or southward. Of course this must be ascertained by a spring balance; in any other kind, the weight would be altered as much as the substance weighed.

We see, then, that gravity acts in a line perpendicular to the earth's surface, is equal to the weight of the body on which it acts, and, as before shown, may be considered to act through its centre of gravity. It is now easy to calculate what allowance is to be made for the weight of the simple machines, and whether this weight tells in their favour or against them. In a lever of the first kind, for instance, as the power acts at the longer arm, the centre of gravity will, if the lever be uniform, be in that arm, and therefore gravity is here a third force, which helps the power to sustain a greater weight than it otherwise could.

In the first system of pulleys, on the other hand, their weight acts against the power, one-half of the weight of the pulley next the power being supported by it, one-fourth of the next, and so on. Hence the weight that can be raised is less than theoretically it should be.

We now pass to the second kind of force—resistance of surfaces. We shall better understand this by assuming a case. A ball rests on a horizontal table; the force of gravity presses it vertically downwards with a force equal to its weight, and yet the ball does not fall. Evidently there must be some force counteracting that of gravity. This force is the resistance of the table, which presses it upwards with a force exactly equal to its weight; for, if it were not equal, motion would ensue. This resistance acts, too, in a line perpendicular to the surface, for it must be exactly opposite to the line in which gravity acts, or else the two forces would have a resultant, in whose direction the ball would move. We learn, then, the following general principle:—

Action and re-action are always equal, and act in exactly opposite directions.

When two surfaces press on one another, the line of action of the resistance must pass through the point of contact. If the surfaces be smooth and one be a plane, it will also be perpendicular to that plane.

The third kind of force is the tension of strings or fine rods. When an omnibus is drawn by horses, the forces which act directly on it are the tensions of the traces, and by these tensions it is moved. About this kind of force there is little difficulty, as it acts along the direction of the cord by which it is communicated to the body moved, and its intensity is

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measured by the number of pounds it will support. We accordingly pass on to consider the nature and effects of the fourth kind, namely, friction. This has been frequently referred to, and, as it often interferes with the accuracy of the results we obtain, it is important to become familiar with its effects.

If we attempt to cause one body to slide or move over another, we find a certain amount of resistance to our efforts. This resistance or opposition to attempted motion is friction. All surfaces have a degree of roughness or unevenness of texture, and the inequalities of two such surfaces fit into one another, the projections of the one catching those of the other. We find this friction more or less in all cases of attempted motion. If two surfaces were absolntely smooth, there would be none; this, however, we cannot obtain, but the nearer we approach to it, the less friction we have.

If a block of wood lies on the ground, I may be unable to push it along. Move it now to a surface of clear ice, the resistance will be less; and if we place it on narrow smooth runners, like those of a sledge, we still further reduce friction. In all cases, however, it exists; and as we see, it is only called into play when motion is attempted; and since it prevents the body from moving (unless the force applied be powerful enough to overcome it), its line of action must be contrary to that of the attempted motion, as otherwise it could not neutralise the force applied.

Now it will easily be seen that it is of great importance to be able to ascertain the amount of friction between surfaces. On a railway we want to know what force is required to overcome the friction of a train along a level part of the line. We can easily, by the principles of the inclined plane, find the additional force required to draw it up an incline. Many practical questions of this sort are constantly met with, and there are two common ways of solving them.

The most usual method is by the apparatus represented in Fig. 82. A slab of the substance over which the other is to slide, is laid horizontally on a table. A block, A, of the second substance is taken, a cord is fastened to it and passed over a pulley at the edge of the table, so as to be parallel to its surface; at the other end of this cord a scale-pan is fastened. Weights are now placed in this, or, better still, sand is poured into it, until A just begins to move. The weight of the sand in the pan divided by that of A, gives the fraction which expresses the proportion that the friction bears to the weight to be moved. Thus, if the substance weigh 2 pounds or 32 ounces, and a weight of 5 ounces is required to move it, the fraction is $\frac{5}{32}$. This is called the *Co-efficient of Friction.*

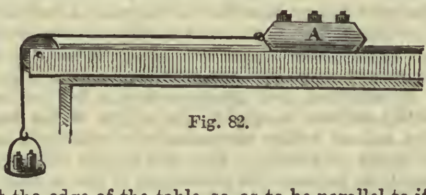

Fig. 82.

The other way of ascertaining this quantity is sometimes easier. A block, A (Fig. 83), of one substance is laid on a plane, BC, made of the other, and the end C is then lifted till A is just on the point of sliding down the plane. The full amount of friction is now at work, and we may consider this as a case of a body kept at rest on an inclined plane. The forces which act on A are its own weight in the direction A W, the resistance of the plane in the direction A R perpendicular to its surface, and the force of friction which acts up the plane along A F. Now, since there is equilibrium, this last force is equal and opposite to the resultant of A R and A W, that is, to A E. The three forces, then, may be represented by the three sides of the triangle W A E, but this triangle is similar to the triangle B C D; therefore we may take BC as representing the weight, and CD the friction, and $\frac{CD}{BC}$ is the co-efficient of friction. We have, then, the following rule:—Incline the plane till the body is on the point of motion; the elevation of the end of the plane divided by its length gives the required fraction.

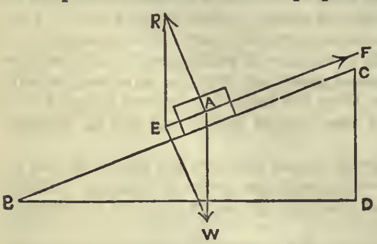

Fig. 83.

This suggests the way of making a useful calculation, like the following:—On how steep an incline will a cart stand safely if the co-efficient of friction be $\frac{1}{30}$? We see that the incline must be somewhat less than 1 foot in 30, as, if it be greater, the cart will run down from its own weight. By these and similar means thousands of experiments have been tried, a few of which are here given as illustrations. You can easily try others yourself. Along a railway friction is reckoned to be from 8 to 10 pounds per ton; on a good road about $\frac{1}{25}$th of the load; this amount, however, varies very greatly with the character of the road. The co-efficient of friction for steel on ice is only $\frac{7}{500}$, while that of oak on oak or elm is over $\frac{1}{2}$.

There are, however, certain general rules, discovered by experiment, which are more important to remember.

1. Friction is proportional to the pressure. If we place weights on A (Fig. 82) so as to double the pressure, we shall find it requisite, also, to double the weights in the pan, and so for any other alteration of the pressure of A.

2. The amount of friction does not vary with the extent of the surfaces in contact. This at first seems strange, but, if we consider it, we see the reason. Suppose a block of deal two inches thick move over another surface of deal. If the block weigh 10 pounds, the force required to overcome friction will be about $3\frac{1}{2}$ pounds. Now saw the block into two, of half the thickness, and lay them side by side. Each has half the weight of the original block and the same surface, and so the friction of each will be one-half of $3\frac{1}{2}$ pounds; the two together will therefore move with the same friction as the one did, though the extent of surface is doubled.

3. The amount of friction varies with the natnre of the bodies and the smoothness or otherwise of their surfaces.

Various ways of diminishing friction are adopted in practice. Those parts of any machine which work together are made as smooth as possible, and oil or grease applied to them. The bearings, too, or boxes in which the axles of wheels turn, are made of a different kind of metal from the axles themselves, and many other expedients are resorted to. Still there is a loss of power from this cause, which often amounts to $\frac{1}{3}$ or even $\frac{1}{2}$.

There are two kinds of friction—sliding and rolling. Sliding friction is that of which we have spoken; but if a body be made round, and allowed to roll over and over instead of sliding, a different kind of friction comes into action. The rudest application of this is when a man, instead of pushing a stone along the ground, puts rollers under it, and thus moves it with far more ease, fresh rollers being put under in front when needed. Wheels are a further advance upon this, as they not only save the trouble of constantly replacing the rollers, but, as they only touch the ground at the sides of the body, and not along the whole width as rollers do, they avoid much of the friction.

Sometimes when a large axle has to turn in bearings, friction-wheels are introduced. These are small wheels, on the edge of which the axle turns, and they transfer the friction to their own small axles. Many such appliances to avoid friction are constantly met with. Castors on chairs and tables, and narrow irons on skates, are familiar examples.

We must not, however, imagine from all this that friction is always a hindrance. Far from it. If we try and walk along a very glassy surface of ice, we are soon painfully reminded of the absence of the customary friction between our boots and the surface on which we are walking, and hence in frosty weather gravel or ashes are scattered on the paths. All the driving force a railway engine has is from the friction of its wheels with the rails. It was at first proposed that the driving-wheels should be toothed, and notches cut into the rails into which these teeth might catch; but the friction was soon found to be sufficient. On damp days, however, we frequently see the porters at a station putting gravel on the rails, in order that there may be more friction at starting. The brake, also, which is applied to stop a train or machine, acts by pressing a block against the wheel, and thus causing an amount of friction which is soon sufficient to overcome the momentum acquired. So, when a nail is driven into a piece of wood, it is held in its place merely by friction, and the same cause enables the fibres of cotton or hemp to cling together so as to be woven into a cord or rope. We see, then, that friction is one of the most important forces we have to consider.

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LESSONS IN FRENCH.—LIII.

§ 15-1.—The Adjective.

(1.) The adjective serves to denote the quality or manner of being of the noun.

(2.) Adjectives are of two sorts: *qualifying adjectives* and *determinative adjectives.*

(3.) We call *qualifying adjectives* those which add to the idea of the object that of a quality proper to it: as, **bon**, *good;* **noble**, *noble;* **courageux**, *courageous.*

(4.) *Determinative adjectives* are those which add to the idea of the object, that of a particular limitation or determination; as, **quelque**, *some;* **tout**, *all;* **autre**, *other;* **mon**, *my;* **nul**, *no;* **un**, *one;* **deux**, *two.*

§ 15-2.—Qualifying Adjectives.

(1.) These adjectives may express qualities: 1. Simply; 2. With comparison; 3. Carried to a very high degree. Hence the three degrees of qualification: the positive, the comparative, and the superlative.

(2.) The positive is nothing but the adjective in its simplest signification:—

Moi, je suis à Paris, *triste, pauvre, reclus.* BOILEAU.	*At Paris I am sad, poor, and secluded.*

(3.) The comparative is the adjective expressing a comparison between several objects. There is, then, between the objects compared, a relation of *equality, superiority,* or *inferiority.*

(4.) The comparison of equality expresses a quality in the same degree, in the objects compared; it is formed* by placing **aussi**, *as*, or **autant**, *as much*, before the adjective, and the conjunction **que**, *as*, after it:—

L'Allemagne est *aussi* peuplée *que* la France. VOLTAIRE.	*Germany is as populous as France.*
À leur tête est le chien, superbe *autant qu'*utile. DELILLE.	*At their head stands the dog, as noble as useful.*

(5.) The relation or comparison of superiority expresses a quality in a higher degree in one object than in another; this comparison is formed by placing **plus**, *more*, before the adjective, and **que**, *than*, after it:—

Les actions sont *plus* sincères *que* les paroles. MLLE. DE SCUDERY.	*Actions are more sincere than words.*
Le pied du cerf est *mieux* fait que celui du bœuf. BUFFON.	*The foot of the stag is better formed than that of the ox.*

(6.) The comparison of inferiority expresses a quality in a lower degree in one object than in another; it is formed by placing **moins**, *less*, before the adjective, and **que**, *than*, after it:—

Le naufrage et la mort sont *moins* funestes *que* les plaisirs qui attaquent la vertu. FÉNELON.	*Shipwreck and death are less fatal than those pleasures which attack virtue.*

(7.) The adverbs **aussi, autant, plus,** and **moins,** must be repeated before every adjective used in the comparative degree in the same sentence:—

Il est plus grand et plus fort que son frère, quoiqu'il soit plus jeune.	*He is taller and stronger than his brother, although he is younger.*

(8.) We have only three adjectives which are comparative of themselves: **meilleur**, *better;*† **moindre**, *less;* **pire**, *worse.*

Meilleur, instead of *plus bon*, which is never used in the sense of *better:*—

Il n'est *meilleur* ami ni parent que soi-même. LA FONTAINE.	*We have no better friend, no better relation than ourselves.*

Pire, instead of *plus mauvais*, which may however be used:—

Le remède est parfois *pire* que le mal. LENOBLE.	*The remedy is at times worse than the evil.*

Moindre, instead of *plus petit*, an expression also in use:—

Ce n'est pas être petit que d'être *moindre* qu'un grand. BOISTE.	*Being less than great is not being small.*

(9.) The *superlative*, or third degree of qualification, expresses the quality carried to a very high, or to the highest degree; hence there are two sorts of superlatives: the relative and the absolute.

(10.) The superlative relative marks a very high or the highest degree *relatively, i.e.*, with comparison: it is formed by placing **le, la, les,** *the;* **mon, ma, mes,** *my;* **ton, ta, tes,** *thy;* **son, sa, ses,** *his;* **notre, nos,** *our;* **votre, vos,** *your;* **leur, leurs,** *their,* before the comparative of superiority or inferiority:—

Un bienfait reçu est *la plus sacrée* de toutes les dettes. MME. NECKER.	*A benefit received is the most sacred of all debts.*
La probité reconnue *est le plus sûr* de tous les serments. (THE SAME.)	*Acknowledged probity is the most secure of all oaths.*

(11.) The words **le plus, le moins,** must be repeated before every adjective:—

Ce sont les livres *les plus* agréables, *les plus* universellement lus, et *les plus* utiles. BERNARDIN DE ST. PIERRE.	*These books are the most agreeable, the most universally read, and the most useful.*

(12.) The superlative absolute expresses also a very high degree, but, absolutely, without comparison: it is formed by placing before the adjective one of the words, **très, fort, infiniment, extrêmement,** &c.:—

Il y a à la ville, comme ailleurs, de *fort* sottes gens. LA BRUYÈRE.	*There are in cities, as elsewhere, very silly people.*
Je vous prie de croire que je ne songe qu'à vous, et que vous m'êtes *extrêmement chère.* MME. DE SÉVIGNÉ.	*I beg you to believe that you are my only thought, and that you are extremely dear to me.*

§ 16.—Gender and Number of Adjectives.

(1.) The adjective has, of itself, neither gender nor number; it must assume the gender and number of the noun which it qualifies.

(2.) The termination of the adjective varies according to the gender and number of the noun which it qualifies or determines:—

Masculine.	*Feminine.*
Un homme *prudent.*	Une femme *prudente.*
A prudent man.	*A prudent woman.*
Des hommes *prudents.*	Des femmes *prudentes.*
Prudent men.	*Prudent women.*

§ 17.—Formation of the Feminine of Adjectives.

(1.) All adjectives ending with *e* mute, remain unchanged in the feminine:—

Masculine.	*Feminine.*
Un homme *agréable.*	Une femme *agréable.*
An agreeable man.	*An agreeable woman.*
Un mur *solide.*	Une maison *solide.*
A strong wall.	*A strong (well built) house.*

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* In French, adjectives cannot be compared, as in English, by means of changes in the termination: with the exception of **meilleur**, *better;* **moindre**, *less;* and **pire**, *worse*, all comparisons must be formed by means of adverbs.

† **Mieux**, *better;* **pis**, *worse;* **moins**, *less.* The English words *better, worse, less* are sometimes adverbs, and when they are so, should be rendered by the several words placed at the commencement of this note. A practical way of determining the nature of those words in English is:—

1. To change the word *better* into the expression "*in a better manner.*" If this change may be made without altering the sense, the word *better* is an adverb, and must be rendered by **mieux**:—

He reads better (in a better manner) than his brother.	Il lit *mieux* que son frère.

2. If you can change *worse* into "*in a worse manner,*" it should be translated by **pis**, or **plus mal**:—

He reads worse (in a worse manner) than his brother.	Il lit *pis*, or *plus mal*, que son frère.

3. When you may substitute "*a smaller amount or quantity*" for the word *less*, it should be rendered by **moins**:—

He reads less (a smaller amount) than his brother.	Il lit *moins* que son frère.

(2.) Adjectives not ending in *e* mute, form their feminine by the addition of *e*:—

Masculine.	*Feminine.*
Un garçon *diligent.*	Une fille *diligente.*
A diligent boy.	*A diligent girl.*
Un homme *poli.*	Une dame *polie.*
A polite man.	*A polite lady.*

(3.) EXCEPTIONS:—

First Exception.—Adjectives ending in *as, el, eil, en, et, on, os, ot,* form their feminine by doubling the last consonant and adding *e*:—

Masculine.	*Feminine.*	*Masculine.*	*Feminine.*
Gras, *fat.*	Grasse.	Muet, *dumb.*	Muette.
Cruel, *cruel.*	Cruelle.	Bon, *good.*	Bonne.
Vermeil, *ruddy.*	Vermeille.	Gros, *big.*	Grosse.
Chrétien, *Christian.*	Chrétienne.	Bellot, *pretty.*	Bellotte.

Although **ras**, *close-shaved, shorn,* ends in *as*, its feminine is **rase**.

The following adjectives in *et*, and all adjectives in *er*, form their feminine by simply adding *e*, and a grave accent is put over the *e* preceding the final consonant:—

Masculine.	*Feminine.*
Complet, *complete.*	Complète.
Incomplet, *incomplete.*	Incomplète.
Concret, *concrete.*	Concrète.
Discret, *discreet.*	Discrète.
Indiscret, *indiscreet.*	Indiscrète.
Inquiet, *uneasy.*	Inquiète.
Secret, *secret.*	Secrète.
Replet, *replete.*	Replète.
Dernier, *last.*	Dernière.
Fier, *proud.*	Fière.
Premier, *first.*	Première.
Cher, *dear.*	Chère.

The feminine of **prêt**, *ready*, is **prête**.

Second Exception.—Adjectives ending in *f* change *f* into *v* and add *e* in their feminine:—

Vif, *lively.*	Vive.	Neuf, *newly made.*	Neuve.

Third Exception.—Adjectives ending in *x* form their feminine by changing *x* into *s*, and adding *e*:—

Heureux, *happy.*	Heureuse.	Vertueux, *virtuous.*	Vertueuse.

The following, however, do not conform to this rule:—

Masculine.	*Feminine.*	*Masculine.*	*Feminine.*
Doux, *sweet.*	Douce.	Préfix, *prefixed.*	Préfixe.
Faux, *false.*	Fausse.	Roux, *red-haired.*	Rousse.

Fourth Exception.—Adjectives ending in *eur*, derived from participles present by dropping *ant* and substituting *eur*, change the final *r* into *se*; as,

Pres. Part.	*Masculine.*	*Feminine.*
flattant, *flattering.*	flatteur,	flatteuse.
trompant, *deceiving.*	trompeur,	trompeuse.

Fifth Exception.—Those ending in *érieur*, also **majeur, mineur, meilleur**, follow the general rule, that is, add *e* to form the feminine; as,

extérieur, *exterior,*	*make in the feminine*	extériure,
supérieur, *superior,*		supérieure,
majeur, *of age, major,*		majeure,
mineur, *minor, under age,*		mineure,
meilleur, *better,*		meilleure.

Sixth Exception.—The following adjectives having two forms for the masculine, form their feminine as follows:—

Masculine.		*Feminine.*	
beau,*	bel,	belle,	*handsome.*
fou,	fol,	folle,	*foolish.*
mou,	mol,	molle,	*soft.*
nouveau,	nouvel,	nouvelle,	*new.*
vieux,	vieil,	vieille,	*old.*

* The forms **beau, fou, mou, nouveau,** and **vieux**, are used before words masculine beginning with a consonant or sounded *h*; and **bel, fol, mol, nouvel** and **vieil** before words masculine beginning with a vowel or silent *h*; *e.g.*, **un beau cheval, fol espoir, vieil ami, vieux pont,** &c.

Irregular Adjectives.

(4.) The following adjectives form their feminine irregularly:—

Masculine.	*Feminine.*
aigu, *sharp.*	aiguë.
ambigu, *ambiguous.*	ambiguë.
bénin, *benign.*	bénigne.
blanc, *white.*	blanche.
carduc, *decrepit, infirm.*	caduque.
coi, *quiet.*	coite.
épais, *thick.*	épaisse.
exigu, *scanty.*	exiguë.
exprès, *express.*	expresse.
favori, *favourite.*	favorite.
frais, *fresh.*	fraîche.
franc, *free, frank.*	franche.
franc, *Frank, Frankish.*	franque.
gentil, *pretty, genteel.*	gentille.
grec, *Grecian, Greek.*	grecque.
hébreu, *Hebrew.*	hébraïque, used only of the Hebrew tongue.
jumeau, *twin.*	jumelle.
long, *long, slow.*	longue.
malin, *cunning, malignant.*	maligne.
nul, *null, no.*	nulle.
oblong, *oblong.*	oblongue.
public, *public.*	publique.
sec, *dry, barren.*	sèche.
tiers, *third.*	tierce.
turc, *Turkish.*	turque.

(5.) The following compound adjectives alter only their last component:—

Masculine.	*Feminine.*
aigre-doux, *sourish.*	aigre-douce.
mort-né, *still-born.*	mort-née.

Note.—The plural masculine of **aigre-doux**, *sourish*, is **aigres-doux**; its plural feminine is **aigres-douces**. The plural masculine of **mort-né**, *still-born*, is **mort-nés**; its plural feminine is **mort-nées**.

For rules on the agreement of compound adjectives, *see* § 83 (6).

(6.) The following have no feminine:—

châtain, *chestnut colour, auburn.* dispos, *active.*

§ 18.—FORMATION OF THE PLURAL OF ADJECTIVES.

(1.) *General Rule.*—The plnral of adjectives is formed by the addition of *s* to the masculine, or to the feminine termination:—

Masculine.		*Feminine.*	
Singular.	*Plural.*	*Singular.*	*Plural.*
grand, *great,*	grands.	grande,	grandes
petit, *small,*	petits.	petite,	petites.

(2.) This rule has no exceptions with regard to the feminine termination.

(3.) With regard to the masculine termination, it is snbject to the three following exceptions:—

First Exception.—Adjectives ending in the singular with *s* or *x*, do not change their form in the plural:—

Singular.	*Plural.*
bas, *low,*	bas.
doux, *sweet, soft,*	doux.

Second Exception.—Adjectives having in the singular the termination *eau*, form their plural masculine by the addition of *x*:—

Singular.	*Plural.*
beau, *handsome, beautiful,*	beaux.
jumeau, *twin,*	jumeaux.
nouveau, *new,*	nouveaux.

The adjectives **fou, mou, feu,** and **bleu** form their plural by adding *s*: **fous, mous, feus, bleus.**

Third Exception.—Adjectives ending in *al* form their plural masculine by changing *al* into *aux*:—

Singular.	*Plural.*
libéral, *liberal,*	libéraux.
national, *national,*	nationaux.
rural, *rural,*	ruraux.

The following are exceptions, forming their plural regularly; they are hardly ever used in the masculine plural :—

Singular.	*Plural.*
bancal, *bandy-legged,*	bancals.
fatal, *fatal,*	fatals.
final, *final,*	finals.
matinal, *early,*	matinals.
médial, *medial,*	médials.
pénal, *penal,*	pénals.
théatral, *theatrical,*	théatrals.

KEY TO EXERCISES IN LESSONS IN FRENCH.

EXERCISE 189 (Vol. III., page 164).

1. Is my cousin as obliging as yours? 2. She is as obliging and much more charming than mine. 3. Are your children obliging? 4. My children, anticipating all my wants, leave me nothing to desire. 5. Read very attentively the following pages. 6. Those young ladies, following their mother's example, apply to reading. 7. Showy colours do not please me. 8. My sisters seeing that it was going to rain hastened to return. 9. What have you let fall? 10. I have let my pen fall; the point is blunted. 11. Have you made them speak? 12. I made them speak, but with difficulty. 13. Have you had alterations made in your house? 14. I have had some made in it. 15. In what part have you had them made? 16. I have had some made in the dining and drawing rooms. 17. Have you let that man pass? 18. I have not tried to prevent him. 19. Whom have you heard say that? 20. I heard my father say it. 21. I have heard him repeat it. 22. He heard you say it. 23. He has seen you do that. 24. He has seen you do it. 25. I saw him pass.

EXERCISE 190 (Vol. III., page 164).

1. Les eaux dormantes sont-elles bonnes pour les chevaux? 2. Buffon dit qu'elles sont meilleures pour les chevaux que les eaux vives. 3. Vos sœurs sont-elles prévoyantes? 4. Elles ne sont pas très prévoyantes. 5. Mes sœurs, prévoyant qu'il allait pleuvoir, apportèrent leurs parapluies. 6. Qu'avez-vous laissé tomber? 7. J'ai laissé tomber mon couteau et mon livre. 8. Les couleurs voyantes plaisent-elles à M. votre frère? 9. Les couleurs très voyantes ne lui plaisent pas. 10. Avez-vous lu les pages suivantes? 11. Avez-vous vu la mourante? 12. Votre sœur, mourant dans la crainte de Dieu, était très heureuse. 13. Votre sœur, suivant votre exemple, s'applique à l'étude. 14. Les avez-vous fait lire? 15. Je les ai fait lire et écrire. 16. J'ai fait écrire mon frère. 17. J'ai fait relier un livre. 18. M. votre père a-t-il fait faire des changements à sa maison? 19. Il y en a fait faire. 20. À quelle chambre en a-t-il fait faire? 21. Il en a fait faire à la chambre de mon frère. 22. À qui avez-vous entendu dire cela? 23. Je l'ai entendu dire à ma sœur. 24. Lui avez-vous entendu dire cela? 25. Je ne le lui ai pas entendu dire. 26. Avez-vous vu passer mon père? 27. Je ne l'ai pas vu passer. 28. Je l'ai entendu parler. 29. Faites-le parler. 30. Laissez-le tomber. 31. Ne le laissez pas tomber. 32. Qu'est-ce que M. votre frère a laissé tomber? 33. Il n'a rien laissé tomber. 34. À qui avez-vous entendu dire cela? 35. Je l'ai entendu dire à votre frère. 36. Je vous l'ai entendu répéter. 37. Nous vous avons vu faire cela.

LESSONS IN ENGLISH.—XXXVI.

LATIN STEMS (*concluded*).

SOME Latin stems supply us only in part with derivatives, giving, for instance, the noun, and leaving the Saxon to furnish the adjective; or giving the adjective, and leaving the Saxon to furnish the noun. Such a fact illustrates the composite character of our present English tongue. If it be a token of perfection in a language that it is produced and evolved out of its own elements like a tree, with its stem, branches, and leaves, the English has little claim to perfection. But a perfection of this kind is only theoretical. That is the best language which most effectually answers the purpose of speech. Thus viewed, the English possesses very high qualities. In virtue of the facts just mentioned, examples of which I am about to append, the English possesses a most desirable variety, which adds not only to the colouring and polish of our style, but also to its capability and force.

LATIN NOUNS WITH THEIR DERIVED ADJECTIVES, AND CORRESPONDING SAXON NOUNS.

Latin Nouns.	*Derived Adjectives.*	*Saxon Nouns.*
initium	*initial*	*beginning.*
pectus, pectoris	*pectoral*	*breast.*
cadaver	*cadaverous*	*carcass.*
felis	*felin*	*cat.*
vacca	*vaccine*	*cow.*
morbus, morbi	*morbid*	*disease.*
canis	*canine*	*dog.*
auris	*auricular*	*ear.*
finis	*final*	*end.*
hostis	*hostile*	*enemy.*
oculus	*ocular*	*eye.*
ager, agri	*agrarian*	*field.*
grex, gregis	*gregarious*	*flock.*
tutela	*tutelary*	*guardianship.*
manus	*manual*	*hand.*
caput, capitis	*capital*	*head.*
merces	*mercenary*	*wages.*
equus, or *eques*	*equestrian*	*horse.*
domus	*domestic*	*home.*
insula	*insular*	*island.*
culina	*culinary*	*kitchen.*
lux, lucis	*lucid*	*light.*
pulmo	*pulmonary*	*lungs.*
mens, mentis	*mental*	*mind.*
pecunia	*pecuniary*	*money.*
luna	*lunar*	*moon.*
os (oris)	*oral*	*mouth.*
nasus	*nasal*	*nose.*
locus	*local*	*place.*
vulgus	*vulgar*	*rabble.*
annulus (annus)	*annular*	*a ring.*
emulus	*emulous*	*a rival.*
radix, radicis	*radical*	*root.*
regula	*regular*	*rule.*
mare, maris	*maritime*	*sea.*
pastor	*pastoral*	*shepherd.*
humerus	*humeral*	*shoulder.*
latus, latĕris	*lateral*	*side.*
visus	*visual*	*sight.*
miles, milĭtis	*military*	*soldier.*
ver	*vernal*	*spring.*
sol	*solar*	*sun.*
furtum	*furtive*	*theft.*
femur, femŏris	*femoral*	*thigh.*
dens, dentis	*dental*	*tooth.*
fœdus, fœdĕris	*federal*	*treaty.*

The similarity which exists between the Latin and the corresponding English affords the student aid either to learn the words which are of Latin extraction found in English, or to become acquainted with the Latin vocabulary itself. Suppose, for instance, that you meet with the word *lateral*, and know, or, not knowing, ascertain, that it is a word of Latin origin which signifies *that which pertains to the side.* Having this information, you are enabled to remember that *latus*, the noun whence lateral comes, denotes *the side.* Or if you know that latus means *the side*, then you readily infer that lateral means *that which pertains to the side.* In this way, you may make the Latin roots with which you have become acquainted teach you the import of scores, nay, hundreds, of derivatives.

And observe, too, the specific service which the Latin element renders. We have the noun *side*, but we have no corresponding Saxon adjective. The want is supplied by the Latin.

In meaning, these nouns and adjectives do not always strictly correspond. Thus ager, *field*, and agrarian do not strictly correspond; I mean, you cannot infer the exact meaning of *agrarian*, for instance, from the meaning of *ager*. You are thus taught that it is an intelligent, not a slavish, study in which you are engaged. Rules are not chains, but guiding-posts.

Some of the words in the last lists, and in previous lists, which appear as Latin or Saxon, are not exclusively of Latin or Saxon origin. To *wade*, given as a derivative of *vado*, is a Saxon root, being common to both the Latin (Celtic) and the Saxon tongues. *Waddle*, a diminutive of *wade*, is also Saxon. *Rule* and *regula* may be considered as the same word in different forms; also *oculus* and *eye*; so *insula* and *island*; *leo* and *lion*; *mens* and *mind*. Similar facts abound in our language, and show that in order to know one language well you must study several, and that the proper way to study languages is to study them in their mother tongues—in the primitive groups or classes where they are found, and whence they shoot and branch.

I subjoin a list in which the richness of our language is still more exemplified :—

Latin Nouns.	*Latin Adjectives.*	*Saxon Adjectives.*	*Saxon Nouns.*
corpus, corpŏris	*corporeal*	*bodily*	*body.*
puer, pueri	*puerile*	*boyish*	*boy.*

Latin Nouns.	*Latin Adjectives.*	*Saxon Adjectives.*	*Saxon Nouns.*
frater	fraternal	*brotherly*	*brother.*
onus, *onĕris*	onerous	*burdensome*	*burden.*
dies	diurnal	*daily*	*day.*
mors, mortis	mortal	*deadly*	*death.*
terra	terrestrial	*earthly*	*earth.*
pater	paternal	*fatherly*	*father.*
culpa	culpable	*faulty*	*fault.*
ignis	igneous	*fiery*	*fire.*
caro, carnis	carnal	*fleshly*	*flesh.*
capillus	capillary	*hairy*	*hair.*
odium	odious	*hateful*	*hate.*
salus, salūtis	salutary	*healthy*	*health.*
cor, cordis	cordial	*hearty*	*heart.*
cœlum	celestial	*heavenly*	*heaven.*
auxilium	auxiliary	*helpful*	*help.*
glacies	glacial	*icy*	*ice.*
rex, regis	regal	*kingly*	*king.*
lex, legis	legal	*lawful*	*law.*
vita	vital	*lively*	*life.*
amor	amorous	*lovely*	*love.*
mater	maternal	*motherly*	*mother.*
nox, noctis	nocturnal	*nightly*	*night.*
robur	robust	*strong*	*strength.*
mars, martis	martial	*warlike*	*war.*
aqua	aqueous	*watery*	*water.*
voluntas	voluntary	*willing*	*will.*
femina	feminine	*womanly*	*woman.*
sylva	sylvan	*woody*	*wood.*
mundus	mundane	*worldly*	*world.*
annus	annual	*yearly*	*year.*

The diverse meanings of capillary and *hairy* suffice to prevent you from thinking that these pairs of adjectives—one from the Latin, one from the Saxon—are in each case identical in meaning. Frequently, however, that which is indicated by the one is that which the other signifies. When the two are of the same import, the one may be used for the other. To which of the two you should give the preference depends on circumstances. If you are addressing the people, you will do well to employ words of Saxon origin. Nor fancy that by so doing you lower your style. Simplicity in diction, like simplicity in dress, betokens real respectability. Write, because you have something to say; and if you have nothing to say, do not write; and if you write, write so as to be understood by those for whom you write; *the best style is that which is most readily understood.*

Composition and Parsing.

Make short sentences out of the list which I now give of

Words with their Proper Prepositions.

Words.	F. R.
Deviate from,	via, *a way.*
Devolve on, upon,	volvo, *I roll.*
Devote to,	votum, *a vow.*
Dictate to,	dico, *I say.*
Die of (a disease), by (the sword or famine), for (another)	
Differ with (a person in opinion), from (a person or thing in some quality)	fero, *I bear.*
Different from,	fero, *I bear.*
Difficulty in,	facilis, *easy.*
Diminution of,	minutus, *small.*
Disabled from,	
Disagree with,	
Disagreeable to,	
Disappointed of (a thing not obtained), in (a thing obtained),	
Disapprove of,	probus, *good.*
Discourage from,	cœur, *heart.*
Discouragement to,	
Disengaged from,	gage, *a pledge.*
Disgusted at, with,	gustus, *taste.*
Dislike to,	
Dismissal from,	missus, *sent.*
Disparagement to,	
Dispense with,	dispenser, *to set free.*
Dispose of, to, for,	positus, *placed.*
Dispossess of,	possideo, *I possess.*
Dispute with,	puto, *I think.*

Study and parse carefully the following admirable remarks. Having done so, write, as well as you can, on the same subject; and if you have kept your earlier attempts, compare them with the essay you produce on the love of knowledge. The comparison will give you both instruction and encouragement.

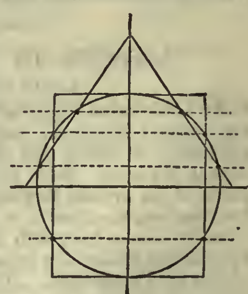
THE LOVE OF KNOWLEDGE.

But while I am descanting so minutely upon the conduct of the understanding, and the best modes of acquiring knowledge, some men may be disposed to ask, "Why conduct my understanding with such endless care?—and what is the use of so much knowledge?" What is the use of so much knowledge?—what is the use of so much life?—what are we to do with the seventy years of existence allotted to us?—and how are we to live them out to the last? I solemnly declare that, but for the love of knowledge, I should consider the life of the meanest hedger and ditcher as preferable to that of the greatest and richest man here present. For the fire of our minds is like the fire which the Persians burn in the mountains—it flames night and day, and is immortal and not to be quenched! Upon something it *must* act and feed—upon the pure spirit of knowledge, or upon the foul dregs of polluting passions. Therefore, when I say, in conducting your understanding, Love knowledge with a great love, with a vehement love, with a love coeval with life, what do I say but love innocence—love virtue—love purity of conduct—love that which, if you are rich and great, will sanctify the blind fortune which has made you so, and make men call it justice; love that which, if you are poor, will render your poverty respectable, and make the proudest feel it unjust to laugh at the meanness of your fortunes; love that which will comfort you, adorn you, and never quit you—which will open to you the kingdom of thought, and all the boundless regions of conception, as an asylum against the cruelty, the injustice, and the pain that may be your lot in the outer world; that which will make your motives habitually great and honourable, and light up in an instant a thousand noble disdains at the very thought of meanness and fraud! Therefore, if any young man here have embarked his life in the pursuit of knowledge, let him go on without doubting or fearing the event; let him not be intimidated by the cheerless beginnings of knowledge, by the darkness from which she springs, by the difficulties which hover around her, by the wretched habitations in which she dwells, by the want and sorrow which sometimes journey in her train; but let him ever follow her as the angel that guards him, and as the genius of his life. She will bring him out at last into the light of day, and exhibit him to the world comprehensive in acquirements, fertile in resources, rich in imagination, strong in reasoning, prudent and powerful above his fellows, in all the relations and in all the offices of life.—*Sydney Smith.*

LESSONS IN GEOGRAPHY.—XXXV.

CONSTRUCTION OF MAP OF AFRICA, ETC.

The projection for a map of Africa is constructed on a principle entirely different to that of the conical form of projection used for Europe and Asia. It will be seen, on reference to our map of the continent of Africa (Vol. III., p. 357), that this division of the world is pretty nearly bisected, as far as length is concerned, by the equator, the most northern point of the mainland being rather more than 37° north of the equator, while its most southern point is nearly 35° to the south of that line. Considering the equator, then, as the centre parallel of the parallels of latitude that traverse Africa, it is plain that a straight line supposed to pierce the sphere at 20° or 25° north and south of the equator, would be *parallel* to the axis of the sphere, and not *inclined* to it, as in the case of straight lines piercing the sphere in two points, both of which are on the same side of the equator; and it is equally clear that a line entering the sphere and coming out of it again in such a manner as to be parallel to the axis of the sphere, would lie in the surface of a cylinder as in the annexed figure, and not in a cone. It is true that the projection of a map of Africa might be developed on the surface of a cylinder supposed to circumscribe the sphere after the manner of the kind of projection called "Mercator's Projection," in which all the meridians and parallels are represented by straight lines at right angles to each other, and which peculiar mode of construction will be explained in a future lesson. This style of projection, however, which is used in charts and nautical maps, is not so well suited for representations of very large areas of land, as the parts at the top and bottom—or, in other words, north and south of the map—are distorted, and larger in proportion than the central parts; and the mode of projection most generally adopted for a map of Africa is, in consequence, that which we are now going to describe.



The main features of this projection consist in tracing the parallels in parallel straight lines, instead of representing them by arcs of concentric circles as in the conical projection, and by using curved lines for the meridians, instead of straight lines converging to a certain fixed point, as in the projections for maps of Europe and Asia.

On examination of our map of Africa, to which reference has been made above, it will be seen that the meridian of 15° E. has been selected as the central meridian of the map, which crosses the equator at right angles, but which does not appear in the map itself. For this central meridian line our readers may select the meridian of 15° or 20°, as may appear most desirable. We shall, however, in the following description, take the meridian of 15° as the central meridian in our map, and—supposing that the majority of our students who are following these lessons in Geography, and constructing maps from our instructions, are working on a large instead of a small scale—imagine meridians and parallels to be drawn intermediate to those which appear in our map, so that these lines would be but five degrees apart in our learner's projections, instead of ten degrees as in the map; that is to say, a parallel would be drawn at every fifth degree north and south of the equator, instead of every tenth degree, as in the map, and a meridian at every fifth degree east and west from the meridian of 15° east from Greenwich, which we have assumed as the meridian in our projection that crosses the equator at right angles, instead of marking in a meridian five degrees east and west of this central meridian, as in our map, and then drawing meridians ten degrees apart east and west, proceeding in each direction from the meridians that have been traced five degrees each way from the central meridian.

Having drawn two straight lines at right angles to each other, one to represent the equator and the other the meridian of 15° east from Greenwich, we must, in order to draw the parallels, first assume a space equal to five degrees of latitude, and set off eight of these spaces north and south of the equator along the central meridian. Through the points thus marked draw straight lines parallel to the equator on either side of it. Those on the north of it will represent the parallels of 5°, 10°, 15°, 20°, 25°, 30°, 35°, 40° *north* latitude; while those on the south of it will represent the parallels of 5°, 10°, 15°, 20°, 25°, 30°, 35°, 40° *south* latitude. If the learner wish to do so, he may delineate more of the southern part of Europe, as in our map, and more of the ocean to the south of Cape Colony, by setting off more spaces to the north and south of the equator; there is, however, no necessity for doing this, as it has been done in our map merely for the sake of filling up a given space, namely, that of a page of the POPULAR EDUCATOR. The parallels of 40° north and south will serve very well as the inner line of the border of the map at top and bottom, and define the limits of the map to the north and south. It will now be necessary to insert the dotted lines representing the Tropic of Cancer and the Tropic of Capricorn, which must be drawn parallel to the equator through points at the distance of 23° 30′ from it on either side of it, north and south.

In order to draw the meridians, because at the equator the degrees of longitude are equal in length to those of latitude, we must again open our compasses to the extent of the line assumed as equal to a space of five degrees of latitude, and set off eight of these spaces east and west, or right and left, of the central perpendicular line which represents the meridian of 15° E. from Greenwich. The points thus obtained will be those through which the meridians must pass at the equator; those on the right of the central meridian being points through which the meridians of 20°, 25°, 30°, 35°, 40°, 45°, 50°, 55° *east* from Greenwich will pass; while those to the left hand are those through which the meridians of 10°, 5° *east* from Greenwich, 0°, or the meridian of Greenwich itself, and 5°, 10°, 15°, 20°, 25° *west* from Greenwich will pass. The points through which the meridians of 55° *east* from Greenwich and 25° *west* from Greenwich pass may be taken as points through which to draw straight lines parallel to the central meridian, to form the limits of the map to the east and west and the inner line of the border of the map on either side.

As the distance between each meridian decreases gradually from the equator to the poles, means must now be taken to determine the relative distance of every fifth meridian from the central meridian along each parallel drawn in our projection. To do this, a diagonal scale must be constructed (as in the case of projections for the maps of Europe and Asia) on the line assumed at first as being equal to a space of five degrees of latitude. The method of constructing this diagonal scale has been explained in Vol. II., page 356. We must now turn to the table of geographical miles in a degree of longitude under each parallel of latitude (Vol. II., page 357), and from this we find that the length of a degree of longitude on the fifth parallel north or south of the equator is 59·77 geographical miles. Opening the compasses to this extent, as represented on our diagonal scale, set off distances along the fifth parallel of latitude north and south of the equator, on either side of the central meridian, as far as the border-line of the map will permit, and proceed in the same manner along each pair of parallels of latitude north and south of the equator, ascertaining the distance equivalent to five degrees of longitude under each parallel in question from the table already mentioned, and opening the compasses to the proper extent in each case by aid of the diagonal scale. The points thus found on each parallel will be those through which the meridians must be traced. This may be effected by drawing short straight lines from point to point in each successive parallel to the north and south, or by means of a thin band of steel, so bent that its edge may pass through every point marked for the passage of each meridian across the parallels. The border must now be completed, the degrees numbered, and the title of the map and scales of geographical and English miles inserted, after which the outline and different places may be fixed in position as before.

The following table will afford sufficient names for the construction of a map of Africa on a small scale. If a large scale be adopted, as we have advised, the latitudes and longitudes may be obtained from the index of places appended to any ordinary atlas. Our readers will often find that the latitude and longitude of a place according to one index will differ from the latitude and longitude assigned to the same place in another index. This arises in most cases from a difference in the results obtained at different times by independent observers, or some different point being selected by each for making the observation.

TABLE OF LATITUDES AND LONGITUDES OF PLACES IN AFRICA.

Name of Place.	Country, etc.	Latitude.	Longitude.
Abomey . . .	Upper Guinea .	7° 26′ N.	2° 3′ E.
Aboukir . . .	Egypt . . .	31 17	30 4
Accra . . .	Upper Guinea .	5 35	0 6 W.
Agulhas (Cape) . .	Cape Colony . .	34 50 S.	19 57 E.
Alexandria . .	Egypt . . .	31 9 N.	29 54
Algiers . . .	Algeria . . .	36 43	3 3
Anamaboo . .	Upper Guinea .	5 14	0 53 W.
Angra Pequena (Cape)	South Africa . .	26 25 S.	15 5 E.
Antalo . . .	Abyssinia . .	13 17 N.	39 25
Apollonia (Cape) .	Upper Guinea .	5 0	2 32 W.
Axum . . .	Abyssinia . .	14 17	38 47 E.
Bambara . . .	Soudan . . .	16 8	2 42 W.
Bathurst . . .	Cape Colony . .	33 26 S.	26 45 E.
Bengazi . . .	Tripoli . . .	32 18 N.	20 10 E.
Berbera . . .	Nubia . . .	10 28	45 7
Biban . . .	Tunis . . .	33 15	11 19
Birbeh . . .	Egypt . . .	26 15	31 40
Bizerta . . .	Tunis . . .	37 16	9 48
Blanco (Cape) . .	Tunis . . .	37 19	9 43
Bojador (Cape) . .	Sahara . . .	26 12	14 27 W.
Bomba . . .	Lower Guinea .	10 48 S.	21 28 E.
Bon (Cape) . .	Tunis . . .	37 11 N.	11 3
Bona . . .	Algeria . . .	36 51	7 42
Brava . . .	Zanguebar . .	1 3	43 57
Cabes . . .	Tunis . . .	33 51	10 1
Cairo . . .	Egypt . . .	30 3	31 21
Cantin (Cape) . .	Marocco . .	32 32	8 14 W.
Cape Coast Castle .	Upper Guinea .	5 15	0 30
Cape Town . .	Cape Colony . .	34 56 S.	18 27 E.
Ceuta . . .	Marocco . .	35 52 N.	5 18 W.
Clanwilliam . .	Cape Colony . .	32 5 S.	18 57 E.
Coomassie . . .	Upper Guinea .	6 50 N.	2 16 W.
Corrientes (Cape) .	Mozambique . .	24 10 S.	35 12 E.
Cossire, or Kosseir .	Egypt . . .	26 5 N.	34 16
Cyrene . . .	Tripoli . .	32 47	21 47

Name of Place.	Country, etc.	Latitude.	Longitude.
Damietta	Egypt	31° 23' N.	31° 48' E.
Delgado (Cape)	Zanguebar	10 23 S.	40 29
Denderah	Egypt	26 9 N.	32 39
Derna	Tripoli	32 46	22 38
Elmina	Upper Guinea	5 8	1 28 W.
Falcon (Cape)	Algeria	35 48	0 48
Ferro (Cape)	Algeria	37 3	7 8 E.
Fez	Marocco	34 6	4 53 W.
Formosa (Cape)	Upper Guinea	4 16	6 23 E.
Freetown	Sierra Leone	8 30	12 32 W.
Frio (Cape)	West Africa	18 34 S.	12 0 E.
Funchal	Madeira I.	32 46 N.	16 59 W.
George Town	Cape Colony	33 53 S.	22 17 E.
Gondar	Abyssinia	12 37 N.	37 29
Goree	Senegambia	14 34	17 26 W.
Guardafui (Cape)	East Africa	11 53	51 22 E.
Hammamet	Tunis	36 23	10 35
James Town	Upper Guinea	5 33	0 12 W.
Jerba I.	Tunis	33 45	10 50 E.
Johanna	Comoro I.	12 10 S.	44 27
Khartoom	Nubia	15 34 N.	32 31
Kubo	Soudan	14 53	1 15 W.
Lagos	Upper Guinea	6 28	3 38 E.
Lamo I.	Zanguebar	3 30 S.	40 49 E.
Latakoo	South Africa	27 19	24 6
Lebda	Tripoli	32 50 N.	14 4
Loango	Lower Guinea	3 30 S.	11 46
Lopez (Cape)	Lower Guinea	0 33	8 35
Louis, St.	Senegambia	16 7 N.	16 30 W.
Magadoxo	Zanguebar	2 3	45 13 E.
Marocco	Marocco	31 45	7 32 W.
Massowah	Egypt	15 37	39 27 E.
Matifou (Cape)	Algeria	36 48	3 12
Mesurado (Cape)	Liberia	6 17	10 53 W.
Mesurata	Tripoli	32 26	15 3 E.
Mirik (Cape)	West Africa	19 23	16 32 W.
Mogador	Marocco	31 30	9 42
Monaster	Tunis	35 46	10 46 E.
Monrovia	Liberia	6 15	10 52 W.
Morgan (Cape)	Cape Colony	32 40 S.	28 25 E.
Mourzouk	Sahara	25 49 N.	14 12
Mozambique	Mozambique	15 2 S.	40 46
Natal (Cape)	Natal	29 54	30 53
Negro (Cape)	Lower Guinea	15 50	11 39
Nun (Cape)	Marocco	28 46 N.	11 0 W.
Nunez (River)	Senegambia	10 40	14 38
Oliphant (River)	Cape Colony	31 36 S.	18 13 E.
Oran	Algeria	35 40 N.	0 38 W.
Palmas (Cape)	Liberia	4 27	7 47
Paul de Loanda (St.)	Benguela, W. Africa	8 54 S.	13 7 E.
Pietermauritzberg	Natal	29 41	30 3
Portendik	Senegambia	18 7 N.	15 55 W.
Quilimane	Mozambique	17 45 S.	36 44 E.
Quiloa	Zanguebar	9 0	39 29
Recife (Cape)	Cape Colony	34 2	25 43
Rosetta	Egypt	31 23 N.	30 24
Roxo (Cape)	Senegambia	12 25	16 49 W.
Saccatoo	Soudan	12 59	5 12 E.
Sallee	Marocco	34	0 46 W.
Santa Cruz, or Agadir	Marocco	30 26	9 32
Seven Capes (Cape)	Sahara	24 43	15 2
Shanganny	Zanzibar I.	6 12 S.	39 19 E.
Siout	Egypt	27 10 N.	31 18
Socotra I.	East Africa	12 30	53 45
Sofala	East Africa	20 3 S.	34 29
Spartel (Cape)	Marocco	35 48 N.	5 52 W.
Suakin	Nubia	19 6	37 23 E.
Suez	Egypt	29 57	32 32
Syene, or Assouan	Egypt	24 6	32 54
Tananarivo	Madagascar	18 46 S.	47 0
Tangier	Marocco	35 45 N.	5 47 W.
Tete	Mozambique	16 12 S.	33 26 E.
Tetuan	Marocco	35 32 N.	5 22 W.
Thebes (Ruins of)	Egypt	25 38	32 38 E.
Three Points Cape	Upper Guinea	4 48	2 6 W.
Tripoli	Tripoli	32 48	13 3 E.
Tunis	Tunis	36 46	10 9
Verd (Cape)	Senegambia	14 48	17 33 W.
Voltas (Cape)	Cape Colony	28 44 S.	16 28 E.
Whydah	Upper Guinea	6 22 N.	2 27
Williamstown	Cape Colony	32 48 S.	27 30

THE UNIVERSITIES.—V.

CAMBRIDGE.—III.

In our last article upon this University we alluded to the fact that the Senate are now admitting students to the University who are not members of colleges. The fact—and of course it is of some importance—that this is intended to diminish the cost of University education, makes it necessary that we should notice it rather more fully.

The scheme which is at present in operation provides for the appointment of a board which shall stand to non-collegiate students in the same relation as the college stands to its own members—*i.e.*, it shall maintain order amongst them, and see that they are duly informed as to all that is required of them; to manage all accounts of the fees received, and present them in due time for admission to degrees.

In reference to the students themselves, it is provided that all laws and regulations at present in force with regard to collegiate students shall apply to the non-collegiate. They are entitled to be matriculated, examined, and admitted to degrees in exactly the same way as others, the officers of the above-mentioned board taking the place of the prælectors and tutors of the colleges. They have to reside with their parents or in lodgings, licensed by the present lodging-house syndicate, and are under the government of the University rules so far as they apply to lodging-houses. They are under the jurisdiction of the vice-chancellor and proctor, and are required also to pay due obedience to all academical regulations. The unattached student pays upon entrance £2 as caution money to the censor of the University, and the fee on matriculation is 15s. At the commencement of every term each student pays to the above board the sum of 35s. Other University fees remain the same as for ordinary members of colleges.

It is obvious that this scheme reduces the expense of living at Cambridge to something very little more than that in London or elsewhere.

But it must be remembered that no provision for education is included in the above payments. The system is not intended to include this, but to enable poor students, and students of special subjects, to curtail their social expenses as much as they please. As such, the scheme is deserving of every commendation.

We pass now from the University proper to the influence which it extends throughout the country by means of its local examinations, both for boys and girls. They are intended chiefly for the advantage of the middle-class schools, for whom there exists no organised system of inspection, such as the Privy Council provide for schools of a lower class; nor any recognised criterion of merit, such as the universities supply for schools of a higher class. They enable schoolmasters to send in for examination either whole classes or chosen representatives, and, by attracting to various centres the youth from all parts of England, they provide a largeness of competition which makes them a valuable test of excellence, and a powerful stimulus to increased exertion.

The syndicate appointed for the purpose undertake to conduct an examination at any place where a local committee, formed for the purpose, will guarantee at least twenty-five candidates. If girls are to be examined as well as boys, it is necessary that there should be a committee of ladies, one of whom will undertake the office of local secretary.

This committee will have to see to the proper accommodation of all students not resident in the place of examination; to provide a suitable room for the examination, separate from that in which the boys are examined; and to send a responsible representative to be present during the time of examination.

The University fee, whether for boys or girls, is £1 per candidate, and the local committee have the power to charge an additional fee to cover their own expenses. After each examination, the students who pass with credit, or satisfy the examiners, are entitled to receive certificates to that effect, which also specify the subjects in which the student has been examined. The names are also published in three alphabetical honour classes, and a list appended of those who merely pass. In determining the classes, account is taken of every part of the examination, provided that in that part the student has obtained more than a certain fixed minimum of marks. Regard is had throughout to the handwriting and spelling.

The examinations themselves, which are the same for boys and girls, are divided into two divisions, one for senior students, under the age of eighteen, the other for junior students, under the age of sixteen.

EXAMINATION OF JUNIOR STUDENTS.

The examination of junior students is divided into three parts:—

Part I.

This is preliminary, and embraces reading aloud, writing from dictation, English grammar (including parsing and analysis of sentences), and arithmetic In these every student must satisfy the examiners.

Part II.

This comprises nine sections, and every student must satisfy the examiners in at least two of these; but no one will be examined in more than six.

1. *Religious Knowledge.*—Part of the historical Scriptures of the Old Testament, and two New Testament subjects; and the Church Catechism.

This section must be taken in by every student, unless the parents or guardians object.

2. *English.*—This embraces a paper on a chosen portion of either English or Roman History, at the choice of the candidate; a paper on physical, political, and commercial geography, with especial reference to Great Britain and her dependencies; and, lastly, one on a specified Play of Shakespeare.

3. *Latin.*—Papers on two chosen Latin books, involving geographical and historical allusions, grammar and parsing; also one passage from some Latin author, not announced beforehand, and a passage of English, with Latin words supplied for translation into Latin.

4. *Greek.*—Corresponding papers to those in Latin, omitting the composition.

5. *French.*

6. *German.*

In these the papers will correspond to those in Latin.

7. *Pure Mathematics.*—Euclid, Books I., II., III., IV., and VI.; Algebra as far as proportion; Plane Trigonometry, including the solution of triangles and the use of Logarithms; and the leading propositions of Mechanics.

8. *Natural Philosophy.*—(*a*) Chemistry; (*b*) Practical Chemistry; (*c*) Elements of Statics and Hydrostatics; (*d*) The experimental Laws of Heat. To pass in this section, candidates must satisfy the examiners in (*a*) and in one of (*b*), (*c*), (*d*). No one can be examined in more than one of the three (*b*), (*c*), (*d*).

9. (*a*) *Elementary Zoology*, embracing the classification of animals and the uses of animal products. (*b*) *Botany.*—The classification of plants and their geographical distribution, specimens being given for description. No student will be examined in both (*a*) and (*b*).

Part III.

This is additional and voluntary. Students may offer themselves for examination in geometrical drawing and perspective; also in drawing from the flat and from models; and in music.

EXAMINATION OF SENIOR STUDENTS.

Part I.

This is preliminary, and the subjects are the same as those in the junior examination, a more extended knowledge of them being required.

Part II.

A. *Religious Knowledge.*—Subjects as above, with the addition of the Book of Common Prayer, and Paley's "Horæ Paulinæ;" also, in the New Testament subject, credit will be given for a knowledge of the original Greek.

B. *English.*—(*a*) History of England; (*b*) Geography—Physical, Political, and Commercial; (*c*) a Play of Shakespeare; (*d*) Political Economy; (*e*) Greek and Roman History; (*f*) Logic. Two at least of the six divisions must be taken.

C. *Latin* and *Greek* as above, including one piece of Latin composition. Either language is sufficient for a pass.

D. *French* and *German* as above, with a piece of composition in both languages. Either language is sufficient for a pass.

E. *Mathematics.*—Algebra, and Euclid I. to IV., VI., and XI. to Prop. 21. Questions also in (*a*) Plane Trigonometry and Simple Geometrical Conic Sections; (*b*) Elementary Statics, Hydrostatics, and Astronomy.

F. *Natural Philosophy.*—(*a*) Facts and general principles of Chemical Science; (*b*) Practical Chemical Analysis; (*c*) Statics, Dynamics, and Hydrostatics; (*d*) Heat; (*e*) Electricity and Magnetism; (*f*) Physical Geography. To pass in this section every student must satisfy the examiners in two of the six subjects. Division (*b*) cannot be taken without (*a*). No one will be examined in more than three subjects. A fair knowledge of inorganic chemistry will obtain a pass in (*a*).

G. (*a*) Zoology, and elements of Animal Physiology; (*b*) Botany and the elements of Vegetable Physiology. No student will be examined in more than one of the divisions.

H. (*a*) Drawing from the Flat; (*b*) Drawing from Models; (*c*) Perspective; (*d*) Imitative Colouring. Candidates must satisfy examiners in (*a*) and in one of (*b*), (*c*), (*d*).

I. *Music*, embracing the history and principles of the art.

Of these nine sections, no one will be examined in more than five. Every one must take section A, unless it be objected to by parents or guardians; and every student must satisfy the examiners in three of the first seven, or in two of the first seven and one of the last two.

Higher Local Examinations are also held twice a year. These are open to all who are seventeen years of age, or who have obtained a first, second, or third class in the senior local examinations. Full particulars as to this examination can be had by applying to the Secretary of the Local Examination Syndicate at Cambridge, who will also furnish any further information that may be required.

COMPARATIVE ANATOMY.—XVII.

PTEROPODA—CEPHALOPODA.

PTEROPODA.

PERHAPS there is no class of animals less likely to come under the notice of the reader than those which belong to this class. This is not because they are few in number, for they exist in such countless numbers in the ocean that, though they are all of small size, they discolour large tracts of its waters; clouding it just as the countless flakes of the snow-fall make the heavens look turbid. Ships may sail for many hours through these swarming myriads, and it is supposed that they form a large part of the diet of the huge whales which, rushing through the throng with open mouth, strain out the little creatures from the waters by the aid of the whalebone fringes of their jaws, and so manage to satisfy an appetite which must be as exacting as their bulk is large. The reason that we see so little of these multitudinous creatures is that they are strictly oceanic in their habits—that is, they live in mid-ocean, and seldom come near any shores. Moreover, they seem to be more or less nocturnal in their habits, retiring into the depths of the sea during the heat of mid-day, and coming to the surface in the evening. They have, however, been seen, even during the day, sporting about in the neighbourhood of those great masses of ocean-weed called sargassum, which float in the middle of the Atlantic, occupying the centre of that vast revolving current, part of which is called the Gulf Stream.

The distinguishing character of these animals, from which they derive their name, is that they possess two wide expansions of the mantle, which are very muscular, stretching away on either side from the back of the neck. These flaps have been called wings, and the animals themselves butterflies of the sea; those who have observed their motions say that it is so brisk and constant that the simile is not an unnatural one.

There are two divisions of the Pteropoda, in one of which there is no shell, of which Clio Borealis, a little creature about half an inch long, may be taken as the type; while the other consists of animals which have shells, and of these Hyalea may be taken as a good example. In Hyalea the shell is a pretty object, reminding one of a watch-pocket such as is hung to a bed. It is all in one piece, but cut down the sides by such deep slits that it may be said to consist of two portions, one of which is flat, or nearly so, and the other is bulging. The animal rests in this little inflexible pocket, and can retract itself completely within the cavity; but ordinarily, when not alarmed, it thrusts its head and wings out of the top, and protrudes two folds of its thin mantle through the side slits, and bends them round the shell, both before and behind, so as to make their edges meet. The head is often not very distinct, and although some of these creatures have very elaborate organs for seizing and holding prey, they are so minute as to require high powers of the microscope to detect them at all. The organs of sense are but ill-developed. Thus, though they certainly occupy a position between the Gasteropoda and Cephalopoda, they seem in some respects inferior to both. The mass of internal organs of the animal occupies a much smaller space than the interior of the shell. They are carnivorous, feeding on small animals. The mouth leads, in hyalea, into a narrow throat, and this into a round stomach. The short intestine opens into the cavity between the mantle walls. They are *opistho branchiate*—that is, their gills are situated behind the heart. The heart is, as in all molluscs, systemic, and receives blood from the gills, and propels it to the body. The liver is large, and there is below it an organ supposed to perform the functions of a kidney.

The nervous system consists of a central mass, composed of two ganglia, united by a band which passes *under* the throat, and this sends off nerves to the wings and mantle. In Clio Borealis there are four large ganglia and two small ones in the same position. This creature has a bi-lobed hood, which can cover all the head, while the tentacles run through it, and so warn the animal, by the sense of touch, of any external object; and then, if this object be prey of any kind, it throws back its hood and exposes six organs, placed three on each side of the mouth, which are studded over with an immense number of tubes, each of which can protrude from its end twenty organs which can act as suckers, and so their minute victims are secured and passed to the triangular mouth, which is furnished with small, singularly-shaped jaws. In Clio Borealis there are two round dark spots at the back of the hood to which nerves run, and these were once supposed to be eyes; but as little stones have been found in these organs, they are now supposed to be ears. The sexes are united in each individual.

CEPHALOPODA.

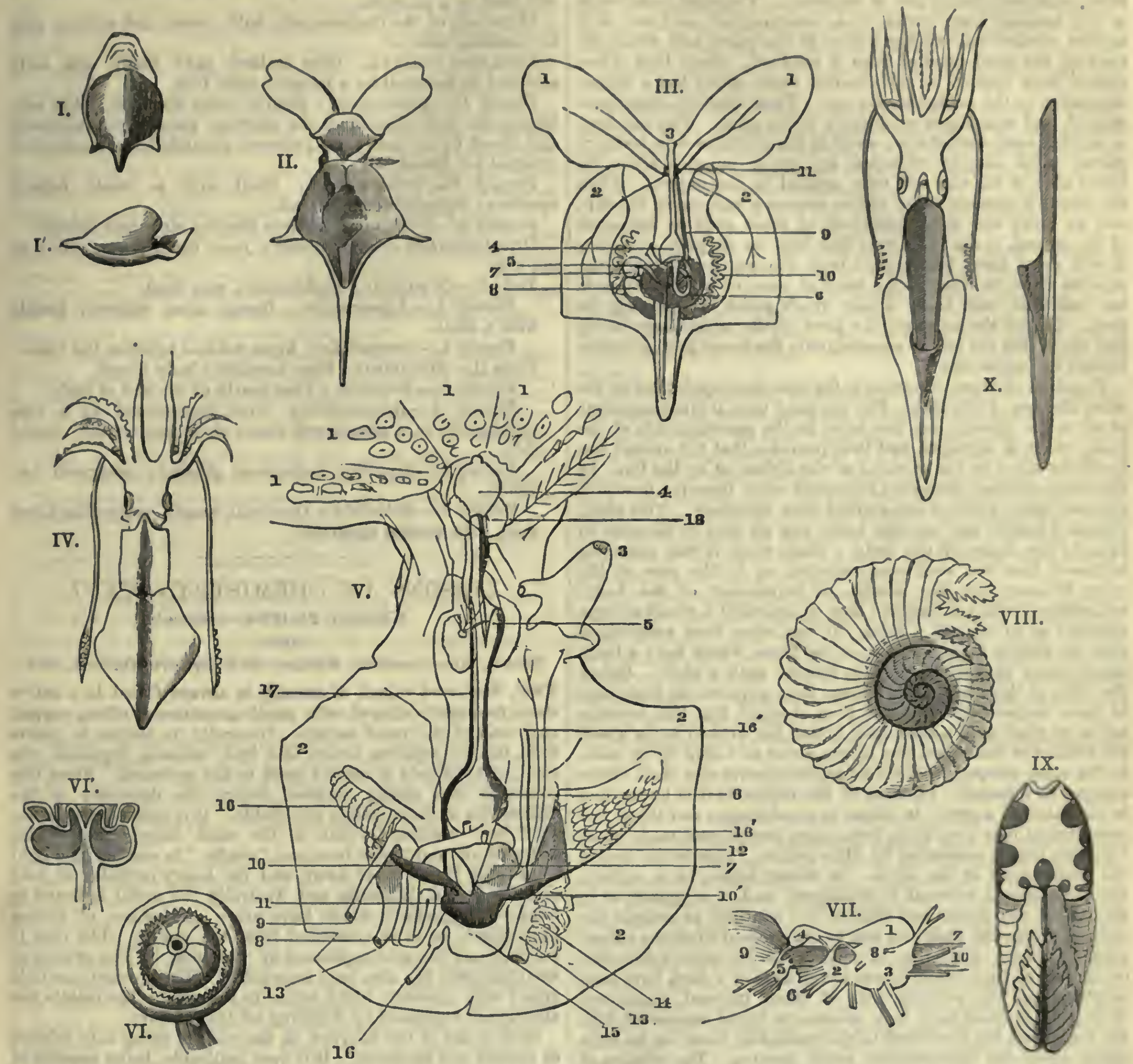
This last and highest class of the Mollusca differs from the rest in containing animals with far higher powers of locomotion and perception than any of the others. The different species are, it is true, often very uncouth and grotesque in appearance, but probably the grotesqueness is due to the fact that they seldom come under our notice. Every creature which we have never observed before, and which differs in external form from those with which we have been previously acquainted, always creates the impression of outlandishness, however well it may be adapted to its own conditions of life. If we were to account strange and grotesque those forms which differ most from the type upon which most creatures are formed, both man and the horse would be thought very strange creatures. When, however, we find organs whose uses we know well, and with whose outward form the eye is familiarised, blended with other organs which have never before come under our notice, no doubt the impression of uncouthness is strongest. Thus, the fact that a cuttle-fish has large eyes on each side of its head very much like our own, and also a beak like that of a parrot, united with a body like a leathern bag, from the mouth of which stretch long arms studded with sucking cups, makes this creature not only appear singular, but even disgusting to some.

In the higher examples of Articulata we find that as they become more organised and complicated in structure, and better suited to the accomplishment of the noble vital functions, so do they tend to differ from all other creatures in the other branches of the animal kingdom. We may, perhaps, assume that the branch Vertebrata contains the highest of all animals; but in proportion as insects become perfected, so far do they differ from vertebrates. Though the functions be the same, the methods by which they are performed differ utterly. The faculties of perception and locomotion are some of the highest animal powers, and these are possessed in quite as large measure by the dragon-fly as by man or the dog; but the instruments by which the former moves and sees are not only quite different from those employed by the latter, but they are the more different, as manifested throughout the class Insecta, as they become more perfect. On the other hand, as the Mollusca become more highly organised they become more like the Vertebrata, and most of all like them in those organs which minister to the higher functions, for which the sub-kingdom is *not* noted. Thus, not only does the eye of the cuttle-fish much resemble that of a vertebrate, but, associated with the greater powers of perception and locomotion, is the development of a large concentrated brain, enclosed in some cases in a cartilaginous box, from which prolongations are extended to shield and support the sense-capsules (ears and eyes), and also to support the organs of motion. This cartilage seems to be the true representative or *homologue* of the internal skeleton of the vertebrates, and in this class it becomes developed from the merest rudiment until it entirely supplants the shell, which we find, not only in this class, but in the other classes of the Mollusca, playing the part, not merely of a protection, but also a fulcrum, or fixed hard part, from which muscles could move the soft parts of the body. However much we might wish it otherwise, we must, therefore, consider ourselves more nearly allied to the gross, dull, and sluggish Mollusca, than to the active and graceful articulates; but though the gap in the series which cuts off the vertebrates from the invertebrates is doubtless the most decided and definite which is found in the whole animal kingdom, yet the cephalopods furnish a link which connects us with the Mollusca, while there is no such link between the articulates and the branch to which we belong.

The Cephalopoda are so called because the integument of the body is drawn out round the mouth into long, tapering, flexible thongs, which are the instruments which have to serve, not only as feelers and arms, but also as legs. In this latter capacity they are used when the animal makes its way over solid ground, and, from their position, the animal must of course walk upon its head, and hence the name head-footed, or head walkers. This mode of progression is, however, seldom resorted to, as the creatures are oceanic rather than terrestrial, and made for swimming rather than walking. They only approach the shore to lay their eggs, but swim the sea in order to procure prey. Not unfrequently, however, they have a retreat in the dark cranny of some submarine rock, in the neighbourhood of which the refuse of their prey is seen to accumulate.

The cephalopods are divided into two great divisions, called, according to the number of their gills, *Tetrabranchiata* and *Dibranchiata;* or, according to the number of their arms, *Tentaculifera* and *Acetabulifera.* To the former belongs the pearly nautilus, whose shells are so commonly seen in naturalists' shops, but which belong to at most only two species of animals. All the rest of this once numerously represented sub-class are fossil. The ammonites of the secondary period all give indications that they belong to this division, and their variety of form and number—the number of individuals—which lived during that period is truly amazing. It is curious that, while all the ammonites have died out, the nautilus, which still exists, represents a genus which lived in the primary ages, long before the former came into existence. It is probable that no other genus, and certainly none so high in the animal scale, has had so prolonged an existence on our planet. Since the *Nautilus pompilius* and the *Nautilus umbilicatus* are the only two existing species, we are compelled to interpret the structure of all the soft organs possessed by this class by an examination of these species only, and even this examination is difficult to accomplish; for though the shells of these creatures are comparatively numerous, and are found washed up at the sea margin, the animals are oceanic and very wary, so that they can only be captured on rare occasions. In fact, we are dependent upon the investigations of two anatomists only, Mr. Owen and M. Valenciennes, for a description of the nautilus.

The pearly nautilus has a shell rolled up in a spire, whose whorls are all in one plane—that is, the outer circles are wound evenly round the inner ones, as a piece of flat tape is wound upon itself. This method of rendering the shell compact is very general throughout the class (though not absolutely universal), and serves to distinguish the shells of Cephalopoda from those of the Gasteropoda, which are never wound evenly round the central portion, but always to one side of the plane, in which the preceding whorls lie just in the same manner as the string of a peg-top is wound around it. This shell is divided into a number of chambers, all of which communicate with each other by a little tubular opening, situated in the centre of each partition. Though these chambers and the communicating tubes are lined with live membrane proceeding from the animal, all the essential parts of that animal are contained in its bag-like, short, cylindrical body, which is lodged in the last large chamber of the shell, whose orifice is wide. As the nautilus grows it secretes more shell from its mantle, thus extending the mouth of the last chamber, and then periodically builds up a wall behind it by the secretion from the hind part of the body. In the nautilus the edges of the partition between the two chambers are plain, but in the ammonites these edges are so folded as to present very complicated and beautiful patterns when viewed from which the water flows, after being received through some slits in the sides, into the chamber in which the gills are lodged, is split down its whole length. This funnel is situated on the opposite side of the head to the hood, so as to occupy the outer side of the shell mouth. The mouth has two jaws, which are of



Pteropoda:—I., I'. Shells of Hyalea. II. Animal in its Shell (Diacria). III. Hyalea Complanata, drawn as though it were transparent, to show the viscera, etc. Cephalopoda:—IV. Loligo, a decapod acetabuliferous genus. V. Octopus Vulgaris, the poulpe opened to show the arrangement of the organs. VI. Sucker from the Arm of a Sepia. VI'. The same in section, to show the piston and the muscles which retract it. VII. Side View of the Ganglionic Ring or Central Nervous System of Sepia. VIII. Side View of an Imperfect Ammonite, showing the notched suture. IX. Side view of same. X. Restored Belemnite and its Shell.

Refs. to Nos. in Figs.—III. 1, 1, fins or wings; 2, 2, mantle which lines and also overlaps the shell; 3, mouth; 4, stomach; 5, intestine; 6, liver; 7, ventricle of heart; 8, auricle of ditto; 9, ascending vessel which gives branches to the fins; 10, gills; 11, ganglion, giving nerves to fins and mantle. V. 1, 1, 1, 1, roots of the arms, which are cut short; 2, 2, mantle thrown back; 3, funnel, or locomotive pipe; 4, buccal mass; 5, crop; 6, stomach; 7, blind sack opening into the stomach; 8, intestine; 9, arms; 10, 10', auricles; 11, ventricle; 12, gill heart (there are two of these, but the left is concealed); 13, 13, venæ cavæ—veins leading direct to the branchial hearts; 14, spongy masses round venæ cavæ, supposed to be kidneys; 15, ovary; 16, 16', oviduct; 17, ascending aorta, or main trunk. VII. 1, supra-œsophageal ganglion; 2, sub-œsophageal ganglion (anterior); 3, ditto (posterior); 4, 5, upper and under mouth ganglia; 6, nerves in arms; 7, ditto to mantle; 8, ditto to eye; 9, buccal mass; 10, throat.

from the outside. The head of the nautilus is but little distinct from the body, and from its upper side the mantle is developed into two folds. One of these adheres to the shell, and the other is puckered into a kind of hood, which falls as a kind of door to close the opening of the shell when the animal retires within it. This thickened part is also used to crawl upon. The funnel, a shelly structure, and this is surrounded by a multitude of feelers, all of which can be retracted into sheaths. These animals have four gills instead of two, and they have no ink-bag; otherwise, their internal structure is not unlike the other class.

The Dibranchiate cephalopods are of higher organism than the nautilus. They have been called Acetabulifera, because of certain curious appendages to their arms. Their arms are not short, numerous, and retractile within sheaths, as those of the nautilus are, but of definite number (eight or ten), long, and on their inner sides—that is, towards the mouth—they are studded with a single or double row of *acetabula*. The word *acetabulum* is the ancient name given to a vinegar-cruet, and was first applied anatomically to the hollow in the pelvis into which the head of the thigh-bone of man is received. Since then it has always been applied to any cup-like organ which has a deeper depression in the centre of the cup. These cups are sometimes stalked, and sometimes set directly to the arms. The cup is of a cartilaginous consistence, while in the pit there is a leathery piston, which can be retracted by proper muscles after the round edge of the cup has been applied to any object. When the piston is retracted it of course creates a vacuum in the cup, and as there are many hundreds of these cups on the arms of the animal, it can lay a very firm hold on its prey, and drag it with great force towards its beak-like mouth. Besides the cup-like discs, or suckers, the arms of some of the cephalopods are furnished with horny hooks, which assist in retaining the prey. Unlike the nautilus, the jaws of the œtopus are horny and sharp, like the bill of a parrot, only the lower jaw protrudes beyond the upper one.

The shell of these creatures is far less developed than in the other division of this class. For the most part, it is not apparent at all on the outside, but lies loose in the muscular skin of the back, which it supports, and thus provides that the animal can be thrust along by the working of the siphon or by the fins. In the paper nautilus, however (*Argonauta argo*), there is a beautiful external shell, which is not divided into chambers. This shell, though it lodges the bag-like body, has no sort of likeness in form to the shape of the body. Thns, when it was naturally supposed that the shell was secreted, as in the case of the other Mollusca, by the mantle, or investment of the body, naturalists could not imagine how so beautiful a structure was moulded on so uncouth a form. It has since been ascertained that the shell is formed by two of the arms, which have a large membranous expansion fitted to secrete such a shell. Before the office of these arms was known, they gave rise in their turn to false conjectures, for it was then thought that this creature sat in its shell as in a boat, and, lifting the webbed arms above the surface of the ocean, was driven along as a ship by its sails. In the other octopods there is no representative of a shell, either external or internal. In some of the decapods it is horny, and in the shape of a pen. In others it is calcareous and thick, but nevertheless it is very light, being quite porous, and made up of very thin plates supported by little pillars. This is the case in the pounce-bone of the sepia. In others, again, as in spirula, the shell, though internal, is chambered, and is supposed, as in the case of the chambered shell of the nautilus, to contain air, which lightens the body and can be compressed when the animal wishes to sink. A number of curious fossils, called *belemnites*, on account of their resemblance to the head of a dart, have been identified as the prolongations of these internal chambered shells, and as these have been sometimes found associated with the hooks and ink-bag found in the cuttle-fish, there can be little doubt about the identification being genuine. The relation of the shell to the extinct animal is shown in the engraving. The funnel or siphon of the Dibranchiata is entire, and not split along its under side. It leads into a gill-chamber, into which also the ova and fæces are discharged. The buccal mass is globular and large. The tongue bears teeth directed backward, but is in part naked, and seems like an organ of taste. The narrow throat leads into a globular stomach or crop. Into the stomach a large blind sack enters, and the intestine is short, as is usually the case with carnivorous animals, as these are. The circulatory system is peculiar in being almost a closed circuit, and in having, not only a heart distributing the blood to the system, after being aërated at the gills, but also in having two distinct hearts driving the blood to the gills. The blood is conveyed to these branchial hearts through two large venous canals, whose walls have a spongy texture. These large veins are supposed to excrete from the blood, by means of the spongy walls, the ammoniacal liquid equivalent to the urine, and since the vessels lie in the water introduced through the funnel and gill-chambers, of course this could become a means of getting rid of matters no longer useful from the nutritive stream. The ink-bag is a peculiar organ situated in the recesses of the body, the duct from which is conveyed up and opens behind the funnel. The secretion is under the control of the animal, and when formed it thickens and obscures the water by a copious discharge. It is said that the Chinese made ink from this secretion, and it is still used as a pigment.

The whole of the Cephalopoda, both recent and extinct, may be classified thus:—

TETRABRANCHIATA.—Eyes stalked, jaws shelly, and body attached to the shell by a muscle; gills, four.

Family 1.—*Ammonitidæ:* Shell of many chambers; that containing the body elongated, the aperture guarded by processes, and closed by an operculum; sutures angulated, and siphuncle* external (or dorsal).

Family 2.—*Orthoceratidæ:* Shell with a small narrow aperture; siphuncle complicated.

Family 3.—*Nautilidæ:* Sutures simple; siphuncle central.

DIBRANCHIATA.—Eyes sessile; jaws horny; two gills; an ink-bag.

Tribe I.—OCTOPODA: Eight arms; eyes fixed.

Family 1.—*Argonautidæ:* Dorsal arms webbed; female with a shell.

Family 2.—*Octopodidæ:* Arms webbed between the roots.

Tribe II.—DECAPODA: Eyes movable; body finned.

Family 3.—*Teuthidæ:* Fins nearly at the end of body.

Family 4.—*Belemnitidæ:* Shell represented by a pen, terminating in a chambered cone; siphuncle on the ventral side.

Family 5.—*Sepiadæ:* Calcareous gladius; elongated tentacles.

Family 6.—*Spirulidæ:* Discordal, pearly, many-chambered shell, with ventral siphuncle.

LESSONS IN CHEMISTRY.—XXVI.

METALS PROPER—*continued.*

GOLD.

SYMBOL, Au—COMBINING WEIGHT, 196·5—SPECIFIC GRAVITY, 19·3.

THIS, the most valued of metals, is always found in a native state, frequently alloyed with small quantities of silver, copper, and some of the rarer metals. Generally its matrix is quartz rock, but by aqueous action this rock becomes degraded into sand, and the gold is carried down to the river-bed. From this source it was chiefly obtained before the discovery of the Californian and Australian gold-fields. It is separated from the sand by "washing"—that is, the sand, largely mixed with water, is allowed to run from one "cradle" to another, the light sand being thus washed away, and the heavy particles of gold remaining. In California and Australia the metal is found in lumps—"nuggets"—which have every appearance of having been fused; or it is extricated from the quartz. The rock is crushed, and the gold separated by "washing." The process of amalgamation has also been resorted to. The crushed quartz is mixed with mercury, which takes up the gold. The metals are afterwards separated by distilling off the mercury.

Gold is one of the heaviest of the metals, being only inferior to iridium and platinum. It is very malleable, being capable of being beaten out so thin as to allow green light to pass through it.

It is very soft. Bracelets of pure gold can be twisted round the arm. It melts at 1100° Cent.

No simple acid, except selenic, will dissolve it; but it is acted on by any mixture which liberates chlorine. Such a mixture is "aqua regia," which is composed of 1 of nitric and 4 of hydrochloric acid. The result of this action is auric tri-chloride ($AuCl_3$).

From this salt pure gold may be obtained by precipitating the metal from its solution by ferrous sulphate, according to this equation:—

$$3FeSO_4 + AuCl_3 = FeCl_3 + Fe_2 3SO_4 + Au.$$

The gold falls as a brown powder, which is purple by transmitted light. Oxalic acid and the chloride of antimony have a like effect to ferrous sulphate.

Gilding is effected by causing gold-leaf to adhere to the sur-

* By siphuncle is meant the tube connecting the chambers of the shell.

face of the article by means of an adhesive varnish; but in the case of metallic articles the gold is precipitated by various means on their surfaces.

The method introduced by Mr. Elkington is simple. Dissolve 1 part of auric tri-chloride, the common "chloride of gold," in a little water. Add to it 20 parts of the bicarbonate of potash very gradually. An equal portion of the bicarbonate is dissolved in 150 parts of water. The two solutions are mixed together and boiled for two hours. The articles to be gilded are dipped for an instant in a mixture of equal parts of sulphuric and nitric acids, to free their surfaces from any trace of oxide. They are removed rapidly into water and washed, and then immersed in the hot gilding solution. If the gold is required to appear dead, a little salt is added to the acids which remove the oxide. Articles of silver or German silver may be gilded in this bath by joining them to a zinc or copper wire and immersing both.

This process has its defect in the fact that as soon as the surface is coated with gold, which is very thin, the deposition is arrested. Hence electro-gilding has superseded it.

In order to render gold sufficiently hard to withstand the wear and tear of use, it is always alloyed. The standard gold is composed of 1 part of copper to 11 of gold.

The *oxides of gold* are the sub-oxide (Au_2O) and *auric oxide* (Au_2O_3), sometimes called auric acid. The former is precipitated as a green powder when a dilute solution of potash is added to a solution of the chloride of gold. The latter falls as a brown powder when magnesia is added to a solution of the terchloride of gold. Sunlight will decompose this oxide into oxygen and gold. When treated with ammonia, fulminating gold is formed.

The *chlorides of gold* correspond with the oxides, being *auric chloride* ($AuCl$) and *terchloride* ($AuCl_3$).

The chloride is got by exposing the terchloride to a temperature equal to the fusing point of tin. Two atoms of chlorine are thus liberated, and the terchloride is reduced to a monochloride. The preparation of the terchloride has been indicated. It is a deep-coloured, yellow crystalline powder. It is the most important of the auric salts, and is used in photography to impart to photographic prints their purple tone.

PLATINUM.

SYMBOL, Pt—COMBINING WEIGHT, 197·4—SPECIFIC GRAVITY, 21·5.

Like gold, platinum is always found in a native state. It is frequently alloyed with gold and silver, and generally with the five rare metals—palladium, rhodium, osmium, ruthenium, and iridium. The mines of Mexico and Brazil produce the metal, but it is chiefly obtained from the gravel deposits at the foot of the Ural Mountains.

On account of its great infusibility it is difficult to procure.

The chemical method devised by Wollaston consisted in dissolving the metal by means of aqua regia. The platinum, mixed with some little iridium, is precipitated from the clear liquid by means of sal-ammoniac, when it falls as a yellow insoluble powder, whose composition is $2NH_4Cl,PtCl_4$. By heating this the chlorine and ammonia are expelled, and the platinum left behind in a porous mass, which is *spongy platinum*. To get the metal in a solid form, this porous mass is reduced to powder and washed. The powder, which is of a dull grey colour, is now submitted in a mould to hydraulic pressure, and it assumes the appearance of a metallic bar. This bar is heated in a wind furnace, and forged by hammering it upon its ends. Platinum possesses the same property as iron; it can be *welded;* that is, when hammered at a high temperature, the particles of the metal unite into a solid mass.

Deville and Debray procured solid platinum by submitting the grains of metal, previously purified by digesting in nitric acid, to fusion in a lime crucible, in the flame of the oxy-hydrogen blow-pipe.

Properties.—Its specific gravity is very high, being only inferior to that of iridium. It does not tarnish under any circumstances when exposed to the air, and cannot be attacked by any simple acid. Hence it is much used in the laboratory for crucibles. Aqua regia, however, converts it into a chloride. Very large and expensive crucibles—some cost £2,000—are used to carry the condensation of sulphuric acid through its last stage. It possesses great ductility, and expands less by heat than any other metal. It has the peculiar power of condensing gases on its surface, and when a jet of hydrogen is directed upon a piece of spongy platinum it is ignited; because the oxygen condensed in the pores of the platinum, being then in a more active condition, combines with the hydrogen, and the heat developed is sufficient to ignite the gas. This property is advantageously used in the Davy lamp. Above the wick is a coil of fine platinum wire, and when by any accident the flame is extinguished, the vapours of the hydro-carbons rising from the wick combine with the oxygen on the surface of the platinum, and thus the wire is rendered red-hot, and the lamp re-lighted.

Platinum combines readily with other metals, and phosphorus at high temperatures.

When fused with potash or soda, in contact with the air, it will oxidise. There are two oxides, *platinous oxide* (PtO) and *platinic oxide* (PtO_2). They are procured by the precipitation of corresponding salts by a regulated quantity of alkali. Both oxides are soluble in an excess of the alkali.

There are sulphides of a like composition to the oxides.

The chlorides are the most important salts.

When the metal is dissolved in aqua regia a red solution is obtained, which consists of a tetrachloride ($PtCl_4$), *platinic chloride*. When evaporated to dryness a salt is procured, which has two molecules of hydrochloric acid in it ($PtCl_6H_2$) at 230° C. This acid is given off, and also two atoms of chlorine, leaving *platinous chloride* ($PtCl_2$). At a still higher heat the metal is reduced.

Platinic chloride is of great service in analysis in determining the quantity of potash or ammonia present in a solution.

It forms with both these, sparingly, soluble salts.

In the case of potash, when the salt is submitted to a red heat, metallic platinum and potassium chloride are left; but with the ammonia salt nothing but the metal remains. The action of ammonia on platinous chloride is remarkable. Many salts are formed by an atom of platinum replacing some of the hydrogen of the ammonia; but these salts are of more interest in a theoretical than a practical light.

With platinic chloride any of the potassium salts give a yellow precipitate; but with sodium salts a brown hydrated oxide falls. With ammonia salts the yellow precipitate above alluded to appears, which on heating may be distinguished from the potassium precipitate. By this means these three alkalies may be recognised. Platinum is not reduced from its solutions as gold is by ferrous sulphate or oxalic acid.

The rarer metals associated with platinum do not require notice.

READINGS IN LATIN.—I.

SELECTIONS FROM CÆSAR.

THE student will now be anxious to read more lengthy extracts of the Latin authors, of which he has at present only come across separate sentences. The large number of these authors, and the great length of their writings, will prevent his gaining, except at the expenditure of a great deal of time and trouble, anything like a general acquaintance with their style and character; and, accordingly, it is with this object that we propose to give a series of extracts from those writers who are generally included in the course of study of this language. We shall take the different authors one by one, giving a slight sketch of the subject of their writings, and their special peculiarities of diction, and adding extracts from them for the student to translate. To each of the extracts will be appended short notes, explanatory of such difficulties as the student will not be likely to be able to solve merely by the aid of his Latin Dictionary and the Latin Lessons; while in each case a translation of one at least of the passages selected will be given along with the succeeding set of extracts, sometimes from original sources, sometimes from published translations of acknowledged merit.

It is to be observed that these readings may be made useful in more ways than one for acquiring a knowledge of Latin. They should be first translated literally, and then rendered into idiomatic English; and this second translation should be retranslated into Latin, and when it is done, compared with the original. We cannot impress too strongly upon the student the advantages of this course of proceeding; he will find that his mind will gradually become stored with Latin phraseology, and his own style of writing Latin composition will have the advantage of being formed upon the best models. We should add that this system is most readily applicable to the prose extracts, though it will be found of great service also in verse-making.

CÆSAR.

Our first extracts are taken from the writings of Cæsar, an author whose works, from the simplicity of their style, are usually put into the hands of beginners. The author was the famous Roman general, Caius Julius Cæsar, the founder of the Roman Empire, though never actually emperor himself. His chief warlike exploits were his subjugation of Gaul (now France and Switzerland) and Britain, and his best-known work, "The Commentaries on the Gallic War," is a brief compilation of the notes which he kept during the course of his campaigns. It has been observed of them that they are "a series of sketches taken on the spot, having all the graphic power of a master-mind, and the vigorous touches of a master-hand." The narrative is clear and simple, and scarcely any difficulty in the language presents itself. The first extract is from an account of a battle with the Helvetii, who lived in the modern Switzerland and the south of France.

CÆSAR.—"DE BELLO GALLICO," Lib. I. cap. xxv.

Cæsar, primum suo,[1] deinde omnium ex conspectu remotis equis, ut æquato omnium periculo[2] spem fugæ tolleret, cohortatus suos,[3] prœlium commisit.[4] Milites, e loco superiore pilis[5] missis facile hostium phalangem[6] perfregerunt. Eâ disjectâ,[7] gladiis destrictis[8] in eos impetum fecerunt. Gallis magno ad pugnam erat impedimento,[9] quod, pluribus eorum scutis uno ictu pilorum transfixis et colligatis, quum ferrum se inflexisset, neque evellere neque, sinistrâ impeditâ, satis commode pugnare poterant, multi ut, diu jactato[10] brachio, præoptarent[11] scutum manu emittere, et nudo corpore pugnare. Tandem vulneribus defessi, et pedem referre,[12] et quod mons suberat circiter mille passuum,[13] eo se recipere cœperunt. Capto monte et succedentibus nostris, Boii et Tulingi, qui hominum millibus[14] circiter xv agmen hostium claudebant, et novissimis[15] præsidio erant, ex itinere nostros latere aperto aggressi, circumvenere.

NOTES.

1. Suo agrees with conspectu. *First out of his own sight, then out of the sight of all.* The possessive adjectives, suus, meus, tuus, are used always in preference to the genitives, sui, mei, tui, of the personal pronouns.
2. Remotis equis, æquato periculo, abl. absolute. There are other examples in this extract.
3. Suos, *his men:* understand milites.
4. Prœlium committere, *to join battle*, to engage.
5. Pilis, *long javelins.*
6. Phalangem, *the thick array.* The phalanx was an order of battle array in use among the Greeks, in which the soldiers were massed thick together; and thus it is applied by Cæsar to the thick mass in which the Gauls fought.
7. Disjectâ, *cast different ways (dis jacio), dispersed.*
8. Destrictis (from de stringo, to strip off, like leaves off a branch), *with drawn swords.* Another abl. abs.
9. Gallis magno erat impedimento, *it was a great hindrance to the Gauls.* A double dative after *erat.*
10. Ut diu jactato, *considering that their arms had long been tossed about.*
11. Præoptarent, *wished anxiously;* præ, before anything else.
12. Pedem referre, *to carry back the foot, to retreat.* Compare pedem inferre, to march upon.
13. Mille passuum, *a thousand paces,* about our *mile.* The word mile owes its derivation to this.
14. Millibus, ablative of the instrument by which a thing is achieved.
15. Novissimis, *the newest,* so *the last, the hindmost.* Novissimis præsidio, a double dative. Compare Gallis impedimento, above.

The following describes the commencement of a war with some Alpine tribes :—

CÆSAR.—"DE BELLO GALLICO," Lib. III. cap. ii.

Quum dies hibernorum[1] complures transissent frumentumque eo[2] comportari jussisset, subito per exploratores[3] certior factus[4] est, ex ea parte vici, quam Gallis concesserat, omnes noctu discessisse, montesque, qui impenderent, a maxima multitudine Sedunorum et Veragrorum[5] teneri. Id[6] aliquot de causis acciderat, ut subito Galli belli renovandi legionisque opprimendæ consilium caperent: primum, quod legionem, neque eam plenissimam,[7] detractis cohortibus duabus, et compluribus singillatim, qui commeatus petendi[8] causa missi erant, absentibus, propter paucitatem despiciebant: tum etiam, quod propter iniquitatem[9] loci, quum ipsi ex montibus in vallem decurrerent et tela conjicerent, ne primum quidem posse impetum suum[10] sustineri existimabant. Accedebat,[11] quod suos ab se liberos abstractos obsidum nomine dolebant: et Romanos non solum itinerum causa, sed etiam perpetuæ possessionis,[12] culmina Alpium occupare conari et ea loca finitimæ[13] provinciæ adjungere, sibi persuasum habebant.

NOTES.

1. Hibernorum (sc. castrorum), *winter quarters;* here used of the time spent in them.
2. Eo, *thither*, to the hiberna castra.
3. Exploratores, *scouts.*
4. Certior factus, *he was informed;* in the active, certiorem facio, I inform; lit., I make more sure.
5. Sedunorum, Veragrorum, names of tribes who lived in the neighbourhood of Geneva and the valley of the Rhone.
6. Id, *it*, refers to the next clause, ut subito Galli—caperent; it, namely, the fact of the Gauls' sudden determination.
7. Plenissimam, and that not at its full strength. The reason for its weakness is explained by the two following ablatives absolute.
8. Commeatus petendi. The participle in *dus* agreeing with the substantive is used by the Latin authors generally in preference to the gerund governing a case.
9. Iniquitatem (in-æquus), unevenness of the ground.
10. Suum, *theirs;* namely, the Gauls'. The reciprocals *sui* and *suus* always refer to the subject of the principal verb in the sentence. Here the subject of the principal verb, *existimabant*, is *Galli* understood.
11. Accedebat. The nominative to this verb is the sentence quod—dolebant. *There was this additional reason* (lit., this was added)—supply *for their defection—that they grieved.*
12. Possessionis, genitive after causâ.
13. Finitimæ, *neighbouring;* i.e., to the Roman territory.

The next extract describes Cæsar's landing in Britain, which was not achieved without some difficulty. The Britons were drawn up on the shore to repel their attack, and prevent the possibility of their coming to land. The historian proceeds as follows :—

CÆSAR.—"DE BELLO GALLICO," Lib. IV. cap. xxv.

Quod ubi Cæsar animum advertit,[1] naves longas,[2] quarum et species erat barbaris inusitatior, et motus ad usum expeditior,[3] paullum removeri ab onerariis[4] navibus et remis incitari et ad latus apertum[5] hostium constitui, atque inde fundis,[6] sagittis, tormentis,[7] hostes propelli ac submoveri jussit: quæ res magno usui nostris[8] fuit. Nam et navium figura, et remorum motu, et inusitato genere tormentorum permoti barbari constiterunt, ac paullum modo pedem retulerunt. Atque nostris militibus cunctantibus,[9] maxime propter altitudinem maris, qui decimæ legionis aquilam[10] ferebat, contestatus deos, ut ea res legioni feliciter eveniret: Desilite, inquit,[11] commilitones, nisi vultis aquilam hostibus prodere: ego certe meum reipublicæ atque imperatori[12] officium præstitero.[13] Hoc quum magna voce dixisset, ex navi se projecit atque in hostes aquilam ferre cœpit.[14] Tum nostri, cohortati inter se, ne tantum dedecus admitteretur,[15] universi ex navi desiluerunt: hos item alii ex proximis navibus quum conspexissent, subsecuti hostibus adpropinquarunt.

NOTES.

1. Animum advertit, used for the compound animadvertit, is to be looked upon for the purposes of construction as one word, *turned his mind to, observed,* and governs quod, *which thing,* viz., the advantage which the Britons possessed in being drawn up on the shore.
2. Naves longæ, *ships of war.* So called from the shape in which they were built.
3. Expeditior, *more handy, manageable.*
4. Onerariis, *ships of burden* (onus).
5. Apertum, *exposed,* open to attack.
6. Fundis, *slings.*
7. Tormentis, engines for hurling (*torqueo*) missiles.
8. Magno usui nostris, *a great aid to our men.* Double dative after fuit.
9. Militibus cunctantibus, ablative absolute, *when the soldiers were delaying.*
10. Qui aquilam ferebat, *he who bore the eagle, the standard-bearer* (the eagle was the standard of the Roman legions). This supplies the nominative to inquit.
11. Inquit is only used when the exact words of the speaker are quoted, and never stands as the first word in a sentence. Aio, *I affirm,* follows much the same rules.
12. Imperatori, *the general;* originally applied, as here, to the general of an army, who was invested with supreme military command (*imperium*). Afterwards it was used to denote the absolute sovereigns of Rome, the Emperors.
13. Officium præstitero, *I will be sure to do my duty by.* Officium præstare alicui, to do one's duty by any one. The future perfect, *I shall have,* is used to give additional force, *I shall certainly.*
14. Aquilam ferre cœpit, *went, standard in hand, against.*
15. Cohortati, etc., *having admonished one another not to allow of such a disgrace.*

PARSING EXERCISE.

Parse *jussit, constiterunt, retulerunt, vultis, desiluerunt, subsecuti.*

CIVIL SERVICE PAPERS.—I.

INTRODUCTION.

It is the intention, in the series of papers that will follow upon the subject of the Civil Service, to explain as fully as is necessary for all practical purposes, not only what the Civil Service is, but how to get into it. The various branches of the service will be pointed out, their relative importance will be explained, and the most accurate information will be given as to open competitions, the means of obtaining nominations where required, as to the examinations to be passed, as to the salaries given, and as to the nature of the duties which devolve upon successful candidates after admission into the service. The aim and object of this series of papers is to enable those who have not other means of knowing, to ascertain for themselves what the conditions of service are, and to put them in the way of working up to the standard of educational requirements, without being necessarily driven to employ expensive assistance; and to place in the hands of the thousands who draw the means of self-education from the POPULAR EDUCATOR, the further means of turning their education to account in an honourable and useful way.

The Civil Service is the office-staff of the country. Over every important department of State is placed a minister of the Crown, responsible to Parliament, and changing with the Government; but, for the purposes of actual administration, there are under each minister a number of sub-departments which are charged with the execution of details, with carrying out the orders of the minister, and with the performance of all business naturally pertaining to his branch of government. Thus, the War Office, with its sub-departments, is charged with the transaction of all business pertaining to the army, the Admiralty with all naval matters, the Treasury with all affairs relating to the public income and expenditure. These offices are manned by persons on what is called the establishment, which includes both the directors and the doers of departmental business, the secretaries, heads of departments, and the clerks, assistants, and writers. The aggregate of these "establishments" is the Civil Service.

How does one get into it? At one time the process was perfectly easy for those who possessed influence enough to get nominations. Nomination carried with it the appointment; the idea—if there was any definite idea on the subject—being that the minister would not nominate any one who was not competent for the post. As a matter of fact, however, ministers *did* appoint persons who were often notoriously unfit; they rarely appointed any one because of special fitness, but gave nominations to their friends and those for whom their friends asked, without inquiring into the qualifications of the candidates. Appointments in the Civil Service were looked upon as a means of repaying political adherents for service done, and as a means also of providing for the needy sons of "good families" on friendly relations with the minister. Whether the public service was helped or not was a secondary consideration, and no steps were taken to justify, by examination or otherwise, the nomination of the minister. For some years before the Civil Service Commission was instituted, there was a practice in some of the offices by which nominees underwent a *pro formâ* examination, after admission, by the chief clerk of the department to which they were accredited. But this examination was of the very slenderest kind, and consisted more in ascertaining by whose interest the candidate had come in than in finding out what ideas he had, or how much or how little his education had fitted him for the service.

In the year 1855 the principle was recognised that, in the interests of the public service, candidates for appointments should be subjected to examination after receiving a nomination, and not be appointed until the minister nominating should have had a certificate from the examiners of the fitness of the candidates. As an expression of this principle, the Civil Service Commission was issued to certain well-qualified persons, who were empowered to erect educational standards of efficiency, and to try all candidates by such standards. The principle of nomination was retained, but nominees were tested either with reference to the standard only, or with reference to their relative merits in a competitive examination. The Commissioners communicated with every branch of the public service, and ascertained from heads of offices the subjects in which candidates for the respective departments were required to be proficient; and having ascertained what was wanted, arranged examinations accordingly, and the practice is now (in cases where nominations are given) to send with them notice to attend before the Civil Service Commissioners, who arrange, as a matter of course, for the examination to take place. Examinations for all offices in London take place in London; for Scotland, in Edinburgh; for Ireland, in Dublin. The offices of the Commission are in Cannon Row, Westminster.

This mode of making presentations lasted until 1870, when an Order in Council was published, throwing open to competition appointments in a large number of the departments. After the 31st of August in that year, admission to clerkships in any of the departments named in the Order could only be obtained by those persons who had passed certain examinations, and who possessed the requisite health, character, and other qualifications stated. No personal influence was of the slightest avail, and the competition was open, limited only by the conditions we have named, to every natural-born subject of the Queen. By this important Order in Council, about two-thirds of the public offices in this country were removed from the sphere of patronage, and offered honourable and useful careers to young men of energy and ability, whatever their previous position in life. It was no longer necessary to seek assistance, to depend upon private friendship or political connection, to sacrifice independence in the expectation of substantial reward for subserviency. Any youth who had received a fair elementary education, and would devote a couple of years to systematic study, might reasonably hope to receive an appointment which would afford him a progressive income, and opportunity for attaining a higher and more remunerative position in the service, if his abilities were commensurate. In order still further to ensure that the appointments were conferred upon fit persons, successfully passing the competitive examination was not made an absolute passport to permanent employment, but a six months' probation in the office to which the candidate was appointed was established, as a test not only of the ability, but also of the regular habits and other personal qualifications of the young official. That period creditably passed, it might be considered that the appointment was secured, except of course, in the case of misconduct, infirmity, or other reasonable cause for dismissal.

This system of open competition applies to all the principal departments, with the exception of the Foreign Office and the Post Office. In the latter office, however, the clerkships in the Secretary's department are thrown open to competition. In what may be styled the closed, or, in official language, the nomination departments, appointments can only be obtained by personal influence with the ministerial heads of departments, and even when nominations are obtained a rigorous examination must be passed before the nominee is established in the office. Vacancies are comparatively few, and when one occurs there are many applicants for the position, each backed up by private influence. In the course of these papers we shall afford full particulars of the qualifications the applicants must possess, and the examinations they will be called upon to pass; but readers of the POPULAR EDUCATOR must have a far greater interest in knowing what appointments can be obtained by ability and perseverance, and what steps are to be taken to secure them. We shall, therefore, at once describe the principal features of the Open Competition scheme.

As a preliminary, we may state that the appointments to be competed for are divided into two classes, called respectively Class I. and the "Lower Division," "the former to be filled by candidates of a high order of educational attainments, the latter by persons of less mature age and less extended acquirements." These are the words of Her Majesty's Civil Service Commissioners; and it will be seen that the arrangement is highly advantageous to the candidate. All situations in the Civil Service do not demand the same range of educational acquirements, and inferior appointments are thus opened to persons who are well qualified to perform the required duties, although they might not be able to attain the level necessary to be reached by those who aspire to positions requiring high educational qualifications.

Public notice is given by advertisement in the principal newspapers of the intention of the Civil Service Commissioners to hold examinations, on certain days, in London, Edinburgh, and Dublin; and at least ten days before the day fixed (or at such period as may be named in the advertisement), persons desirous of becoming candidates must apply to the Civil Service Commissioners, by letter, in their own handwriting, addressed to the office, Cannon Row, Westminster, for permission to attend the preliminary examination. A reply will be received, containing instructions as to the time and place of examination, fees, etc., and a paper which must be filled up, for the purpose of satisfying the Commissioners that the applicants possess the following qualifications for candidature:—

1. That they are natural-born subjects of Her Majesty.

2. That they are not less than eighteen or more than twenty-four years of age on the first day of the competitive examination. (For "Lower Division" examinations the limits of age are seventeen and twenty. Members of the military and naval services will be considered to have, on leaving their former service, the same age as when they entered it.)

3. That they possess good health and character.

4. That they have not previously been selected candidates, and declined to accept the situations offered them, or have been actnally employed in the Civil Service.

Having established his right to compete, the candidate pays a fee (of £1, if competing for a first-class appointment, or 10s. for the lower division), and attends the preliminary examination. This is only for the pnrpose of preventing the time of the gentlemen who conduct the competitive examinations being wasted on candidates quite unqnalified to compete. This is a reasonable precaution, to which none can objeet, and as the snbjects are limited to handwriting, orthography, elementary arithmetic, and English composition, no person who has any chance of succeeding when the real competition comes, is likely to be excluded. This preliminary examination having weeded out the entirely incompetent, the candidate must prepare himself for the next test of his ability. First he must decide whether he will try for appointments included in Class I. or Class II. Let ns suppose that he enters for the higher prize; if so, he is called upon to pay a fee of £5, and having done so, he must prepare himself for examination. It is possible, but certainly not very probable, that he may attain the full number of marks appended to each subject; but he may comfort himself with the assnrance that a nnmber considerably nnder that amount will be considered creditable, and unless he is associated with wonderfully clever and well-informed competitors he will probably pass. The marks obtained by each candidate are added up, and those candidates (the number in accordance with the appointments then vacant) who obtain the highest number of marks are the selected candidates.

The competitive examination will take place in the following branches of knowledge:—

		Marks.
English Composition (including Précis-writing)		500
History of England—including that of the Laws and Constitution		500
English Language and Literature		500
Language, Literature, and History of	Greece	750
,, ,, ,,	Rome	750
,, ,, ,,	France	375
,, ,, ,,	Germany	375
,, ,, ,,	Italy	375
Mathematics (pure and mixed)		1,250
Natural Science; that is (1) Chemistry, including Heat; (2) Electricity and Magnetism; (3) Geology and Mineralogy; (4) Zoology; (5) Botany		1,000
_ The total (1,000) marks may be obtained by adequate proficiency in any two or more of the five branches of science included under this head.		
Moral Sciences; that is, Logic, Mental and Moral Philosophy		500
Jurisprudence		500
Political Economy		375

None of these snbjects is obligatory, and, indeed, proficiency in all is scarcely to be expected. It will be better, therefore, that the candidate should select those subjects with which he is best acquainted, and not attempt too many. But he mnst at the same time remember, that a certain number of marks must be obtained before he can hope to succeed, and that those who can acquit themselves creditably in the widest range of snbjects will probably achieve the highest total. The examination, which extends over sixteen or seventeen days, is conducted by printed questions, to which written answers must be given, and by verbal questions which the examiners may think fit to put, to ascertain whether the candidate possesses a competent knowledge of the subject in hand, or has been merely "advanced" for the occasion. It must be understood that, unless a great acquaintance with the subject is exhibited, no marks will be allowed. The candidate must trust entirely to his memory, as he will not be permitted to refer to any book or memorandum, and any attempt to do so, or to "look over" another candidate, would lead to his being immediately removed from the list of candidates.

The examination for appointments under Class II. is held under precisely similar conditions, but the list of subjects is adapted to persons less highly educated, and, as in the superior grade, none of the subjects are obligatory. The fee for this examination is 10s., in addition to the preliminary fee of 10s. The following are the subjects:—

1. Handwriting.
2. Orthography.
3. Arithmetic.
4. Copying MS. (to test accuracy).
5. English Composition.
6. Geography.
7. Indexing or Docketing.
8. Digesting Returns into Summaries.
9. English History.
10. Book-keeping.

As we have explained, the number of candidates selected depends upon the number of appointments vacant. The selected candidates will be entitled to choose, in the order of their precedency, the particular departments and situations to which they desire to be appointed, provided they are duly qualified according to the special rules applicable to each department, which are settled by the Civil Service Commissioners and the chief authorities of the department, subject to the approval of the Treasury. In case of a vacancy occurring in a department for which no one on the list is in all respects qualified, the Commissioners either hold a special open competition for the appointment, or offer it to the candidate highest at the time on the list of selected candidates, subject to his passing a qualifying examination within such period as they may determine,

A few hints as to the preparation for these examinations may be advantageons. It is well, if the expense can be afforded, to employ "a coach," or a tutor whose special business it is to edncate candidates up to the mark of proficiency. A "coach" knows the stock questions, and knows also the trick and style of each particular class of examination; and where cramming is necessary, it is almost indispensable to employ such help. But it is far from being essential. Any one who has thoronghly mastered his subjects, whether by private study or tuition, has no need to fear the most artfully-contrived questions. It is quite competent to a diligent private stndent, working with such material as the POPULAR EDUCATOR furnishes and points out to him, to qualify himself for an examination of one of the better sort of offices in the Civil Service. In addition to testing his power by such specimens of examination papers as we have been enabled to provide, let him get as many of the papers as possible, and make a habit of going right through them, getting, if possible, some able friend to look over his answers for him, and to set him right when in error. Examples of the papers are contained in the Annual Reports of the Civil Service Commissioners, which can be obtained at the office for the sale of Parliamentary Papers, Great Queen Street, Lincoln's Inn Fields.

In dealing with the Government Offices for the purpose of these articles, the intention is to group them according to their standing, as this method will, we think, be more useful and instructive than the alternative mode of grouping according to their alphabetical order. In each instance we state whether appointments are obtained by open competition or nomination. When the former is the case, the examinations of candidates are conducted on the system we have jnst described. In the case of nomination departments we append particulars of the examinations required to be passed.

Group I. includes the Treasnry, the Home, Colonial, and Foreign Offices. In each case the full establishment of clerks is given (first-class and lower division), together with a list of the varions salaries.

*

GROUP I. (FOUR OFFICES).

1.—TREASURY, WHITEHALL.

Open Competition.

The business of the Treasury is to control the spending and revenue departments of Government; to decide upon all questions of principle affecting the revenue of the country; to prepare the ways and means, subject to the revision of Parliament, for carrying on the business of the country, and generally to influence, to a very large extent, the whole machinery of the administration.

The establishment and salaries are as follow:—

Four principal clerks, £1,000 to £1,200; 7 first-class, £700 to £900; 2 second-class, £250 to £600; 1 accountant, £600 to £800; 1 assistant accountant, £400 to £550. *Supplemental Establishment*—6 clerks, £250 to £500; 3 ditto, £225 to £350; 2 second-class, £100 to £200; 10 clerks (lower division), £80 to £200. *Solicitor's Office*—3 clerks, £100 to £300: and 1 (shorthand), £100 to £150.

2.—HOME OFFICE, WHITEHALL.

Open Competition.

This office carries on the ministerial part of the Government at home, is responsible for the preservation of the peace and safety of the inhabitants of the country, and is the supreme authority on all questions of internal policy. Age of admission for established clerks, 18 to 24.

The establishment and salaries are as follow:—

Three principal clerks, £900 to £1,000; 3 senior, £700 to £800; 7 junior, £200 to £600. *Account Branch*—1 clerk in charge of accounts, £400 to £600; assistant ditto, £310 to £400; 1 supplementary clerk, second-class, £100 to £250; 3 clerks (lower division), £95 to £250. *Statistical Branch*—1 statistical clerk, £350 to £500; 1 supplementary clerk, £100 to £250; 1 clerk (lower division), £90 to £250. *Registry and Copying Branch*—Superintendent, £350 to £500; superintendent of copying branch, £250 to £350; 9 clerks (lower division), £95 to £250.

Mineral Statistic Branch—1 clerk, £300; 1 ditto, £250.

Inspectors of Factories, Fisheries, Explosives, and Burials—4 lower division clerks, £95 to £250; 1 ditto, £80 to £200.

Messengers and office-keepers, for this as for all other departments, do not come under the system of open competition, but are appointed by nomination. They are required to be British subjects under 40 years of age, and previous to entrance upon their duties are examined in—

i. Reading.
ii. Writing from dictation.
iii. Elementary Arithmetic (the first four rules).

3.—COLONIAL OFFICE, WHITEHALL.

Open Competition.

The Colonial Office, governed by the Secretary of State for the Colonies, carries out the colonial policy of the country, instructs and supervises governors of British dependencies, and watches generally over the interests of the colonies. Age of admission for clerks, 18 to 24; for messengers and porters, 21 to 35.

The establishment and salaries are as follow:—

Four principal clerks, £900 to £1,000; 7 first-class clerks, £700 to £800; 11 second-class clerks, £250 to £600; and several special and lower division clerks.

In our next paper we shall describe the more elaborate examinations required for the Foreign Office, a very important nomination department.

In succeeding papers we shall give similar information respecting other principal offices, subordinate situations in connection with the Post Office and Telegraph Establishments, and specimens of examination papers.

It may save our readers some trouble if we inform them that any application to the Commissioners, except in the manner we have indicated would be fruitless, as they decline to advise candidates as to the course of reading, particular tutors, or places of education, or to give information as to salaries, duties, course of promotion, pensions, etc.

EXERCISES IN EUCLID.—I.

THE question is frequently asked, What is the utility of the geometrical element in mathematical studies? Without in any way attempting to discuss its merits, we content ourselves with giving the only satisfactory answer which can be given, that such studies are pursued, not for their results, but for the intellectual habits which they generate. The power to apprehend and the power to convince are both strengthened; the habit of clear and consecutive reasoning is developed by the successive stages through which the mind is conducted in the course of a geometrical investigation. It is our purpose, therefore, to aid our readers by giving them a series of exercises upon the various propositions of Euclid, consisting principally of "riders" which may be deduced from them. Each article will take a certain number of propositions, and the riders given will be deduced from them without assuming any subsequent ones. At the conclusion of each article the ground to be covered by its successor will be stated, and the enunciations given of those riders which will be proved, that the student may, if he so please, exercise himself beforehand, by attempting their solution. It may be mentioned here that the term "rider" is applied to a deduction from any proposition of Euclid because the deduction is borne up or supported by the mathematical reasoning worked out in the proposition, as a horseman, or *rider*, is supported or carried by the horse that he bestrides; or, in other words, that the proposition carries the deduction on top of it, as it were, pretty much as the horse carries its rider. This explanation of a term which is familiar enough to any Cambridge man, may be necessary for the information of many of our self-taught students who now meet with the apparently singular but decidedly appropriate expression for the first time.

We assume a knowledge of *definitions*, *axioms*, and *postulates*. *Definitions* are the explanations of terms to be used in the course of investigation; *axioms* are statements of things obvious to common sense; *postulates* are statements of things requisite, without which the investigation cannot be carried on. All those requisite for the first book are given at the commencement of any ordinary edition of Euclid's Elements, a book which, we presume, is in the possession of all who intend to follow us in these exercises. Those who have not yet provided themselves with a copy may obtain a useful edition issued by the publishers of the POPULAR EDUCATOR.*

It will be seen that some of the propositions are headed "Problem," some "Theorem." Strictly speaking, a "theorem" is the proof of a geometrical fact; a "problem" is the solution of some geometrical difficulty, or a method of executing some geometrical device which may aid us in the solution of "theorems." The riders which we shall give will be some "problems," some "theorems." In either case the method of solution may be thus indicated. We have certain given facts, and a certain end to be deduced from them. Taking first the facts, endeavour to argue from them towards the required end. Then, assuming the required end to be accomplished, endeavour to argue back from it to the original facts; and if some common ground can be found in which these processes meet in one, the problem is solved or the theorem is proved. Thus, if we were endeavouring to argue out for ourselves Prop. I., Book I., we have given a straight line A B, and have to find a point C, such that C A, C B, and A B shall be all equal. Assuming this accomplished, we see that A is the centre of a circle passing through B and C; and B is the centre of a circle passing through A and C. Thence our method is obvious.

Let us apply this method to the following proposition:—

PROPOSITION I.—If in the figure of Euclid I. 1 (Fig. 1), the circles cut again in F, and the line C F cut A B in G;

Then A G = G B; (β)
Angle A C G = angle B C G; (α)
And angles A G C, B G C are right angles. (γ)

Join A F, B F; then A C, A F are equal, being radii of the same circle (Def. 15). And for the same reason B C, B F are equal.

* Cassell's Euclid: being the First Six Books, with the Eleventh and Twelfth of EUCLID, edited by Prof. Wallace, M.A. Cloth limp, 1s. Cassell's Sixpenny Euclid (Books I. to IV.), paper 6d.; cloth, 9d.

But A C = B C; and by Axiom 1 things which are equal to the same thing are equal to one another. Therefore A C, A F, B C, B F are all equal. Then, in the two triangles A C F, B C F, since A C = C B, and C F is common, also base A F = base F B, therefore, by Euclid I. 4, the angle A C F = the angle B C F.

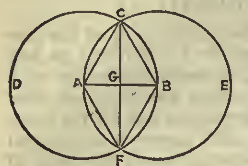


Fig. 1.

Hence the angle A C B is bisected by the line C F. (α)

Again, in the two triangles A C G, B C G, because side A C = side C B, and side C G is common, also included angle A C G has just been proved equal to included angle B C G, therefore, by Euclid I. 8,

Base A G = base G B. (β)

Again, in the two triangles A G C, B G C, because side A G = side G B, and side G C is common; also base A C = base C B; therefore, by Euclid I. 4, included angle A G C = included angle B G C. But these are adjacent angles which the straight line C G makes by standing on the straight line A B. Therefore, by Def. 10, each of them is a right angle. (γ)

This gives us at once the results of Props. IX., X., XI., and XII. of Book I.

PROPOSITION II.—In the figure of Euclid I. 2 (Fig. 2), required to draw from D a straight line D M N, cutting the circles in M and N, such that M N, the part intercepted between them, may be equal to A L or B C.

Suppose D M N to be thus drawn, then D N, D L, being radii of the same circle, will be equal; but M N, by the supposition, is equal to A L; and, by Axiom 3, if equals be taken from equals the remainders are equal. Therefore, if M N, A L be taken from D N, D L, the remainders D M, D A will be equal. Hence, if from D, as centre, we describe a circle, with D A as radius, cutting the small circle in M and joining D M, produce it to meet the large circle in N, D M N will be the line required; for, since D A, D M are radii of the same circle, D A = D M (Def. 15); and, since D L, D N are radii of the same circle, D L = D N. Therefore, by Axiom 3, if D A, D M are taken from D L and D N, the remainders A L, M N will be equal; that is, the part of D N intercepted between the circles will be equal to A L, and therefore equal also to B C. Q. E. F.

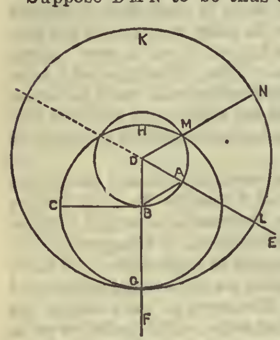


Fig. 2.

Corollary.—It is obvious that there will be certain limits beyond which the problem will be impossible. This will be the case when the circle described with centre D and radius D A does not cut the smaller circle. When it touches the smaller circle, there will be only one possible position for D M N, that of passing through the point of contact. When it cuts there will be two positions, as indicated in the figure by the dotted line.

PROPOSITION III.—On a given base A B (Fig. 3), to describe an isosceles triangle A B C, such that each of the sides A C, B C may be four times the base A B.

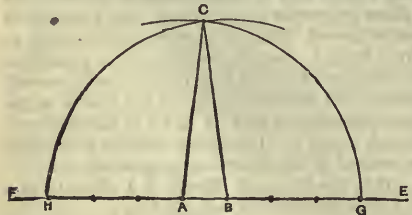


Fig. 3.

Produce A B both ways indefinitely to E and F, and from B E, the greater in the side remote from A, cut off B G equal to three times B A (I. 3), and from A F on the side remote from B cut off A H equal to three times A B (I. 3), then A G will be equal to four times A B, and B H will be equal to four times B A. From centre B, at distance B H, describe a circle (Post. 3), and from centre A, at distance A G, describe another circle, and let these two circles cut in C. Join A C, B C, then A B C shall be the triangle required. For since A C, A G are radii of the same circle, A C = A G; but A G = 4 A B, therefore A C = 4 A B. Similarly B C = B H = 4 A B; therefore A C = B C, and the triangle A B C is isosceles, and each of its sides equal to four times the base. Q. E. F.

PROPOSITION IV.—If A B C (Fig. 4) be an isosceles triangle, vertex A, and two points H, K be taken in the sides A B, A C, such that A H = A K, and if B K, C H meet in F, then A F bisects the angle B A C.

For in the triangles C A H, B A K, since A C = A B, and A H = A K, also the included angle C A B is common to the two triangles, therefore the base B K is equal to the base C H (I. 8). Again, in the triangles A C H, A B K, because A C is equal to A B and C H to B K, and also the base A H to the base A K, therefore the included angle A C H is equal to the included angle A B K (I. 4). But the whole angle A C B = whole A B C (I. 5), and, by Axiom 3, if equals be taken from equals the remainders are equal; therefore if A C H, A B K be taken from A C B, A B C, the remainders F C B, F B C will be equal, and consequently the side F C = side F B (I. 6). Then, in the two triangles C A F, B A F, because A C = A B and A F is common, also base F C = base F B, therefore also included angle F A C is equal to included angle F A B, that is, A F bisects the angle B A C. Q. E. D.

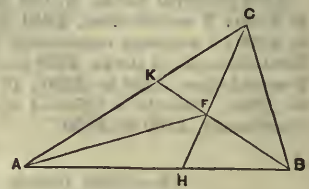


Fig. 4.

PROPOSITION V.—If A, B (Fig. 5) be two points on opposite sides of a line C D, required to find in C D a point E, such that the angle A E C may equal the angle B E C.

By means of Prop. I. we may draw A F perpendicular to C D. Produce A F to G (Post. 2), and make F G = F A (I. 3). Join G B, and produce it to cut C D in E, then E is the point required. Join A E. Then, since A F = F G, and F E is common to the two triangles A F E, G F E, also the included right angle A F E is equal to the included right angle G F E, therefore the base A E is equal to the base G E (I. 4). Again, because A E = E G, and F E is common, also base A F = base F G, therefore included angle A E F = included angle G E F (I. 8), therefore C D bisects the angle A E B. Q. E. F.

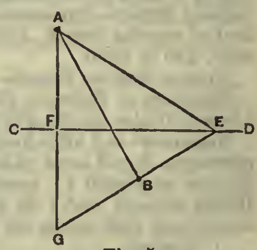


Fig. 5.

In the present paper we have used Book I. 1—8. In our next paper we shall use Book I. 1—16, and give solutions of the following propositions:—

PROPOSITION VI.—In the figure of Euc. I. 5, if G O at right angles to A G cut A H produced in O, H being the intersection of B G, F C, then O F shall be perpendicular to A F.

PROPOSITION VII.—If A C, the side of an isosceles triangle A B C, be bisected in D, and B D produced to E, so that D E = D B, then if A E be joined, the angle A E D shall be equal to the angle D B C.

PROPOSITION VIII.—If A B be two points on the same side of a given line C D, find in C D a point E, such that the angle A E C may be equal to the angle B E D.

PROPOSITION IX.—Given two straight lines A B, A C, intersecting in A, and another straight line D of limited length: required to form a right-angled triangle of which the base shall coincide with A C, one side shall coincide with A B, and the other side be equal to D.

PROPOSITION X.—In an isosceles triangle A B C, if A L be drawn from vertex A perpendicular to the base B C, and if A L be produced to M so that L M = L A, then shall B L be equal to B A.

PROPOSITION XI.—If in any triangle the sides A B, A C be bisected in L, M, and L O, M O be drawn at right angles to A B, A C, meeting in O, then O N, drawn perpendicular to B C, will bisect B C.

PROPOSITION XII.—In the figure of Euc. I. 9, if with centre A and radius A F, a circle be described cutting A B, A C in L M, then shall E L be equal to B M.

LESSONS IN ENGLISH LITERATURE.—I.

INTRODUCTION.

THE literature of England is a collection of works of art, each one of which may be studied separately, for the sake of its individual excellence, without regard to its connection with the rest, or the circumstances of its production. Such a study will develop the taste and judgment, and give pleasure in proportion to the capacity of the student; and it requires only diligence in reading, and sufficient discernment to appreciate what is read. All that a teacher can do to assist it, is to point out what are the works best worthy of study, and to call attention to some of their more prominent beauties. This service we hope to render to such students in the course of the following lessons, so far as our space permits us.

But those who would gain the full benefit of the study of English literature must regard it from a wider point of view. The literature of a country is one of the most instructive parts of its history. Every thoughtful student of history seeks to know not only what men have done, but what they have thought and felt. He seeks to know not merely the great external events of the period he is studying—the wars, the revolutions, the religious controversies, the social struggles—but also the motives which influenced men, the extent of their knowledge, their standard of right and wrong, their likes and dislikes: in short, he wishes to know not men's acts only, but men; and for this he must look chiefly to the literature they have left behind them. Every student of English literature, then, ought to endeavour, in all that he reads, to read not only beautiful poetry or eloquent prose, but history as well.

It is not merely that he will find historical facts embedded in what he reads, which he might not meet with elsewhere, though this is true. He will also find such facts related often by eye-witnesses, and therefore with all that freshness and vividness of description which stimulates the imagination and impresses the memory. He will, moreover, be able to observe for himself, and at first hand, what effect was produced upon men's minds at the time by the great events of history with which he is familiar.

All these things are of importance. But the connection between national history and a national literature lies much deeper still; and it is of the utmost importance that every student of literature should at the outset clearly realise it. Every one must observe that literature in England has not been like a river flowing on in a steady and unbroken course; but has ebbed and flowed like the tide, though without the regularity of the tide. In the days of Edward III., at the close of the fourteenth century, there was produced a great mass of literature, of which Chaucer's poems are the most important examples. For a century afterwards there is almost a total blank. Then began gradually the revival, which culminated in the days of Elizabeth and James I. in an amount of literary life such as has never been seen in England before or since—the age of Shakespeare and the great dramatists, of Spenser and the countless contemporary poets. And the same alternation of activity and depression is to be seen throughout the whole history of our literature. But what it is important for the student to observe is, that these changes are not isolated or meaningless events. Literary activity is only one of the many forms in which an increased mental energy exhibits itself, and a period fertile in great books is sure to be a period fertile in great deeds and great changes. Thus the age which produced the poetry of Chaucer was the same in which the feudal organisation of society was broken up, the same in which the national spirit and vigour of England displayed itself in the French conquests of Edward III., the victories of Cressy and Poitiers; and the same in which Wycliffe led the first great religious reformation in England, the first rebellion against the superstitions of the dark ages and the corruptions of the clergy. The century of literary dearth that followed was a century of national depression, in which the country was desolated by the Wars of the Roses. The Elizabethan era, so rich in literary genius, was also the era of the revival of classical learning, of the Reformation, of the Spanish wars and the defeat of the Armada, of the voyages of Drake and the other great navigators, and of the first colonisation of America.

But not only is the amount of literary genius shown at different times seen to be very different; the character and spirit of the works produced varies not less, and this diversity is no less closely connected with the history of the times. Thus the same exuberance of life and energy, seeking a vent for itself in every direction, which in the days of Elizabeth and her successor sent English sailors and adventurers about the world, discovering strange lands, fighting—half as lawful warriors, half as pirates—on the Spanish main, or colonising Virginia, is apparent in all the Elizabethan dramatists, and above all in Shakespeare. Their characteristics are activity of invention, freedom, and variety. And the same patriotic pride and unity of national spirit which was shown when the Armada threatened our shores is prominent in the literature of the period. It is the very key-note of at least one of Shakespeare's plays, "Henry V." But the next generation of Englishmen lived in a very different world. England was no longer a united nation. The king—Charles I.—and his people have been alienated from one another, the liberties of the nation are at stake, the civil war ensues; and the political contest is intensified and embittered by the religious differences which are so closely connected with it. The day is one in which every man is compelled to choose his side in a contest of surpassing importance; and men do choose their sides, and maintain them with rare earnestness and fidelity. And how does this change of spirit in men show itself in literature? The representative of the literature of the age is Milton. Milton in power of genius falls behind none of the Elizabethan poets, except Shakespeare himself; but in tone and spirit his works stand in the strongest contrast to theirs. Seriousness of spirit, earnestness of purpose, and an intense realisation of the presence of the unseen, are the characteristics of everything he has left us. Nor is the change less instructive in the next generation. The Commonwealth was followed by the Restoration. The cavalier party became in the ascendant. A natural reaction against the austerity of puritanism, combined with the evil example of a licentious court, introduced a tone of morality lower than anything that had ever been known in England before; and this is immediately reproduced in the literature of the day. Dryden and the series of comedians whom we shall have to describe hereafter are its chief representatives; and they stand in the most marked contrast to the writers of the previous generation, in the entire absence of any seriousness or earnestness of purpose, and in their low moral tone.

Nor is it only the changes and movements taking place within our own country, which we may see thus faithfully reflected in the literature of each age. The study of literature enlarges our view and enables us to watch the influence which one nation has exercised upon another, either by means of its living thinkers and writers, or by its older literature. Thus we all read, as matter of history, that at the time of the first great harvest of English literature, in the time of Edward III., the chief impulse to literary activity both in England and elsewhere was derived from Italy; for in Italy had but shortly before been produced the great works of Dante, Boccaccio, and Petrarch. But the extent of this influence can only be appreciated by reading Chaucer's poems, and observing how he—one of the most original of poets—is indebted for his stories, his metres, and to a large extent his style, to his Italian models. This our readers will see more fully when we come to treat of Chaucer's poems in detail. In the same way we read, as matter of history, of the great effect produced in England, as elsewhere, during the Elizabethan era, by the revived knowledge of classical literature, through study of the originals by the few, through the medium of translations with the many. But there is no way in which this influence can be more fully realised than by observing how a man like Shakespeare, who had "small Latin and less Greek," shows in his works that he was affected by it. Play after play, as "Julius Cæsar" and "Antony and Cleopatra," is taken from classical sources; and in each he shows not only that he can follow the narrative as he read it, probably in translation, but that he had largely entered into the spirit of the time.

We have said enough to show that the student of English literature has the opportunity of reading English history in the fullest, best, and most reliable way, for he is enabled to get a step nearer to the men with whose history he is dealing than he can do by any other method. But the advantage of keeping the connection between literature and history always in view is not entirely on the side of history. We have said that the various books which go to make up the total of English literature may be studied as isolated works of art, and may be so studied with both pleasure and profit. No man, for instance, could read "Hamlet" without enjoyment, whether he knows anything of Shakespeare and his times or not. But the pleasure we receive and the benefit we derive from a great work is in proportion as we understand the author's meaning; and we understand his meaning in proportion as we are able by an effort of imagination to place ourselves in his position, to see things as he saw them, and judge them as he judged them. And we shall be able to do this to a very small extent indeed if we are not fully acquainted with the circumstances under which he wrote and the influences by which he was surrounded. For all reasons, therefore, we would impress upon our readers the importance, when reading any English author, of doing so with as full a knowledge as they can obtain of his character, his history, and his times.

But in order that English literature may be studied in the manner and from the point of view which we advise, it is necessary that the student, when he enters upon the study of any work, should have the means of at once assigning to it its proper place in the catalogue of literature. This he cannot do without having the history of our literature, at least in its broader features, mapped out in his mind, knowing the sequence of the great writers, and their connection with one another, and the characteristics of each literary period. Such a knowledge is the more easily attained, because our literature easily and naturally divides itself into several well-marked periods, corresponding very closely to the most important stages in our political history. And the object of the following lessons will be to enable students of English literature to acquire this knowledge, so necessary for a thoroughly useful system of reading, as well as to direct their choice of books to read, and give them such assistance as may be possible in understanding and appreciating what they read.

In laying out the outline of a history of English literature, the first thing to be determined is the point from which to date its commencement. And as to this there is, we think, little room for hesitation. English literature, for the purposes of the student, begins with the age of Chaucer, the latter half of the fourteenth century, the reign of Edward III. Before that time there had been many works written in England, and in different languages, but it could not be said that there was any literature addressing itself to the whole people of England, or written in a language which was that of the whole people.

The population of England, as our readers are well aware, had been recruited from many sources. The oldest inhabitants of the island of whom history gives us any account were of Celtic blood, akin to the Celts of Ireland and the Highlanders of Scotland, but much more nearly akin to those now of Wales and Cornwall. They fell under the yoke of the Roman empire, and for five hundred years Roman institutions and Roman civilisation prevailed in the country. The Romans abandoned their occupation of Britain in the middle of the fifth century, but they did not leave the Britons to the enjoyment of peace or security. Immediately after, if not before, the departure of the Romans a dangerous friend, soon to become a formidable enemy, had appeared on the coasts of Britain. The Saxons, a people from the banks of the Elbe and the shores of the German Ocean, had commenced their long series of invasions. The history of the struggle between the Saxons and the Britons is lost in obscurity, but it ended in the complete subjugation of Britain under the Saxon dominion; and some form of their language—a language of the German stock, and the parent of our modern English—has ever since been the language of the great bulk of the inhabitants of this island. The Danes were the next invaders; but though they established their dominion for long, and although their tongue no doubt materially modified the dialect of those parts of England with which they had most to do, the language of the country remained substantially unchanged; and it may be said that at the date of the Norman conquest, with the exception of the Celtic-speaking districts, which we need not here consider, the language of England was one, and that was Anglo-Saxon.

But the Norman conquest brought a great change. The Normans, or Northmen, who invaded and conquered England under William of Normandy, were a Scandinavian race, nearly akin to the Danes; but during their long abode in the province of Normandy they had abandoned their original tongue, and adopted the French language, the language of those they had vanquished; and French was the language which they carried with them into England. From this time onward there were two spoken languages in England, the Norman-French of the court and the feudal castles, and the Saxon of the mass of the people. Each of these languages had its writers, books intended for the nobles being written for the most part in French, those intended for the people in Saxon. But there was also a third kind of literature in this country. In the monasteries, which were scattered over all parts of the country, chroniclers and religious writers used Latin as their literary tongue.

We have spoken of the Saxon tongue as the parent of our modern English, and we have just spoken of the Saxon literature which preceded the period at which the history of English literature properly begins. And it may therefore be asked why we arbitrarily select a particular point of time after which we say the literature was English, while what went before was not? In answer to this, we say that we do not draw the line at the point at which we have drawn it on the ground of any sudden or marked change in the language, though the language did undergo much modification at the very period in question; but for the reason we have given above, that the Saxon or English literature before Chaucer's day was not the literature of the whole English nation, but of the English-speaking portion of the nation: in his time it became that of the nation. The changes by which the language of the first Saxon invaders has in the course of centuries been transformed into the English of our day have been very gradual; and there is no one point of time at which it can be said that Anglo-Saxon became English. But in order to the better understanding of what we shall have to say in future lessons, it is well that our readers should be acquainted with the several stages into which the progress of the language is divided by most modern scholars. It must be remembered, however, that these divisions are not always very clearly marked, and are not given in quite the same way by all the authorities. The language is said to be *Anglo-Saxon* down to the middle of the twelfth century. The name of *Semi-Saxon* is given to it for the next hundred years, down to the middle of the thirteenth century. From that time until the latter end of the fourteenth century it is called *Old English*. Then the name of *Middle English* is applied to the English in use down to the reign of Elizabeth. And after that period the language is said to be *Modern English*.

In our next lesson we shall give a brief account of the remains which have come down to us of those various forms of literature—Saxon, French, and Latin—previous to the date at which we commence the history of English literature proper.

But by the days of Edward III. the English language had completely supplanted, while it partly absorbed, the French of the Norman nobles, and had become the language of the whole nation. And that period, the age of Chaucer, is our first period in the history of English literature.

The second period extends from the death of Chaucer over a space of about a hundred years, down to the time of the first revival of literary energy under the Tudor sovereigns.

The third period extends from the first revival of literature, at the period we have mentioned, through the reigns of Elizabeth and James I., and includes within it the most brilliant portion of our literary history.

The fourth period is that which includes the reign of Charles I., the Civil War, and the Commonwealth.

The fifth period is that of the Restoration, beginning with that event, and extending down to the Revolution of 1688.

The sixth period extends from the Revolution, through the reign of Queen Anne and the earlier portion of those of the Georges, and includes what has been habitually called the Augustan age of English literature, or the age of the correct school.

The seventh period is that which is intermediate between the last-mentioned and the great revival of romantic literature at the end of the eighteenth century.

The eighth period is that of the revival of the romantic school of literature, which began in the reign of George III., under the impulse of the same intellectual movement which immediately preceded the great French Revolution, the period to which belong Scott, Byron, and Shelley, and which may be said scarcely yet to have come to an end.

In the following course of lessons we shall treat of these periods in order, and of the principal writers belonging to each of them, examining as fully as we can the most important works of these writers.

LESSONS IN GREEK.—XXIV.

THE SUBSTANTIVE VERB ειμι, *I am* (*continued*).

According to the general statements and explanations already set forth in the previous lesson, the verb may be regarded as a total comprising a number of ideas, or representing a number of facts. This may be exemplified in λειπω, *I leave*, and λειφθειητην, *they two might have been left*: thus—

	Person.	*Number.*	*Tense.*	*Mood.*	*Voice.*
λειπω,	First.	Singular.	Present.	Indicative.	Active.
λειφθειητην,	Third.	Dual.	Aorist, 1st.	Optative.	Passive.

From this instance it may be seen that the Greek verb varies, or is modified in person, in number, in tense, in mood, and in voice. Accordingly, it is the business of the learner to become familiar with the verb in all these its modifications, so as to at once recognise every form he may meet with in reading, and be ready at first sight to assign its meaning. It will be necessary to go through these modifications in detail.

Before we proceed to the general conjugation of the Greek verbs, we must present a peculiar form, namely, that of the substantive verb, or verb of existence, ειναι, *to be*.

CONJUGATION OF THE VERB ειμι, *I am*.

INDICATIVE MOOD.

	PRESENT.	IMPERFECT.	FUTURE.
Sing. 1.	ειμι, *I am.*	ην, *I was.*	εσομαι, *I shall be.*
2.	ει or εις, *thou art.*	ης, *thou wast.*	εση, *thou shalt be.*
3.	εστι, *he is.*	η or ην, *he was.*	εσεται or εσται, *he shall be.*
Dual. 1.			εσομεθον, *we two shall be.*
2.	εστον, *you two are.*	ητην or ηστην, *you two were.*	εσεσθον, *you two shall be.*
3.	εστον, *they two are.*	ητην or ηστην, *they two were.*	εσεσθον, *they two shall be.*
Plu. 1.	εσμεν, *we are.*	ημεν, *we were.*	εσομεθα, *we shall be.*
2.	εστε, *you are.*	ητε or ηστε, *you were.*	εσεσθε, *you shall be.*
3.	εισι, *they are.*	ησαν, *they were.*	εσονται, *they shall be*

SUBJUNCTIVE MOOD.

PRESENT.

Sing.	1.	ω, *I may be.*
	2.	ῃς, *thou mayst be.*
	3.	ῃ, *he may be.*
Dual.	2.	ητον, *you two may be.*
	3.	ητον, *they two may be.*
Plu.	1.	ωμεν, *we may be.*
	2.	ητε, *you may be.*
	3.	ωσι, *they may be.*

OPTATIVE MOOD.

	PRESENT.	FUTURE.
Sing. 1.	ειην, *I might be.*	εσοιμην, *I might have been.**
2.	ειης, *thou mightst be.*	εσοιο, *thou mightst have been.*
3.	ειη, *he might be.*	εσοιτο, *he might have been.*
Dual. 1.		εσοιμεθον, *we two might have been.*
2.	ειητην, *you two might be.*	εσοισθην, *you two might have been.*
3.	ειητην, *they two might be.*	εσοισθην, *they two might have been.*
Plu. 1.	ειημεν, *we might be.*	εσοιμεθα, *we might have been.*
2.	ειητε, *you might be.*	εσοισθε, *you might have been.*
3.	ειησαν, *they might be.*	εσοιντο, *they might have been.*

IMPERATIVE MOOD.

PRESENT.

Sing. 2. ισθι, *be thou.*	*Dual.* 2. εστον, *be ye two.*
3. εστω, *let him be.*	3. εστων, *let them two be.*

Plu. 2. εστε, *be ye.*
3. εστωσαν or εστων, *let them be.*

INFINITIVE MOOD.

Present, ειναι, *to be.* Future, εσεσθαι, *to be about to be.*

* It should be observed that the English given here is only approximate, as the tense is in fact not used in this mood in independent sentences, but as the oratio oblique of the future indicative. Thus ειη answers to εστι, and εσοιτο to εσται.

PARTICIPLES.

	PRESENT. Nom.	Gen.	FUTURE. Nom.	Gen.
Masc.	ων,	οντος, *being.*	εσομενος,	-ου, *about to be*
Fem.	ουσα,	ουσης.	εσομενη,	-ης.
Neut.	ον,	οντος.	εσομενον,	-ου.

Let it be premised that the significations given in the paradigms, or examples of conjugation, are sometimes only approximately correct; for the exact meaning, the student must wait until he is familiar with the details of syntax and other details which will follow.

The verb whose forms are given above belongs, it will be seen, to the class of the verbs in μι. There is another verb, spelt in the same way, but distinguished from it by its accent, which will be given in its place under the verbs in μι—namely, εἶμι, *I will go*; εἰμί, *I am.*

The second person of the present, ει, is more used than εις. In the imperfect, the second person, ης, often becomes ησθα, by the addition of a suffix, θα, added for euphony. The third person is ην more frequently than η.

Instances are found, particularly in the first person singular and the third person plural, of another imperfect, which resembles the imperfect of the middle voice.

Singular, ημην, ησο, ητο. *Plural,* ημεθα, ησθε, ηντο.

A middle imperative form is also found in the second person singular, namely, εσο, *be thou.*

The entire present subjunctive—namely, ω, ῃς, ῃ, etc.—supplies terminations to all the verbs in ω. The second and third person singular have the iota subscript, as seen above.

The optative forms, ειην, ειης, ειη, lend their terminations, ιην, etc., to the optative of the verbs in μι. For the form ειημεν, ειμεν is used; and for ειησαν, ειεν is much more common.

The future, in all its moods, is a middle form; its termination, σομαι, is that of all the middle verbs in the future. The original forms were—

εσομαι, εσεσαι, εσεται.

In εσεσαι the second σ was elided, and the word became εσεαι. The εα was contracted into η, the ι was written under, and thus εσῃ arose.

This observation extends to all the second persons in ῃ of the middle and passive verbs. Εσται, a contracted form of εσεται, is more common than εσεται. In the optative, εσοιο stands for εσοισο.

The participle εσομενος (the Latin *futurus*) is declined like αγαθος, αγαθη, αγαθον.

The substantive verb lacks the perfect, the pluperfect, and the aorist; these tenses are supplied from γιγνομαι, *I become.*

The stem of the verb is ες, as found in εσμεν, εσομαι, etc.

The present participle is declined thus:—

	SINGULAR. Masc.	Fem.	Neut.	PLURAL. Masc.	Fem.	Neut.
Nom.	ων,	ουσα,	ον.	οντες,	ουσαι,	οντα.
Gen.	οντος,	ουσης,	οντος.	οντων,	ουσων,	οντων.
Dat.	οντι,	ουσῃ,	οντι.	ουσι,	ουσαις,	ουσι.
Acc.	οντα,	ουσαν,	ον.	οντος,	ουσας,	οντα.

So decline the participles in -ων of all the verbs.

By the aid of prepositions various compounds of ειμι are formed, and these compounds are conjugated like their primitive; as παρ-ειμι (adsum), *I am present*; απ-ειμι (absum), *I am absent*; μετ-ειμι (intersum), *I am among*; συν-ειμι (una sum), *I am with*; προσ-ειμι (insum, accedo), *I am near, I approach*; περι-ειμι (supersum, superior sum), *I survive, I am superior*; and others. The preposition remains invariable; only the verb undergoes the conjugational changes.

The verb ειμι is instructive in regard to the original personal endings. These personal endings in ειμι are here marked off by a hyphen, thus—ει-μι.

	Singular.	*Dual.*	*Plural.*
1.	ει-μι		εσ-μεν.
2.	εσ-σι(ει)	εσ-τον	εσ-τε.
3.	εσ-τι(ν)	εσ-τον	ει-σι(ν).

The terminations of the three persons of the singular are properly appended pronouns; thus μι is found in με, σι (contracted into ει) is found in σε, and τι in the stem of the article το. Accordingly, in their original form, these were—

THE PERSONAL TERMINATIONS.

		ACTIVE. Principal Tenses.	ACTIVE. Historical T.	MIDDLE. Principal T.	MIDDLE. Historical T.
Sing.	1.	-μι.	-ν.	-μαι.	-μην.
	2.	-σι.	-s.	-σαι.	-σο.
	3.	-τι.	—	-ται.	-το.
Dual.	1.	-μεν.		-μεθον.	
	2.	-τον.		-σθον.	
	3.	-τον.	-την.	-σθον.	-σθην.
Plu.	1.	-μεν.		-μεθα.	
	2.	-τε.		-σθε.	
	3.	-ντι.	-ν(ντ).	-νται.	-ντο.

By studying these terminations now, and by reverting to them afterwards, the student will be materially assisted; but he must make himself thoroughly master of all the paradigms before he attempts to set a step in advance.

VOCABULARY.

Αγορα, -ας, ἡ, a market.

Απορος, -α, -ον, impassable; τα απορα, straits, extremities. Observe that ειναι, with the preposition επι, signifies *to be in the power of.*

Αριστον, -ου, το, breakfast; ἡμιν αριστον εστι, we have breakfast. Ειναι, with a dative of the person, has the force of *to have;* the pronoun must be put in the dative, the person being preserved: thus εστι μοι is *I have;* εστι σοι, *thou hast,* etc.

Ἁρμοττειν, to fit, befit, suit, agree with. The infinitive is in the text used as a noun, and may be rendered *in harmony.*

Γεωργικος, -η, -ον, agricultural; hence the name *Georgics,* given to Virgil's didactic poem on agriculture.

Δυω, I go down, enter; προ δυντος ἡλιου, before sunset.

Επιλειπω, I leave, lack; επελιπε, second aorist active, failed.

Θελω, I desire, I will.

Νικαω, I conquer.

Ὁραω, I see, behold; ὁραν, infinitive present active, *to behold;* εστιν ὁραν, literally, *it is to see,* that is, *you may see.*

Πριαμαι, I purchase; πριασθαι, infinitive present middle, *to purchase;* ουκ ην πριασθαι, literally, *was not to purchase,* that is, *could not be purchased.*

Συγκαλεω, I call together, convoke; ὁ συγκαλων, convener.

Ταξις, -εως, ἡ, a rank or file of soldiers.

Φερω, I bear.

Φυτεια, -ας, ἡ, planting, care.

Ὡρα, -ας, ἡ, an hour (Latin, *hora*), time.

EXERCISE 72.—GREEK-ENGLISH.

1. Ἡ ταξις ην ἑκατον ανδρες. 2. Ην της ὡρας μικρον προ δυντος ἡλιου. 3. Οἱ νομοι ζημιαι εισι των ἁμαρτωλων. 4. Τουτοις θανατος εστιν ἡ ζημια. 5. Ὁ σιτος επελιπε, και πριασθαι ουκ ην. 6. Εστιν ὁραν το ορος. 7. Ἡ Αγησιλαου αρετη παραδειγμα ην. 8. Ἡμιν αριστον ουκ εστιν. 9. Εγω εσομαι ὁ συγκαλων. 10. Οὑτος εστιν ὁ νικων. 11. Εγω μια τουτων ειμι. 12. Βασιλευς νομιζει ὑμας αυτοῦ εἰναι. 13. Εστιν ουν της γεωργικης τεχνης ἡ των δενδρων φυτεια. 14. Εστιν αυτοις αγορα. 15. Εν τοις αποροις ημεν. 16. Ὁ Κυρος εν τουτοις ην. 17. Επι σοι εσται τουτο 18. Ου μικρον αγαθον τῳ ἁρμοττειν προσεστιν. 19. Τῃ βιᾳ προσεισιν εχθραι και κινδυνοι. 20. Τῃ επιμελειᾳ περιειναι των φιλων θελω. 21. Παρην Αγεσιλαος δωρα φερων. 22. Κυρῳ παρησαν εκ Πελοποννησου νηες.

EXERCISE 73.—ENGLISH-GREEK.

1. This is in my power. 2. The laws are in your power. 3. It is in your power (that is, *it depends on you*) to purchase corn. 4. It was in the power of the enemies to be present. 5. It is in the power of good boys to excel. 6. It will be in my power to approach the city. 7. Punishments belong (προσειναι) to sinners. 8. Thy care of thy friends is an example to all. 9. The ships have come to the king.

MECHANICS.—XVII.

STATICAL FORCES.

We must now look at two propositions which are often very useful, and we shall then be able to trace the application of what has been said to a few common cases.

When a body is kept at rest by the action of any number of forces upon it, if we resolve these forces along any two directions at right angles to one another, their resolved parts in each direction must neutralise each other. If they did not, some motion must ensue. In a similar way we can often find whether any number of forces will produce equilibrium, and if not, what their resultant will be. This mode of solving the question is sometimes more convenient than the polygon of forces.

Suppose three forces, represented by A B, A C, and A D (Fig. 84), act on A. Fix on *any* two lines E F and G H at right angles to one another, and both passing through A. From B, C, and D drop perpendiculars on E F and G H. This may be done with a square. Now A B is the diagonal of the parallelogram K A N B, and thus is the resultant of two forces which are represented by A N and A K. We may therefore resolve it into those two, and,

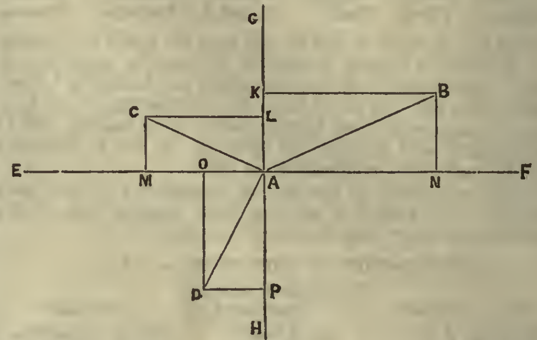


Fig. 84.

instead of A B acting on A, we shall have the two forces A N acting along E F, and A K acting along H G.

In the same way resolve A C and A D into A L and A M, and A O and A P respectively.

We have thus resolved all our forces into others acting in the directions we fixed upon. Three of these, A N, A M, and A O, act along E F; and if A N equals the sum of the other two, these will cancel one another, and so of the forces along G H. If there are any residues in either case we mark off distances from A to represent them, and complete the parallelogram, the diagonal of which will be the resultant.

The other proposition is as follows: If a body be kept at rest by the action of three forces, their lines of action must, *unless the forces be parallel,* pass through one point. For if not, since two of them pass through the point in which they meet (and they must meet, not being parallel), the body will turn till this point comes into the line of action of the third. If in Fig. 85 two of the forces act through B, and the third through A in the direction A C, the body will evidently turn till B, A, and C are in one straight line. The cases when the forces are parallel have all been considered except the one when equal and parallel forces act in opposite directions, and we have what is termed a couple. Let A C and B D represent two such forces. In any other case, if forces act on a body, a single resultant can be found, but here no one force that can be applied will produce equilibrium. The motion, however, which these forces tend to produce, is not one of progression through space, but merely one of rotation round a point midway between A and B. This tendency to rotation increases with the distance A B, and is clearly equal to the sum of the forces multiplied by half that distance.

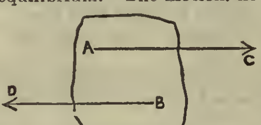


Fig. 85.

The only way to overcome these forces is to introduce another couple having an equal tendency to turn the body in the contrary direction.

EXAMPLES.

1. A lever of the first kind, 8 feet long, weighs 10 pounds. What weight will a power of 10 pounds raise, the fulcrum being 15 inches from the end?

2. In the first system of pulleys there are four blocks, each weighing 2 pounds. If one-fifth of the power be lost by friction, what weight will 15 pounds support?

3. If friction be reckoned at 9 pounds per ton, what power will be required to draw a train weighing 20 tons up an incline of 1 in 100?

4. What strain must a horse pull with, to draw a load of 27 cwt. up an incline of 1 foot in 70, the co-efficient of friction being $\frac{1}{30}$?

5. If the co-efficient of friction be $\frac{1}{25}$, and the strain on a rope which just moves a carriage be 80 pounds, what is the weight of the carriage?

6. A horse has to exert a strain of 116 pounds to pull a wagon weighing $1\frac{1}{2}$ tons. What is the co-efficient of friction?

ILLUSTRATIONS OF PRECEDING PRINCIPLES.

We have now to trace the practical application of the principles already laid down, and the best way of doing this is to take some common instances and carefully examine them, and we shall see that the same rules will apply to other and more complicated cases.

A heavy box is resting on a four-legged table. What are the forces that act on it, and what on the table? On the box there are only two—its own weight acting downwards, and the upward pressure of the table, exactly counterbalancing this weight. We turn, then, to the table, the forces acting on which are not quite so easily determined. There are its own weight and the weight of the box acting through their respective centres of gravity. These are parallel forces, and, as we have seen, have a resultant equal to their sum, and acting at a point in the line joining them, so taken that their distances from it are in the inverse proportion to their intensities. The other force which acts on the table is the resistance of the floor on which it rests, which resistance is transmitted upward through the four legs. If the weight act at a point equally distant from these, each bears an equal share; but if not, it is divided between them in the inverse proportion to their distances. To make this more clear, we will suppose these distances to be 2, 6, 6, and 8 feet respectively. Find the least common multiple of these numbers, that is, the least number each will divide without any remainder. In this case it is 24. This we divide successively by the distances, and obtain the quotients 12, 4, 4, and 3; and these numbers represent the proportion in which the weight is divided between the legs.

Now suppose the weight of the table and box to be 207 pounds. Since 12, 4, 4, and 3, added together make 23, the leg 2 feet off supports 12 parts out of every 23, *i.e.*, $\frac{12}{23}$ of the weight, or 108 pounds. Those 6 feet off support $\frac{4}{23}$, or 36 pounds each; and the other sustains only $\frac{3}{23}$, or 27 pounds. A calculation of this sort is very frequently required to determine the relative strength the different parts of a building should have.

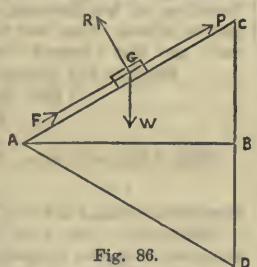


Fig. 86.

We will take another case. A body, G (Fig. 86), rests on an inclined plane, the angle of which, C A B, is 30°, and the co-efficient of friction is $\frac{1}{4}$. What forces act on G, what are their amount, and what other force must be applied to keep it in its place? We will try and solve these questions. As already seen, three forces act on G—its weight acting along G W, the resistance of the plane acting along G R, and the force of friction, which is $\frac{1}{4}$ of the weight and acts along F G. We found, when considering the inclined plane, that the power necessary to sustain G must bear the same proportion to its weight that B C does to A C. This, then, is the first thing we must find out, and we must have a slight acquaintance with mathematics for this; there is, however, no difficulty in the matter. Produce C B to D, so as to make B D the same length as B C, and join A D. The triangles A B C and A B D are exactly equal. For as B C is equal to B D, and each is at right angles with A B, A B C would, if we were to turn it over, exactly lie on A B D. A D is, then, equal to A C. Now in any and every triangle the three interior angles are together equal to 180°, or two right angles, and in A B C we know that the angle C A B is 30°, and A B C, being a right angle, is 90°; therefore A C B must be 60°, and A D B is equal to it, and therefore is also 60°. The angle B A D is likewise equal to B A C, and as each is 30°, the angle C A D is 60°. We see thus that each of the angles of the triangle C A D is 60°, and therefore they are equal to one another; and, since the angles are equal, the sides are also equal, for there is no reason why one should be greater than another. The triangle is thus equilateral and equiangular. We have now found out what we wanted; for, if B C be represented in length by 1, C D will be 2; and A C is equal to C D, therefore it is also 2, and the proportion B C bears to A C is 1 to 2, or $\frac{1}{2}$. On an incline of 30°, then, the power must be half the weight; but, in this case, friction sustains one-fourth, and therefore a power must be applied, acting in the direction G P, and equal to one-fourth of the weight, in order to maintain equilibrium.

We have now to solve the remainder of the question. We know how much G W, G F, and G P are; but we want to know what portion of the weight is borne by the plane, that is, what proportion A B, which represents the resistance of the plane, bears to A C. To find this, we need another very important geometrical proposition, which you will find fully proved in Lessons in Geometry, Problem XXX., Vol. I., page 337.

In every right-angled triangle the square described on the side opposite the right angle is equal to the sum of the squares on the sides containing it. If we represent the sides by numbers expressing their lengths, the rule holds equally true. Suppose, for example, we measure off from one of the sides containing the right angle a length of 4 inches, and from the other a length of 3 inches, we shall find the line joining these two points is equal to 5 inches.

The square of 4 (which means 4 multiplied by itself) is 16, and the square of 3 is 9. These added together make 25, which is the square of 5. The usual way of writing this is $4^2+3^2=5^2$. In this way, if we know the length of any two sides of a right-angled triangle, we can always calculate the third. Now in the case we are examining, we know that the side A C is equal to 2 and the side B C to 1; but the square of A C is equal to the sum of the squares A B and B C; the square of A B must, therefore, be equal to the difference between those of A C and B C. Now these are 4 and 1; the square of A B is, then, equal to 3, and the length of A B must be represented by the quantity which, multiplied by itself, will make 3. This is called the square root of 3, and is written $\sqrt{3}$. By arithmetic we can easily find exactly what this number is, but you can see that it is very nearly $1\frac{3}{4}$. The proportion, then, of A B to A C is $1\frac{3}{4}$ to 2, or 7 to 8, and the plane sustains a pressure equal to about $\frac{7}{8}$ of the weight. We have thus discovered the magnitude of all the forces as required.

When, as in our last lesson, we have resolved all the forces acting on a body along two lines at right angles, we can in this way find the magnitude of the resultant without the trouble and possible inaccuracy of actual measurement. Suppose we have a remainder of 12 pounds acting along one of the lines, and one of 5 pounds along the other, the resultant will be equal to $\sqrt{12^2+5^2}$; that is, to the square root of 144 + 25, or 169, which is 13. In the same way we can solve many questions frequently met with. Here is an example. Two forces act on a body; the resultant is 34 pounds, and one of the forces is 16 pounds; what is the other? We first find the square of 34, which is 1,156; from this we take the square of 16, or 256, and we have left 900. The square root of this is 30, and this accordingly is the intensity of the other force.

ANSWERS TO EXAMPLES IN MECHANICS.—XV.

1. A power of 201 pounds.
2. He must pull with a strain of $\frac{1}{25}$ of a ton, or $89\frac{3}{5}$ pounds.
3. It would support a resistance of 616 pounds.
4. A force of nearly 10 pounds must be applied, the gain being $2 \times 3\frac{1}{7}$ feet divided by $\frac{1}{4}$ inch, which equals $301\frac{5}{7}$.
5. The pressure will be $3{,}394\frac{2}{7}$ pounds.
6. The difference between the threads is $\frac{1}{110}$ of a foot. The gain is therefore $1\frac{3}{4} \times 2 \times 3\frac{1}{7} \times 110$ or, 1,210.
7. 135 pounds. The gain is $\frac{12 \times 45}{2}$ or 270.

N.B.—In the foregoing, friction was not taken into consideration.

CORRESPONDENCE IN FRENCH.—I.

As a suitable pendant to our "Lessons in French" and "Reading in French," we now bring under the notice of our readers a valuable series of model business letters in English and French, relating to the various transactions of commercial life.

Under each heading the student will first find a model letter couched in language appropriate to the subject under consideration in English. Immediately after is given, in every case, a close but idiomatic translation of the English model letter into French.

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It is unnecessary to do more than point out that any one who has carefully studied the "Lessons in French," which have already appeared in the POPULAR EDUCATOR, may soon become an adept in French commercial correspondence by means of these model letters of business. We would recommend the learner first to copy the English form without looking at the French translation below; then endeavour, by aid of his dictionary and grammar, to translate the English form thus copied out into French; and, lastly, compare his work with the French model that follows the English form, and correct his translation by its aid. He should also practise himself in translating each French model into English, afterwards correcting his translation by the English forms.

1.—CIRCULAR ON THE RETIREMENT OF A PARTNER IN A FIRM.

Amsterdam, August 16, 1882.

Messrs. Legrand & Co., London.

Gentlemen,—We take the liberty of informing you that our Mr. Jean Van Steen will, in conformity with a long-expressed desire, retire from this date from our firm.

Though we regret being deprived of his active co-operation and long experience, the fact of his retirement will not interfere with the conduct of our business.

We are, Gentlemen, your obedient servants,

J. & B. VAN STEEN.

Amsterdam, le 16 *Août*, 1882.

Messieurs Legrand & Cie, à Londres.

Messieurs,—Nous prenons la liberté de vous faire part que notre sieur Jean Van Steen, désirant quitter les affaires, se retire à dater de ce jour de notre maison.

Sa retraite, quoique nous laissant le vif regret d'être privés de sa co-opération active et de son expérience, ne changera rien dans la marche de nos affaires.

Nous avons l'honneur, Messieurs, de vous saluer,

J. & B. VAN STEEN.

2.—CIRCULAR ANNOUNCING THE ESTABLISHMENT OF A NEW HOUSE OF BUSINESS.

Messrs. Petit & Co., Marseilles. *London, August* 15, 1882.

Gentlemen,—We have the honour to inform you that we have this day established a house of business under the firm of

Masters & Johnstone.

We are in hopes that ample capital, our joint experience, and acquaintance with business matters, will enable us to give satisfaction to all who may honour us with their confidence.

Begging you to take note of our respective signatures, we refer you to the undermentioned firms,

And have the honour to be, Gentlemen,

Your very obedient servants,

FRED. MASTERS.
ANDREW JOHNSTONE.

Fred. Masters will sign: MASTERS & JOHNSTONE.
Andrew Johnstone will sign: MASTERS & JOHNSTONE.

References permitted to
Messrs. H. Bake, London.
Changarnier, Lyons.
Lilienskin, St. Petersburg.
Mackay, Glasgow.

Londres, le 15 *Août*, 1882.

Messieurs Petit & Cie, à Marseille.

Messieurs,—Nous avons l'honneur de vous prévenir que nous venons d'établir une maison de commerce sous la raison sociale

Masters et Johnstone.

Nous nous flattons que des capitaux suffisants, l'expérience et la connaissance des affaires, nous mettront à même de satisfaire tous ceux qui voudront bien nous honorer de leur confiance.

En vous priant de prendre note de nos signatures respectives, nous nous référons aux maisons ci-dessous, et avons l'honneur d'être, avec une parfaite considération, vos très-humbles serviteurs,

FRED. MASTERS.
ANDREW JOHNSTONE.

Fred. Masters signera: MASTERS & JOHNSTONE.
Andrew Johnstone signera: MASTERS & JOHNSTONE.

Références:
Messieurs H. Bake, Londres.
Changarnier, Lyon.
Lilienskin, St. Pétersbourg.
Mackay, Glasgow.

3.—CIRCULAR NOTIFYING THAT A BUSINESS HAS CHANGED HANDS.

Messrs. Roger & Co., Brussels. *Bremen, August* 17, 1882.

Gentlemen,—The natural infirmities incident to old age have constrained me to retire from business, which in future will be conducted by my two sons in their name.

While making known to you this change, I beg you will continue your correspondence with them, and take note of their respective signatures.

I have the honour to remain, Gentlemen,

Your very obedient servant,

FRANZ MEYER.

Mr. Louis Meyer will sign: MEYER BROS.
Karl Meyer will sign: MEYER BROS.

Bremen, le 17 *Août*, 1882.

Messieurs Roger & Cie, à Bruxelles.

Messieurs,—Les infirmités inséparables de la vieillesse m'engagent à renoncer aux affaires du commerce, que je remets dès ce jour entre les mains de mes deux fils pour qu'ils les dirigent en leur nom.

En vous annonçant ce changement, je vous prie de vouloir bien continuer avec eux votre correspondance, et prendre note de leurs signatures.

Je suis, Messieurs, avec la plus parfaite estime,

Votre très-obéissant serviteur,

FRANZ MEYER.

M. Louis Meyer signera: MEYER FRÈRES.
Karl Meyer signera: MEYER FRÈRES.

4.—CIRCULAR ON THE CESSATION OF EXISTENCE OF A FIRM AND WINDING-UP OF AFFAIRS.

Bordeaux, August 18, 1882.

Messrs. Thomas & Co., London.

Gentlemen,—It is with deep regret that I have to inform you of the sad and premature death of my husband, Mons. Martin Auber, only existing partner of the firm of Auber & Co., of this town.

As both my sons are still too young to continue the firm founded by their father, I have but to fulfil the sad duty of thanking my late husband's correspondents for their confidence, and to inform them that the firm Auber & Co. has ceased to exist, and that I intend to superintend the liquidation myself.

Begging you to take note of my signature,

I have the honour to be, Gentlemen,

Your obedient servant,

MARIE AUBER, Widow.

Mme. Auber will sign: AUBER & Co., in liquidation.

Bordeaux, le 18 *Août*, 1882.

Messieurs Thomas & Cie, à Londres.

Messieurs,—C'est avec la plus vive douleur, que j'ai à vous annoncer la perte douloureuse et prématurée de mon époux, le sieur Martin Auber, seul chef de la maison Auber et Cie, de cette ville.

Comme mes deux fils sont encore trop jeunes pour diriger la maison fondée par leur père, il ne me reste que le triste devoir de faire mes remerciements aux correspondants de feu mon mari pour la confiance qu'ils lui ont accordée, et de les prévenir que la maison Auber et Cie n'existe plus, et que je dirigerai la liquidation moi-même.

En vous priant de prendre note de ma signature, et avec l'assurance de ma parfaite considération,

J'ai l'honneur d'être, Messieurs,

Votre humble servante,

MARIE AUBER, Veuve.

Mme. Auber signera: AUBER & CIE, en liquidation.

5.—LETTER OF INQUIRY AS TO SOLVENCY OF A FIRM.

Messrs. Lafitte, Paris. *Havre, August* 19, 1882.

Gentlemen,—We beg to confirm our letter of the 26th of July, and request you to be good enough to let us know your opinion of the solvency of Messrs. Henry Smith Bros., who have referred us to you for the said information.

We shall be obliged if you would also indicate to us the amount of credit we may safely give them.

You may rely upon our discretion.

MERIVALE BROTHERS.

Le Havre, le 19 *Août*, 1882.

Messieurs Lafitte, à Paris.

Messieurs,—Nous vous confirmons notre lettre du 26 Juillet dernier, et vous prions de vouloir bien nous donner des renseignements sur la solvabilité de MM. Henry Smith frères, qui nous ont indiqué votre maison comme pouvant nous les fournir.

Vous nous obligeriez aussi en nous indiquant l'étendue du crédit que vous jugeriez convenable de leur accorder.

Vous pouvez compter sur notre discrétion.

MERIVALE FRÈRES.

LESSONS IN ALGEBRA.—XV.

SIMPLE EQUATIONS (*continued*).

REDUCTION BY MULTIPLICATION.

160. WHEN the unknown quantity is connected with a known quantity by the sign of division, the reduction is effected by multiplying both members of the equation by the latter, if it be the divisor; and by the former, if it be the divisor.

In this case, it will be particularly useful to remember a rule formerly given, namely, that a fraction is multiplied by its denominator, by removing the denominator; or, in other words, putting down the numerator as the product. Also, that after this process has been performed, transposition is still to be employed as in the preceding examples.

EXAMPLE.—Reduce the equation $\frac{x}{c} + a = b + d$.

Here, multiplying both sides by c, we have, for the product, $x + ac = bc + cd$; and, by transposition, $x = bc + cd - ac$.

161. Though it is not always *necessary*, yet it is often convenient, to remove the denominators from fractions consisting of *known* quantities only. This is done in the same manner as in the preceding rule.

EXAMPLE.—Reduce the equation $\frac{x}{a} = \frac{d}{b} + \frac{h}{c}$.

Here, multiplying by a, we have $x = \frac{ad}{b} + \frac{ah}{c}$; again, multiplying by b, we have $bx = ad + \frac{abh}{c}$; lastly, multiplying by c, we have $bcx = acd + abh$. Whence $x = \frac{acd + abh}{bc}$. *Ans.*

162. *An equation may be cleared of fractions by multiplying both members by all the denominators.*

163. In clearing an equation of fractions, it often happens that a numerator becomes a *multiple* of its denominator (*i.e.*, can be divided by it without a remainder), or that some of the fractions can be reduced to *lower* terms. When this occurs, the operation *may be shortened* by performing the division indicated, and by reducing the fractions to their lowest terms.

164. In clearing an equation of fractions, it will be necessary to observe, that the sign — prefixed to any fraction, denotes that the *whole* value is to be subtracted, which is done by changing the signs of *all* the terms in the numerator.

EXAMPLE.—Reduce $\frac{a - d}{x} = c - \frac{3b - 2hm - 6n}{r}$. *Ans.* $x = \frac{(a - d)r}{cr - 3b + 2hm + 6n}$.

EXERCISE 26.

1. Reduce the equation $\frac{x - 4}{6} + 5 = 20$.
2. Reduce the equation $\frac{x}{a + b} + d = h$.
3. Reduce the eqnation $\frac{6}{10 - x} + 7 = 8$.
4. Reduce the equation $\frac{x}{a} = \frac{b}{d} + \frac{e}{g} - \frac{h}{m}$.
5. Reduce the equation $\frac{x}{2} = \frac{2}{3} + \frac{4}{5} + \frac{6}{2}$.
6. Reduce $\frac{x}{3} - \frac{x}{4} = 6$.
7. Reduce $\frac{4x}{5} = \frac{3}{5} + \frac{3x}{5} + \frac{8}{10}$.
8. Reduce $2x - \frac{9x}{5} = \frac{10}{25} + \frac{8}{5}$.
9. Rednce $-x + \frac{x}{2} + \frac{3x}{4} - \frac{2x}{7} + \frac{x}{14} = \frac{10}{4}$.

REDUCTION BY DIVISION.

165. *When the unknown quantity contains any known quantity, as a factor, the equation is reduced by dividing every term on both members by this known quantity.*

EXAMPLE.—Reduce the equation $ax + b - 3h = d$.

Here, by transposition, we have $ax = d + 3h - b$; and dividing by a, we have $x = \frac{d + 3h - b}{a}$. *Ans.*

166. If the unknown quantity has co-efficients in *several terms*, the equation must be divided by the sum of all these coefficients.

EXAMPLE.—Reduce the equation $3x - bx = a - d$.

Here, $3x - bx = (3 - b)\,x$; and $(3 - b) \times x = a - d$.

Whence, dividing by $3 - b$, we have $x = \frac{a - d}{3 - b}$. *Ans.*

167. If any quantity, either known or unknown, is found as a factor in *every term*, both members of the equation may be *divided* by it. On the other hand, if any qnantity is a *divisor* in every term, both members of the equation may be *multiplied* by it. In this way, the factor or divisor will be removed, and the reduction may be effected as before.

EXAMPLES.—(1.) Reduce the equation $ax + 3ab = 6ad + a$.

Here, dividing by a, we have $x + 3b = 6d + 1$; and, by transposition, $x = 6d + 1 - 3b$. *Ans.*

(2.) Reduce the equation $\frac{x + 1}{x} - \frac{b}{x} = \frac{h - d}{x}$.

Here, multiplying by x, we have $x + 1 - b = h - d$; and, by transposition, $x = h - d + b - 1$. *Ans.*

168. *A proportion is converted into an equation by making the product of the extremes, one member of the equation; and the product of the means, the other member.*

EXAMPLE.—Reduce to an equation $ax : b :: ch : d$.

Here the product of the extremes is adx, and the product of the means bch; the equation is, therefore, $adx = bch$. Whence $x = \frac{bch}{ad}$. *Ans.*

169. *An equation may be converted into a proportion, by resolving one side of the equation into two factors, for the middle terms of the proportion; and the other side into two factors, for the extremes.*

EXAMPLE.—Convert the equation $adx = bch$ into a proportion.

Here the first member may be divided into the two factors ax and d; the second into ch and b. From these factors we may form the proportion $ax : b :: ch : d$.

EXERCISE 27.

1. Reduce the equation $2x = \frac{a}{c} - \frac{d}{h} + 4b$.
2. Reduce the equation $ax + x = h - 4$.
3. Reduce the equation $x - \frac{x - b}{h} = \frac{a + d}{4}$.
4. Rednce the equation $x \times (a + b) - a - b = d \times (a + b)$.
5. Reduce to an equation $a \div b : c :: h - m : y$.
6. Reduce to a proportion the equation $ay + by = ch - cm$.
7. Reduce the equation $16x + 2 = 34$.
8. Reduce the equation $4x - 8 = -3x + 13$.
9. Reduce the equation $10x - 19 = 7x + 17$.
10. Reduce the equation $8x - 3 + 9 = -7x + 9 + 27$.

KEY TO EXERCISES IN LESSONS IN ALGEBRA.

EXERCISE 25.

1. $x = b + 4$.	6. $x = 11$.	11. $x = 7$.
2. $y = 2ab - 2hm - a$.	7. $x = 20$.	12. $x =$ [illegible]
3 $x = b - 7h - d - 22$.	8. $x = 31$.	13. $y = 16$.
4. $x = 8bh \div 9$.	9. $x = 8$.	14. $x = 24$.
5. $x = 15$.	10. $x = 6$.	

LESSONS IN MUSIC.—XXI.

EXERCISES—"HONEST FELLOW"—"AULD LANG SYNE."

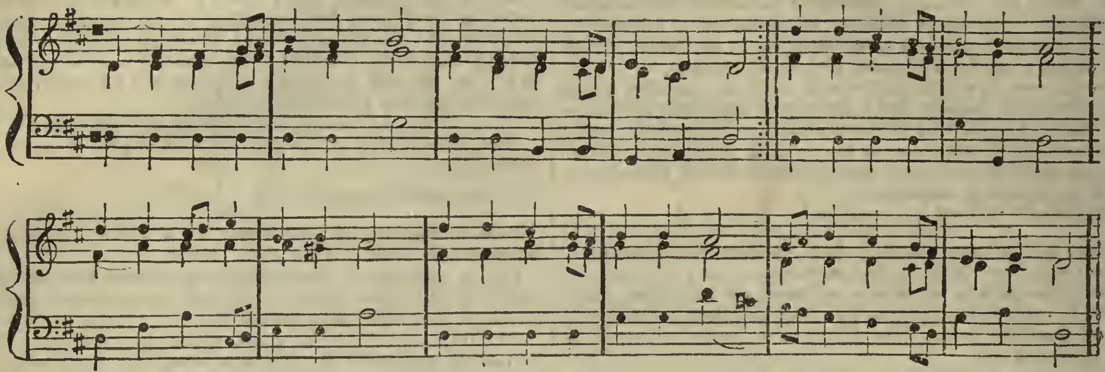
IN our last Lesson in Music (Vol. III., p. 398) we gave the learner a great deal of necessary information on the different kinds of voices of men, women, and boys, proper enunciation, and singing in parts. We now propose, in accordance with our promise, to set before our pupils some exercises in part-singing; but before any student commences to practise these, it will be as well for him or her, as the case may be, to read over once more the lesson to which we have referred, that our remarks on the regulation of the voice, its pitch, quality, and strength, may be fresh in the memory of our readers when they begin to sing in concert the exercises that are now brought under their notice.

In the first of these exercises, some words by Martin Farquhar Tupper are set to an old English tune which admirably suits the rhythm of the poetry. In the second the learner will find another of Burns's heart-stirring lyrics, "Auld Lang Syne," or "Old Long Ago," if there be any need to put the expression, which must be familiar to all, in an English dress. It may, however, be as well to say, for the benefit of those of our readers to whom some of the Scotch words introduced into the poetry may be new, that *braes* means hill-sides; *gowans*, daisies or any wild flowers growing in hedge or meadow; and *burn*, a brook.

EXERCISE 36.—HONEST FELLOW, SORE BESET.—KEY D. M. 80.

(Tune, Old English. Words from the last Edition of "Ballads for the Times," by M. F. TUPPER, Esq.)

OLD NOTATION.



NEW NOTATION.

KEY D DA CAPO.

d :m |m :f .s | l :s |l :— | s :m |m :r .d | r :r |d :—
d :d |d :r .m | f :m |f :— | m :d |d :t_1 .d | d :t_1 |d :—
d :d |d :d | d :d |f :— | d :d |l_1 :l_1 | f_1 :s_1 |d :—

d^1 :d^1 |t :l.s | l :l |s :— | d^1 :d^1 |t.d^1 :r^1 | l :l |s :—
m :m |s :f.m | f :f |m :— | m :s |s :s | s :fe |s :—
d :d |d :d | f :f_1 |d :— | d :m |s :t_1.d | r :r |s :—

d^1 :d^1 |t :l.s | l :l |s :— | f.s :l |s :f.m | r :r |d :—
m :m |s :f.m | f :f |m :— | d :d |d :t_1.d | d :t_1 |d :—
d :d |d :d | f :f |d^1 :ta | l.s :f |m :r.d | f :s |d :—

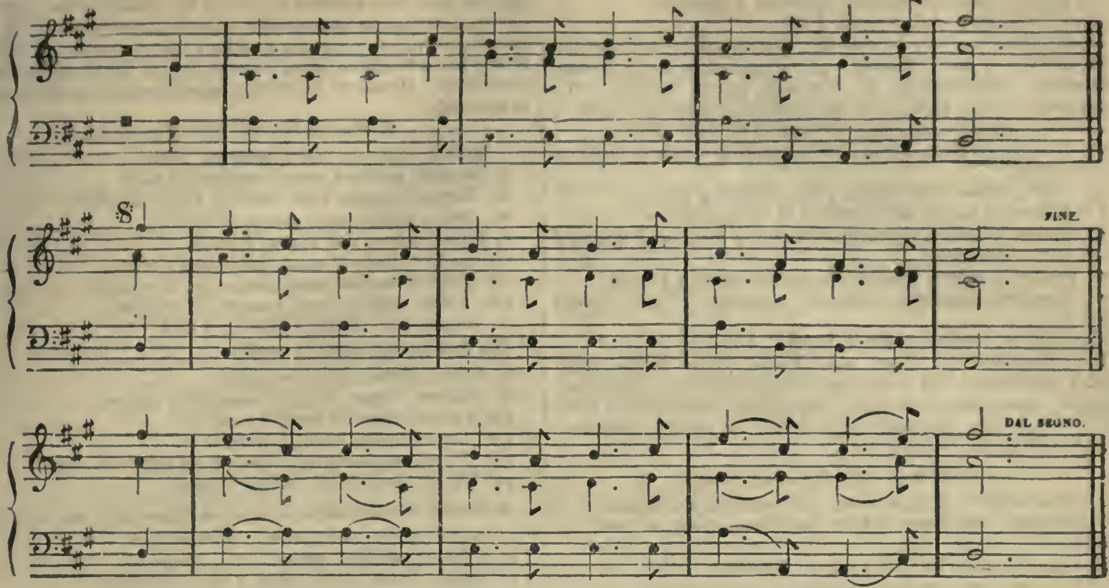
1. *Honest fellow, sore beset,*
   Vexed by troubles quick and keen,
 Thankfully consider yet
   "HOW MUCH WORSE IT MIGHT HAVE BEEN."
 Worthily thy faults deserve
   More than all thine eyes have seen;
 Think thou, then, with sterner nerve,
   "HOW MUCH WORSE IT MIGHT HAVE BEEN."

2. *Though the night be dark and long,*
   Morning soon shall break serene;
 And the burden of thy song,
   "HOW MUCH WORSE IT MIGHT HAVE BEEN."
 God, the Good One, calls to us,
   On his providence to lean,
 SHOUT, THEN, OUT, devoutly thus,
   "HOW MUCH WORSE IT MIGHT HAVE BEEN."

We have here separated the established notation from its accompanying interpreter, thus offering a better exercise for the pupil. *Da Capo* means "return to the beginning." [The dots between the lines of the staff mean the same thing. The students of the old notation will notice the "bass clef," now first introduced. But they must be guided by the place of the key-note indicated by the square note, and neither clefs nor keys will be a difficulty to them.] This piece is arranged for three voices—two trebles and a bass or baritone. We should not, however, omit to point out that, as compared with the "air" and "second treble," the "bass" is written an octave too high in the new notation; but this creates no confusion in practice, as the bass voice is *naturally* an octave lower than the treble.

Exercise 37.—**AULD LANG SYNE.**—Key A. M. 112.

OLD NOTATION.



THE SAME IN THE NEW NOTATION, BUT FOR TWO EQUAL VOICES.

Key A.

: s_1 | d :–.d | d :m | r :–.d | r :–.m | d :–.d | m :–.s
Should | old ac-quaint-ance | be for - got, And | ne - ver brought to
: s_1.f_1 | m_1 :–.s_1 | d :d | s_1 :–.m_1 | s_1 :–.s_1 | m_1 :–.s_1 | d :–.d

l :– | – l | s :–.m | m :–.d | r :–.d | r :–.m
mind? Should | old ac - quaint - ance | be for - got, And
f_1 :– | – :f_1 | m_1 :–.s_1 | d :–.d | s_1 :–.m_1 | s_1 :–.s_1

d :–.l_1 | l_1 :–.s_1 | d :– | – :l | s :–.m | m :–.d
days of "lang | syne?" For | OLD LANG
l_1 :–.f_1 | f_1 :–.s_1 | d_1 :– | – :d | d :– | d :–

r :–.d | r :–.m | s :–.m | m :–.s | l :– | – :l
SYNE, MY DEAR, FOR | OLD LANG | SYNE. WE'LL
s_1 :–.m_1 | s_1 :–.d | m :–.d | d :– | f_1 :– | – :f_1

s :–.m | m :–.d | r :–.d | r :–.m | d :–.l_1 | l_1 :s_1 | d :– | –
TAKE A CUP OF | KIND - NESS YET, FOR | OLD LANG | SYNE.
m_1 :–.s_1 | d :–.d | s_1 :–.m_1 | s_1 :–.s_1 | l_1 :–.f_1 | f_1 :s_1 | d_1 :– | –

2. We two have run about the braes,
 And pulled the gowans fine;
But we've wandered many a weary foot
 Since old "lang syne."
  For old, etc.

3. We two have paddled in the burn,
 From morning sun till dine:
But seas between us broad have roared
 Since old "lang syne."
  For old, etc.

4. And here's a hand, my trusty friend,
 And gi' us a hand of thine;
And we'll take the cup of kindness yet,
 For old "lang syne."
  For old, etc.

To illustrate still further this subject of the different voices, we give our present song—first (in the old notation) as it may be sung by two female voices and one male voice—and, again (in the new notation), as it should be sung by two female voices, or by two male voices, without a third voice accompanying. The laws of harmony will tell you why the accompaniments in the two cases are different. Dal Segno means "return to the sign." The curiously-marked S is put for that sign, and the word "fine" shows where you are to close.

*

LESSONS IN LATIN.—XXXVII.

DEVIATIONS IN THE SECOND CONJUGATION (*continued*).

5. *Perfect in* -I; *Supine in* -SUM.

i. Prandeo, prandere, prandi, pransum, *I breakfast.*

ii. Sedeo, sedere, sedi, sessum, *I sit.*

In the same way are formed the compounds of sedeo which have prefixes of two syllables; as, circumsedeo, circumsedere, circumsedi, circumsessum, *to sit round, enclose, besiege.* The compounds, having prefixes of one syllable, change the *e* into *i*; *e.g.*, assideo, assidere, assedi, assessum, *to sit with* or *by.*

iii. Strideo, stridere, stridi (no supine), *to make a shrill or hissing sound.*

iv. Video, videre, vidi, visum, *I see;* videor, *I appear.*

The following take a reduplication in the perfect:—

v. Mordeo, mordere, momordi, morsum, *I bite;* and hence, *I grieve, vex,* or *provoke.*

vi. Pendeo, pendere, pependi (supine uncertain), *I hang.*

vii. Spondeo, spondere, spopondi, sponsum, *I vow, become liable for.*

viii. Tondeo, tondere, totondi, tonsum, *I shear.*

The compounds of these reduplicated verbs follow their several primitives, but drop the reduplication; as, admordeo, admordi, admorsum, *to bite at;* præpendeo, præpendi, *to hang before;* respondeo, respondi, responsum, *to reply;* detondeo, detondi, detonsum, *to shear off.*

6. *Perfect in* -SI; *Supine in* -TUM.

i. Augeo, augere, auxi, auctum, *I increase* (E. R. *augment*).

ii. Indulgeo, indulgere, indulsi (indultum, rare), *I yield to, indulge.*

iii. Lugeo, lugere, luxi (no supine), *I grieve.*

iv. Torqueo, torquere, torsi, tortum, *I twist, torture.*

VOCABULARY.

Acute, *sharply.*
Ancillaris, -e (from ancilla, *a maid-servant*), *assisting, menial.*
Barba, -æ, f., *a beard.*
Capillus, -i, *the hair of the head.*
Collum, -i, n., *a neck.*
Epistŏla, -æ, f., *a letter.*
Extĕrus, -a, -um, *external, foreign.*
Extorquēre, *to extort, take,* or *wrest.*
Ferreus, -a, -um, *made of iron, iron-hearted.*
Interrĭtus, -ūs, m., *ruin*
Lachrȳma, -æ, f., *a tear.*
Locuplēto, 1, *I enrich.*
Occasus, -ūs, m., *a going down, a downfall.*
Occupo, 1, *I seize.*
Pervidēre, *to see through, handle, investigate.*
Probitas, -ātis, f. (from probus, *good, kind*), *honesty, goodness.*
Quoad, *as long as.*
Rabies, -ei, f., *madness.*
Rabiosus, -a, -um, *mad, raging.*
Residēre, *to remain behind.*
Sica, -æ, f., *a dagger.*
Sicarius, -i, m., *an assassin.*
Tonsor, -ōris, m., *a barber.*
Tonstricula, -æ, f., *a barber-girl.*

EXERCISE 137.—LATIN-ENGLISH.

1. Postquam prandero, ambulabo. 2. Nos cras in horto prandebimus. 3. Audistine nos cras in horto pransuros esse? 4. Quoad ulla spes in animo meo resedit, pro patriæ libertate dimicavi. 5. Jam tres menses obsiderunt hostes nostram urbem. 6. Non sum ille ferreus qui (= ut ego) non movear horum omnium lachrȳmis, a quibus me circumsessum videtis. 7. Multi putant se beneficos in suos amicos visum iri, si locupletent eos quacunque ratione. 8. Cave ne prius de re aliquâ judices quam eam diligenter pervidĕris. 9. Epistolæ tuæ valde me momorderunt. 10. Si quis a cane rabioso morsus est, rabies eum occupat. 11. Quoad tu locutus es, puer ab ore tuo pependit. 12. Spopondistine pro amico? 13. Spopondi. 14. Multa a Lælio et in senatu et in foro vel provisa prudenter, vel acute responsa sunt. 15. Cicero narravit Dionysium ne tonsori collum committeret, tondere filias suas docuisse; ita sordido aucillarique officio regias virgines ut tonstriculas totondisse barbam et capillum patris.

EXERCISE 138.—ENGLISH-LATIN.

1. I have dined. 2. My friends have dined. 3. After my friends have (*shall have*) dined, they will take a walk. 4. Hast thou heard that I am about to dine in the garden? 5. I heard that thou hadst been shaved by a barber-girl. 6. It is not true; the barber shaved me. 7. Give me that dagger. 8. Take (extorqueo) the dagger from the hands of the assassin. 9. The mother and the father will bewail the ruin of the young man. 10. I have taken the dagger from the hands of the slave. 11. What dost thou see? 12. I see a city besieged. 13. Our country has been much increased by wisdom and industry. 14. Wisdom and industry are preferable (potior) to (*than*, abl.) war.

In the word tonsor, *a barber*, we have an instance of the way in which language conveys to posterity a knowledge of customs and manners. Tonsor is properly *a shearer*, from tondeo, *I shear.* The Romans, like the Greeks, were too proud of their beards, as a sign of manliness, to think of in any way parting with them; and the love of self-decoration then displayed itself in trimming and dressing the beard. In time, effeminacy led to the shaving of the beard. Besides being clipped, the chin was also shaven and the hair was plucked out, so as to promote what was considered a becoming appearance. Thus, three methods of hair-dressing prevailed—clipping (cutting), plucking out, and shaving. *Tonsor* has a feminine noun, *tonstrix*, and in the exercise we find *tonstricula.* Hence we learn that hair-dressing was not confined to men only.

7. *Perfect in* -SI; *Supine in* -SUM.

i. Mulceo, mulcere, mulsi, mulsum, *I soothe.*

ii. Mulgeo, mulgere, mulsi, mulsum, *I milk.*

iii. Tergeo, tergere, tersi, tersum, *I wipe* or *scour.*

iv. Ardeo, ardere, arsi, arsum, *I burn.*

v. Rideo, ridere, risi, risum, *I laugh.*

vi. Suadeo, suadere, suasi, suasum, *I advise.*

vii. Maneo, manere, mansi, mansum, *I remain.*

viii. Jubeo, jubere, jussi, jussum, *I command.*

ix. Hæreo, hærere, hæsi, hæsum, *I stick.*

The ensuing are without supines:—

x. Algeo, algere, alsi, *I am cold.*

xi. Fulgeo, fulgere, fulsi, *I shine forth, lighten.*

xii. Turgeo, turgere, tursi, *I swell.*

xiii. Urgeo, urgere, ursi, *I press.*

xiv. Frigeo, frigere (frixi, rare), *I am stiff with cold.*

xv. Luceo, lucere, luxi (lucsi), *I shine.*

8. *Perfect in the passive form (semi-deponents); no Supine.*

i. Audeo, audere, ausus sum, *I dare venture.*

ii. Gaudeo, gaudere, gavisus sum, *I rejoice.*

iii. Soleo, solere, solĭtus sum, *I am accustomed.*

VOCABULARY.

Abstergere, *to wipe away, remove.*
Affulgēre, *to shine upon.*
Cadūcus, -a, -um, *failing, frail.*
Carthaginensis, -is, m., *a Carthaginian.*
Comitas, -ātis, f., *politeness.*
Confectio, -ōnis, *a making, preparation.*
Convivor, *I eat in common.*
Deridēre, *to laugh down* or *at.*
Detergere, *to wipe down.*
Dissuadēre, *to dissuade.*
Elucēre, *to shine forth.*
Exsilium, -i, *exile, banishment.*
Lateo, -ui, 2, *I lie hid* (E. R. *latent*).
Mirifice, *wonderfully.*
Napoleo, -ōnis, m., *Napoleon.*
Oblectare, *to delight.*
Optare, *to wish for.*
Perpetior, perpĕti, perpessus sum, *I suffer greatly.* [*greatly.*
Permulcēre, *to soothe*
Remanēre, *to remain.*
Scintilla, -æ, f., *a spark.*

EXERCISE 139.—LATIN-ENGLISH.

1. Dux mitibus verbis excĭtos militum animos permulsit. 2. Legendis Virgilii carmiuibus animus meus mirifice oblectatus et permulsus est. 3. Ita jucunda mihi hujus libri confectio fuit, ut omnes absterserit senectutis molestias. 4. Non prius ad te veniam quam luctum omnem meum abstersero. 5. Detersane jam est tabula? 6. Quadraginta milia librorum Alexandriæ (at Alexandria) arserunt. 7. Non dubito quin brevi tempore tota Germania bello arsura sit. 8. Quis est cui semper arriserit fortuna? 9. Nescio cur a te derisus sim. 10. Sic mihi persuasi, sic sentio, non esse animos nostros mortales. 11. Quis credat cives pacem dissuasuros esse? 12. Quis confīdit semper sibi illud stabile et firmum permansurum esse, quod fragile et cadūcum sit? 13. Romanorum gloria usque ad nostram memoriam remansit. 14. Lycurgus convivari omnes cives jussit.

EXERCISE 140.—ENGLISH-LATIN.

1. I am accustomed to rejoice at the prosperity of my friends. 2. They have rejoiced. 3. They will rejoice. 4. My sisters have rejoiced. 5. Fortune smiles on brave men. 6. Dost thou think that fortune will smile on the brave? 7. I deny that fortune always smiles on the brave. 8. He laughs at the philosopher. 9. Why is the philosopher derided by a boy? 10. There is no doubt that philosophers have been derided by very foolish persons. 11. Orators wish to soothe the excited minds of the citizens. 12. I am persuaded that orators ought to soothe the excited minds of men. 13. In the reign of Napoleon (*Napoleon reigning*, abl. abs.), all Europe burned with war.

Fabula.—Hœdus et Lupus.

Hœdus[1] stans[2] in[3] tecto[4] domūs[5] lupo[7] prætereunti[8] maledixit[6]. Cui[1] lupus[2], "Non[4] tu[5]," inquit[3], "sed[6] tectum[7] mihi[9] maledixit[8]." Sæpe[1] locus[2] et[3] tempus[4] timidos[6] homines[7] audaces[8] reddit[5].

VOCABULARY.

Hœdus, -i, m., *a kid.*
Inquit, *said.*
In tecto, *under the cover* or *protection.*
Lupus, -i, m., *a wolf.*
Maledicere requires its object to be in the dative case.
Maledīco, 3, *I curse.*
Prætereo, *I pass by.*
Tectum, -i, *a roof.*

Fabula.—Grus et Pavo.

1 5 6 4 3 2 9 7
Pavo coram grus pennas suas explicans, "Quanta est," inquit,
11 10 12 13 14 1 2 3 5 6
"formositas mea, et tua deformitas!" At grus evŏlans, "Et quanta
7 4 9 8 10 11 12 3 1 2 4 5
est," inquit, "levitas mea et tua tarditas!" Monet hæc fabula, ne ob
6 7 8 11 9 10 13 12 14
aliquod bonum quod nobis natura tribuit, alios contemnamus, quibus
15 17 18 19 20 16
natura alia et fortasse majora dedit.

VOCABULARY.

Deformitas, -ātis, f., *ugliness.*	Levitas, -ātis, f., *lightness, fleetness.*	or has alios for its antecedent.
Formositas, -ātis, f., *beauty.*	Pavo, -ōnis, m., *a peacock.*	Tarditas, -ātis, f., *slowness.*
Grus, gruis, c., *a crane.*	Quibus refers to alios,	

KEY TO EXERCISES IN LESSONS IN LATIN.—XXXVI.

EXERCISE 133.—LATIN-ENGLISH.

1. Minerva taught Cicero all arts. 2. The mingled earnestness of modesty is greatly to be admired. 3. So many times have I been occupied, and with such important business, that I am unable (*that it is not allowed to me*) to breathe freely. 4. Know you not how many toils, how many dangers, how many miseries the soldiers have sustained on their way? 5. If virtue has restrained you from bad desires, your life will be happy. 6. Cicero having been told all things by the ambassadors, ordered the prætors to seize the Allobroges on the bridge. 7. Let not their minds mingle with the vices of men. 8. The ascent to heaven is easy to the good. 9. The less minds have mingled with and attached themselves to the errors and vices of men, the easier to them will be the ascent to heaven. 10. The nature of the mind is simple, nor has it in it anything mixed. 11. We live on grapes dried in the sun. 12. We have dried many grapes this season. 13. Cato was of opinion that Carthage should be destroyed. 14. Every fifth year all Sicily was subjected to the census. 15. Two most powerful cities, Carthage and Numantia, were destroyed by Scipio. 16. No forgetfulness has ever blotted out the fame of the Greeks and Romans, nor ever will blot it out. 17. God has filled the world with all good things, and has mixed with it nothing bad.

EXERCISE 134.—ENGLISH-LATIN.

1. Cicero a Minervâ omnes artes edoctus est. 2. Cives sex templa publice voverunt. 3. Templum Veneri dedicaverunt. 4. Mater infantem fovet. 5. Mater semper liberos fovebit. 6. Uxores maritos foverunt. 7. Militum clades per urbem magnum ploratum movit. 8. Nescio quot labores sustinueris. 9. Nescis quot labores sustinuerim. 10. Pater te a vitio arcuit. 11. Age patri gratias, quum te a vitio arcuerit. 12. Cave ne animus vitæ solicitudiuibus se admisceat. 13. Magnum fovi in pectore meo amorem. 14. In meo pectore magnus amor in te fotus est. 15. Quis hoc bellum movit? 16. Hostium duces hoc bellum moverunt. 17. Tua mens excita nunquam sedabitur. 18. Delete hæc verba. 19. Historiam imperii ejus delevit. 20. Mala non sunt facilia deletu. 21. Pater tuus vitium delendum esse censuit.

EXERCISE 135.—LATIN-ENGLISH.

1. Teach me how I may escape these things. 2. I did not receive the letter which should inform me what you were doing. 3. I told you your brother's reason. 4. The judge must be informed of the cause of the affair. 5. His father informs the judges concerning the injuries of Augustus. 6. Your uncle will instruct you about your journey. 7. It is fit and pleasant to teach those desirous of learning. 8. I envy your máster who for so large a fee has taught you to be wise in nothing. 9. I teach many scholars the Latin language. 10. I must be taught to speak Greek. 11. He taught my daughter to play on the lyre. 12. They may teach him to ride a horse and to use weapons. 13. Will you teach me the Greek language? 14. Teach these my sons music. 15. Gladly will I teach you letters.

EXERCISE 136.—ENGLISH-LATIN.

1. Doce me quo modo tibi prodesse possim. 2. Filiam tuam grammaticam docebunt. 3. Docui uxorem meam Latinam linguam loqui. 4. Me docent fidibus. 5. Latiuam linguam doctus est. 6. Doce eos Græce loqui. 7. A pater doctus multa sum. 8. Musicam a sorore meâ docentur. 9. Nescio quid te doceam de belli evento. 10. Latinam linguam docendi suut pueri. 11. Doctus sum Græce loqui. 12. Multi discipuli a me Latinam linguam docti sunt.

Fable.—The Mouse and the Kite.

A kite, caught in a snare, besought a little mouse to set him free by gnawing the meshes of the net (*the meshes of the net being gnawed*). Which being done, the liberated kite seized the mouse and devoured it. This fable shows what thanks the wicked are wont to give in return for benefits.

RECREATIVE NATURAL HISTORY.

THE ANTELOPES.

WE have already treated of three great families of ruminants, the ox, sheep, and deer,* and we must now finish our account of this important order of mammals by some notices of the antelopes. These resemble the ox and sheep in possessing *permanent* and *hollow* horns, and the deer in their forms and motions. If numbers entitle animals to high consideration, then the antelopes will occupy the first rank among ruminants. To a native of Europe this statement may at first seem questionable; but a slight acquaintance with the works of African and Asiatic travellers will lead to the conviction that if a census of the ruminants could be taken, the antelopes would outnumber all the ox, sheep, and goat families combined. These quadruped armies give life to the far-stretching table-lands of Asia, and cover the luxuriant plains of South Africa. Some species find food in the sandy wilds of Thibet, and on the storm-swept steppes of Mongolia; others make their homes in the deep forests of northern India; while some delight in mountain peaks and rocky solitudes. The great number of species into which this extensive family is divided renders it impossible in one short article to describe more than a few of the more remarkable members of the group.

Europe can, at the utmost, reckon but two antelopes among her ruminants, the chamois (*Antilope rupicapra*) and the saiga (*Antilope colus*). The name *rupicapra* (rock-goat), applied to the former, suggests the difficulty which naturalists have felt in classing this creature of the Alpine peaks. We will, however, admit it among the antelopes, and this will give one species of the family to Western Europe, leaving the saiga to the regions of the Lower Danube and the hills of Caucasus. Neither species can be deemed a good example of antelope form and beauty, the rough coat of the chamois, and the heavy, sheep-like body of the saiga, exhibiting little of elegance or grace. But either animal may be taken as a good specimen of the wonderful activity and amazing watchfulness which distinguish the whole family. The skill of the keenest rifleman is often baffled when tracking the chamois along the edge of the avalanche or up the ice-covered peaks. Far off the daring animal stands, on some projection of a rock where no hunter's foot can tread, or bounds from crag to crag as if endowed with supernatural energies. No finer specimen of brute skill and courage can be witnessed in Europe. The muscular power by which the brave creature balances itself on the narrow ledge of rock, and then springs from this across a fathomless gulf to a mere shelf of the opposite precipice, may well excite the envy of the most daring and best-trained hunters. The contest between human power and animal energy is here seen in its highest forms.

The saigas, or antelopes of Eastern Europe, are often seen in flocks many thousands in number when making their autumnal migration from the barren plains of the north to the sheltered valleys of the south. Man keeps a sharp look-out for their approach, and destroys vast multitudes, not for the sake of venison, but to enrich himself by the sale of their horns and skins. The *belles* of Europe and Asia wear ornamental combs made from the transparent substance of the saiga's horn, while the skins may appear, as elegant gloves, in the shops of London and Paris. Thus far this antelope may claim to be a promoter of civilisation, and to share with the tortoise the honour of adorning beauty's head.

The *gazelle*, or Dorcas antelope, has supplied Eastern poets with many an image suggestive of honest praise or fulsome flattery. The lover has won the Moorish lady's heart by sending to her the message, "You have the eyes of a gazelle." Such brevity was to her mind the very soul of wit, and of its meaning no damsel with even the smallest of hearts could doubt. The beauty and speed of the gazelle did not escape the notice of the ancient Hebrew poets and historians. The swiftness of the warrior Asahel and of the Gadites† is likened to that of the gazelle, while in the Song of Solomon the animal is taken as the most expressive symbol of the beautiful.‡ These antelopes are as courageous as they are graceful. When attacked by the lion of the Sahara, the males form themselves into a circle, with the

* See Vol. III., pp. 273, 344, 401.

† 2 Sam. ii. 18, and 1 Chron. xii. 8.

‡ Song of Sol. ii. 9, 17. The reader will bear in mind that the "roe" of these passages is the gazelle.

does and fawns in the centre, and, presenting a line of sharp horns to the enemy, prepare to receive his charge on this row of living bayonets. Readers must not confound the rare algazel (*Antilope gazella*) of Senegal with the beautiful species we have just described. The algazel is little known, but is remarkable for the extraordinary horns which, curving backwards over the neck, form an arc of a large circle. The name usually given to this antelope is very misleading, for "al" being only the definite article, the compound epithet al-gazel signifies *the* gazelle, and thus leads many to confound this species with the more famous Dorcas antelope. The algazel appears to be related to a species around which many a fable has grown. From what animal was the notion of a unicorn derived? The shape of this heraldic creature, and its possession of a horn, naturally lead us to look for its type among the antelopes. The abu-addas (father-addas) or white antelope of Nubia (*Antilope leucoryx*) has been selected as the animal which may have suggested the notion of the unicorn to the ancient naturalists. But as the abu-addas has *two* long horns, it seems impossible to imagine how it could have suggested the idea of a *one*-horned quadruped. The abu-addas is, we admit, so represented in profile on the monuments of ancient Egypt that only one horn is visible; but it is not probable that the old writers on the unicorn were misled by any such pictorial peculiarities. Some have thought that the Chiree antelope, frequenting the forests of the lower Himalayas, and which *sometimes* has but one horn, must have given the first notion of the unicorn. Laughing sceptics may inquire why this constant heraldic companion of the British lion should be traced from any actual animal. Surely, if the zoologists of olden times could form the notion and believe in the existence of a bird which had a worm for its mother and lived for 500 years, it would give such men small trouble to imagine a unicorn. We need not, therefore, weary ourselves by searching among the antelopes for the prototype of that valiant beast which formerly upheld the honour of Scotland, and still nobly aids in supporting the shield of the house of Brunswick. We know that some old museums used proudly to exhibit the carefully-preserved horns of unicorns, as positive proofs of the existence of such animals. But we also know that cruel and unromantic naturalists have proved one to be the tusk of the narwhal, or unicorn whale, and another to have been manufactured from an elephant's tusk! If no antelope can be found with one horn, it may be some consolation to discover a species furnished with four. This is the chickara of India (*Antilope quadricornis*), which certainly possesses that number, though the second pair are hardly an inch long.

These animals present us with remarkable differences, not merely in their horns, but in their bodily structure and forms. The nyl-ghau, or blue ox (*Antilope picta*) approaches a bullock in bulk, while the pigmy antelope of Africa is not larger than a rat. The bulk of the huge nyl-ghau, and its ferocity when assailed, preserve it from the attacks of the ordinary hunters, who, even when they have killed it, are seldom able to carry off their prey. We were looking at the animal in the Regent's Park Gardens on one occasion, when a gentleman from India remarked, "I have often seen sixty or seventy of these in a troop, but they were not worth shooting at." The magnificent Mogul emperor Aurungzebe, who modestly styled himself "the conqueror of the world," was also anxious to vanquish the nyl-ghau, which he attacked seated on his trained elephant.

One of the most notable antelopes is the singular gnu, which we might be pardoned for describing as a horned horse. Some have found in its appearance resemblances to the horse, buffalo, and stag. When a long file is seen galloping over the plains of South Africa, they might easily be taken for a troop of zebras. If the animal now in the Zoological Gardens, London, may be regarded as a fair specimen of his race, then we fear the gnus must have terrible tempers. Perhaps that particular animal may be irritated by his imprisonment, but he is by no means a type of antelope gentleness. He saluted us with a fierce bellow, snorted indignantly, and looked as if nothing would gratify him more than to drive his curved horns into our ribs. Not being able thus to indulge his feelings, he consoled himself by angrily tossing up the straw in his compartment. The keepers evidently understand the gentleman's temper, as they have fixed metal caps on his horns.

Amongst the antelopes of South Africa, the springbok, or leaping buck (*Antilope euchore*), would be the most formidable rival of the gazelle for the prize of beauty. The individual in the Zoological Gardens will give an observer some idea of the elegant proportions of the animal, but the graceful freedom of its motions can be seen only on its native plains. Can the reader picture to himself an army of twenty or thirty thousand of these swift and beautiful creatures of the wilderness galloping over the far-stretching wastes? Such are the grand panoramas of animal life shown to the savage tribes of Africa.

THE DORCAS ANTELOPE.

The blessbok (*Antilope albifrons*), called also the painted goat, may in the opinion of many be considered a more beautiful antelope than the springbok. The mode in which the colours are arranged on the body procured for the animal its name of blessbok or blazebuck,* while the peculiar white mark down the face justifies the epithet *albifrons*. Thus the animal has the good fortune to be appropriately named both in Dutch and Latin.

Other interesting species might be noticed, such as the Prongbuck (*Antilope furcifer*) of North America, the beautiful sasin of India (*Antilope cervicapra*), the dzerens of Mongolia (*Antilope gutturosa*), and many more, but our limited space forbids such extended details.

Readers will, probably, not have failed to notice that the widely-spread family of the antelopes are not always very clearly distinguished from the goats on the one hand and the deer on the other, and even approach, in some particulars, to the ox kind. The *permanent* horns may serve to distinguish the antelopes from the deer, but both possess the *tear-pits*, and one species of antelope, the prongbuck, shows a tendency to the *branched* horn. It will thus be seen that the antelopes touch, at various points, every family of the great ruminating order. Another noteworthy fact is the almost complete absence of these animals from America and Europe; one species only, the prongbuck, being found in the former continent, and not more than two in the latter. Yet the prairies of the New World seem more adapted to the habits of such animals than the wild table-lands of Central Asia.

The countless hosts of antelopes which inhabit many a desert region may suggest to us some notion of the living multitudes found in places which we regard as tenantless because man is absent there.

Does not the almost innumerable variety of form and structure in these animals show what amazing modifications may arise from one simple type of animal organisation?

We trust this very brief survey of a race of creatures living in remote lands, far from the range of our observations, may lead some of our readers to take a wider view over the vast field of animal life, and induce others to receive with deeper interest the zoological reports brought from distant regions.

* A strongly-defined white line along the face of a horse is sometimes called a *blaze*.

LESSONS IN GEOLOGY.—X.

FOSSILS.

A fossil, as the derivation of the word indicates (fossns, *dug up*), means anything which is exhumed from the earth. The application of the word is restricted to organic remains, the substance of which has undergone mineralisation or petrifaction. If any of the original material of the body be still unchanged, the term *sub-fossil* is sometimes used, though it is quite unnecessary; for if any organic body had only been buried a few years, without impropriety it might be called a fossil.

There are three kinds of fossils :—

1. When the animal or vegetable remain is embedded in clay, or some recent deposit, and preserved in its natural state.

2. When the original substance of the body has been removed, and particles of mineral matter have replaced the organic particles, thus forming an exact model of the embedded body.

3. When all the hollow parts of the shell have become filled with fine particles of mud, thus forming a cast of the inside. At a subsequent time the shell became removed, and this cast remained to perpetuate the memory of the buried animal.

Fig. 16*a* is a good example of this action. The "fossil screw" is common in the limestone of the middle oolite—the coral-rag—and is nothing but a cast of the internal structure of the *phasianella* (Fig. 16*b*). Fig. 17 shows the cast of the *pleurotomaria* (Fig. 17*b*) in situ. The lime of which the shell was composed was, in each instance, either dissolved by the water under certain circumstances, or otherwise destroyed. The space it occupied is evident in Fig. 17*a*. In this class are placed the prints of the footsteps of birds and beasts, which are found on rocky slabs. In one sense they are the remains of animal life.

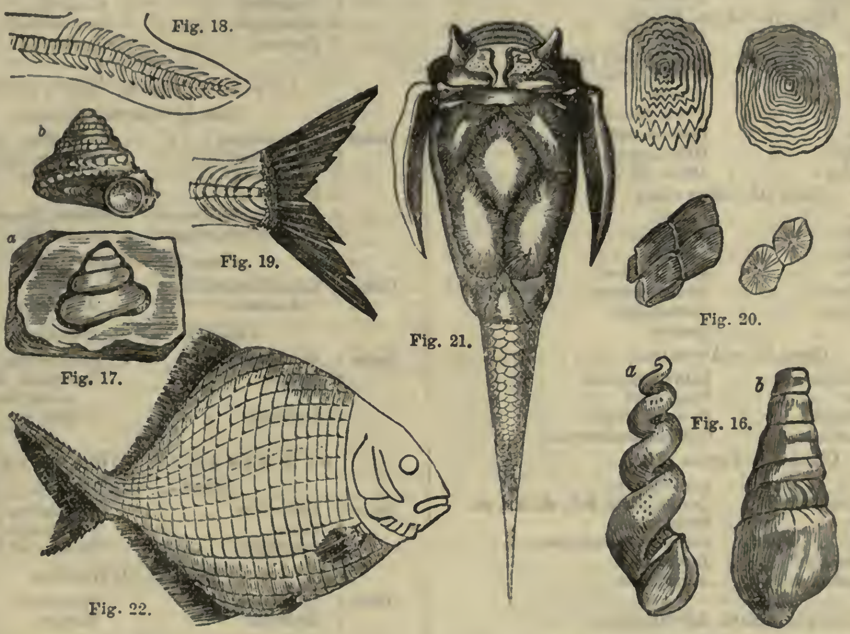


Fig. 18. Fig. 19. Fig. 17. Fig. 22. Fig. 21. Fig. 20. Fig. 16.

The Process of Fossilisation.—The simplest form of fossilisation is when water charged with some mineral in solution saturates a substance, and in its pores deposits the mineral matter.

It is in this manner that petrifying springs "turn into stone" porous bodies immersed in their waters.

This mode of fossilisation may be practically illustrated by steeping thin vertical slices of deal in a solution of green vitriol —sulphate of iron—for several days. The wood is then removed and dried, and upon exposing it to a red heat the vegetable matter is consumed, and nothing but oxide of iron remains, which has so exactly taken the form of the deal that even the casts of the dotted vessels which characterise this species of wood are visible under the microscope.

In this case, as in all cases of recent petrifaction, the original fibre of the wood is left intact, and the pores only are filled up with the mineral matter held in solution in the water. But after a lapse of time a further process sets in, and the original matter of the body begins to decay. Particle after particle makes its escape, either as gas, or, becoming loosened, drops out of its place, and its position is at once filled by an atom of mineral matter. Thus, in time, all the body is replaced by the deposit in which it is buried, and a fossil produced which faithfully preserves the structure of the plant or shell.

Soft animal tissues can never be fossilised, but during their process of putrefaction the gases they emit cause various chemical precipitates to be thrown down from the water in which they are immersed.

The student will frequently find a nodule of clay which, when broken, is found to contain the fossil of an ammonite, or some other shell-fish, bright with a metallic crust of iron pyrites. The presence of this is easily accounted for by the fact that albumen, a constituent of all animal tissues, contains sulphur, and when undergoing decomposition this sulphur escapes as sulphuretted hydrogen gas. If the water be impregnated with iron, a sulphide of that metal would be found at the place where the gas was produced, and thus the fossil would be built up partially of iron sulphide. These replacements of matter frequently take place more than once, and with such wonderful accuracy that a piece of wood, whose ligneous matter had been replaced atom for atom by carbonate of lime, and this again by silica or flint—processes which may have taken ages for their completion—still retains its structure; and, under the microscope, reveals sufficient of the arrangement of the woody fibre to determine its nature.

The observant reader will at once perceive that the best fossils will be found in rocks of the finest grain, such as limestones, whereas sandstones embed fossils which retain no delineation of delicate structure. It frequently happens, especially with fossils of carbonate of lime, that a process of crystallisation has caused a rearrangement of the particles, utterly obliterating all indication of organic structure.

This subject of fossilisation is not sufficiently understood to warrant our dwelling further upon it. We have indicated the general outlines of the process, but the more intricate questions require a greater knowledge of chemistry than we can presume our readers possess. We only would observe that it must not be supposed that in all cases the lapse of many years was required for the completion of the mineralisation, for it frequently happens that the very soft tissues of plants, which would rapidly decay, are beautifully fossilised, especially in siliceous matter, indicating the occasional rapidity of the process.

In enumerating the characteristic fossils of the various systems of rocks, we shall so frequently have cause to refer to the generic names, that we give a full classification of the animal kingdom—omitting the families—as arranged by Professors Owen and Huxley. We shall not have occasion to mention many of the orders here given, but we judge it important to give a table of reference, so that the relative position of those fossils we do not mention may be comprehended. The orders in italics are only known in a fossil state.

KINGDOM, ANIMALIA.

SUB-KINGDOM, VERTEBRATA.

Class I.—Mammalia.

Sub-class. — *Placentalia*.

	Examples.
Archencephala :	
Order 1. Bimana . . .	Man.
Gyrencephala :	
2. Quadrumana . .	Catarhini : Old World Monkeys Platyrhini : New „ „ Strepsirhini : Lemurs.

		Examples.
Order 3.	Carnivora	Digitigrada: Lion, wolf, etc. Plantigrada: Bear, badger. Pinnigrada: Seal, morse. [pig.
4.	Artiodactyla (even-toed, 2 or 4)	Non-ruminantia: Hippopotamus, Ruminantia: Cow, stag, etc.
5.	Perissodactyla (odd-toed, 1 or 3)	Solipedia: Horse. Pachydermata: Rhinoceros, tapir.
6.	Proboscidea.	Elephants.
7.	*Toxodontia*	Toxodon.
8.	Sirenia	Dugong, manatee.
9.	Cetacea	Whale, porpoise.

Lissencephala:

10.	Cheiroptera	Frugivora: Pteropus. Insectivora: Bat.
11.	Insectivora	Hedgehog, mole.
12.	Edentata	Sloth, armadillo.
13.	Rodentia	Rat, hare, beaver.

Sub-class.—*Implacentalia.*

Lyencephala:

Order 1.	Marsupialia	Kangaroo, opossum.
2.	Monotremata	Echidna.

Class II.—Aves (Birds).

Order 1.	Raptores	Eagle, owl.
2.	Scansores	Woodpecker, parrot.
3.	Passeres	Thrush, crow, sparrow.
4.	Columbæ	Pigeon.
5.	Gallinæ	Fowl, peacock.
6.	Cursores	Ostrich, apterix.
7.	Grallatores	Heron, snipe.
8.	Palmipedes	Duck, gull.

Class III.—Reptilia.

Order 1.	Chelonia	Turtle.
2.	Crocodilia	Crocodile.
3.	Lacertilia	Lizard.
4.	*Dinosauria*	Megalosaurus.
5.	*Enaliosauria*	Ichthyosaurus.
6.	*Pterodactylia*	Pterodactyl.
7.	Ophidia	Snakes.

Class IV.—Amphibia.

Order 1.	*Labyrinthodonta*	Labyrinthodon.
2.	Batrachia	Frog, toad.
3.	Saurobatrachia	Proteus, siren.
4.	Ophimoorpha	Cecilia (blindworm).

Class V.—Pisces (Fish).

Order 1.	Dipnoi	Lepidosiren.
2.	Elasmobranchii	Cartilaginous fish, sharks, etc.
3.	Ganoidei	Sturgeon.
4.	Teleostei	Ordinary osseous fish.
5.	Marsipobranchii	Lampreys.
6.	Pharyngobranchii	Amphioxus.

SUB-KINGDOM, ANNULOSA.

DIVISION I.—ARTICULATA.

Class I.—Insecta.

Order 1.	Hymenoptera	Saw-fly.
2.	Coleoptera	Beetles.
3.	Neuroptera	Dragon-fly.
4.	Strepsiptera	Stylops.
5.	Lepidoptera	Butterfly.
6.	Diptera	House-fly.
7.	Orthoptera	Cricket, earwig.
8.	Hemiptera	Bug.
9.	Aptera	Flea.

Class II.—Myriapoda.

Order 1.	Chilopoda	Centipede.
2.	Chilagnatha	Millepede.

Class III.—Arachidna.

Order 1.	Pulmonata	Scorpion.
2.	Amphipneusta	Spiders.
3.	Trachearia	Acarus.
4.	Pycnogonida (?)	Pycnogonum.

Class IV.—Crustacea.

Order 1.	Podophthalmia	Crab, etc.
2.	Edriophthalmia	Isopods.
3.	Branchipoda	Phyllopoda.
4.	Copepoda	Cyclops.
5.	Ostracoda	Cypris.
6.	Cirripedia	Barnacles.
7.	Xiphosura	King-crab.
8.	*Trilobita*	Trilobites.
9.	*Eurypterida*	Eurypterus.

DIVISION II.—ANNULOIDA.

Class V.—Annulata.

Order 1.	Polychæta	Lob-worm.
2.	Oligochæta	Earth-worm.
3.	Discophora	Leech.
4.	Tardigrada	Arctiscon.
5.	Sagittida	Sagitta.

Class VI.—Scolecida.

Order 1.	Trematoda	Fluke.
2.	Tæniada	Tape-worm.
3.	Acanthocephala	Echinorhynchus.
4.	Nematoidea	Thread-worm.
5.	Gordiacea	Hair-worm.
6.	Turbellaria	Planaria.
7.	Rotifera	Rotifer.

Class VII.—Echinodermata.

Order 1.	Holothuridæ	Sea-cucumbers.
2.	Echinidea	Sea-urchins.
3.	Ophiuridæ	Sand-stars.
4.	Asteridea	Star-fish.
5.	Crinoidea	Stone-lily.
6.	*Blastoidea*	Peutremites.
7.	*Cystidea*	Cystidians.

SUB-KINGDOM, MOLLUSCA.

Class I.—Cephalophora.

Order 1.	Dibranchiata	Belemnite.
2.	Tetrabranchiata	Nautilus, ammonite.
3.	Pulmonata	Snail, slug.
4.	Pteropoda	Clio.
5.	Gasteropoda diæcia	Whelk, limpet.
6.	Gasteropoda monœcia	Tornatella.

Class II.—Conchifera.

Order 1.	Lamellibranchiata or Acephala	All ordinary bivalve shells.

Class III.—Molluscoidea.

Order 1.	Brachiopoda	Terebratula, orbicula, lingula.
2.	Bryozoa	Festenella, retepora, and other zoophytes.
3.	Tunicata	Ascidia, etc.

SUB-KINGDOM, CŒLENTERATA.

Class I.—Actinozoa.

Order 1.	Alcyonaria	Alcyonium.
2.	*Rugosa*	Four-starred corals.
3.	Zoantharia	Six-starred corals.

Class II.—Hydrozoa.

Order 1.	Lucernaroida	Sertularia.
2.	Hydroida	Medusa.

SUB-KINGDOM, PROTOZOA.

Class I.—Stomatoda.

Order 1.	Noctilucida (?)	Noctiluca.
2.	Infusoria	Vorticella.

Class II.—Astomata.

Order 1.	Spongiadæ	Sponges.
2.	Foraminifera	Nummulites, orbitolites.
3.	Thalassicolidæ	Thalassicolla.
4.	Gregarinidæ	Gregarina.

The above tabulation is intended for reference. We have left the meanings of the terms unexplained, intending to enter into the explanation of those under which the various fossils we shall deem it necessary to mention will be arranged.

Like all systems of classification, it is only provisional, and as further examination is conducted, it is altered and adapted accordingly.

There is another division of the class "Pisces," which was arranged by Agassiz.

In almost all the fish of the *Palæozoic* period, the limits of which will be defined in the next lesson, the skeleton passed on to the tip of the tail, causing the lobes to be unequal, hence such fish are said to be *heterocercal* (different-tailed)—Fig. 18. Very few of these fish now exist; the shark and sturgeon are examples.

The great majority of recent fish are *homocercal* (having tails with *like* lobes)—Fig. 19. This caudal development will be recognised as that appearing in all existing fish, save those named. Fossil fish have another means of being recognised—by the scales. The earliest fish are covered with scales of bone, faced with a hard, shining enamel. Hence they are called *Ganoid* (*γανος, splendour*). Thin plates like tesselated pavement covered the whole fish. The bony-pike of North America is a living example of this class. After these the *Placoid* (*πλαξ, a plate*) appear. These have their skin covered with plates of enamel, but not of so thick a character as the ganoid. These plates are not regular, and vary in size from considerable dimensions to a point like the shagreen or the skin of the shark. All cartilaginous fish—that is, those which have no bony skeleton—except the sturgeon, are of this class.

The remaining two divisions contain recent and present fish. The *Ctenoid* (from *κτεις, κτενος, a comb*) have scales gimped at one edge, like those of the perch. The remaining division is the *Cycloid*, whose scales are round and horny, like those of the salmon. In the last two instances the scales overlap each other like the slates of a roof. Fig. 20 represents these varieties of scales. The general name of *Icthyolite* (fish-fossil) is applied to all fish remains. Fig. 21 indicates the manner in which the ganoid fish are plated. In this instance five broad enamelled scales coat the back. Fig. 22 is a placoid, in which the plates are much thicker, and arranged like tiles in a pavement. This fish, it will be noticed, is a heterocerc.

LESSONS IN ITALIAN.—XI.

DECLENSION OF NOUNS WITH ARTICLE, ETC., PRECEDING.

THERE are, besides the article, many other words (numerals, pronouns, and adjectives) pointing out with more or less precision the definite character of a noun, and generally connected with it. Some of these are of such primary importance for the very beginnings of reading and conversation, that I consider it useful to present at once their various changes. The declension of these words likewise requires that only the three case-signs *di*, *a*, and *da*, should be placed before them. I shall also lay down here, as a general rule in Italian, that any numeral, pronoun, or adjective which points out the definite character of a noun with a sufficient or with a still greater precision than the article itself, renders the latter superfluous, and such words are, on the other hand, always accompanied by the article when they do not precisely determine the noun before which they are placed.

II.—NOUNS DECLINED WITH SOME IMPORTANT WORD PRECEDING THEM.

Singular.

Un fió-re, a flower.	*U-no scú-do*, a shield.
D' un fió-re, of a flower.	*D' ú-no scú-do*, of a shield.
Ad un fió-re, to a flower.	*Ad ú-no scú-do*, to a shield.
Un fió-re, a flower.	*U-no scú-do*, a shield.
Da un fió-re, from a flower.	*Da ú-no scú-do*, from a shield.
In un fió-re, in a flower.	*In ú-no scú-do*, in a shield.
Con un fió-re, with a flower.	*Con ú-no scú-do*, with a shield.
Per un fió-re, for a flower.	*Per ú-no scú-do*, for a shield.

Plural.

Al-cú-ni fió-ri, some flowers.	*Al-cú-ni scú-di*, some shields.
D' al-cú-ni fió-ri, of some flowers.	*D' al-cú-ni scú-di*, of some shields.
Ad al-cú-ni fió-ri, to some flowers.	*Ad al-cú-ni scú-di*, to some shields.
Al-cú-ni fió-ri, some flowers.	*Al-cú-ni scú-di*, some shields.
Da al-cú-ni fió-ri, from some flowers.	*Da al-cú-ni scú-di*, from some shields.
In al-cú-ni fió-ri, in some flowers.	*In al-cú-ni scú-di*, in some shields.
Con al-cú-ni fió-ri, with some flowers.	*Con al-cú-ni scú-di*, with some shields
Per al-cú-ni fió-ri, for some flowers.	*Per al-cú-ni scúdi*, for some shields.

The word *ú-no* for the masculine, and *ú-na* for the feminine, is considered by many grammarians to be the indefinite article corresponding to *a* or *an* in English. It, however, seems to me illogical to call a word so which serves so many purposes, and has so many meanings. It is a word expressing indefinite unity: for example, *un lí-bro*, a book, and *ú-na cá-sa*, a house, express the general idea of any book and any house. It is, moreover, a word expressing definite unity, that is, a numeral: for example, *un' uô-mo e cín-que dôn-ne*, one man and five women; *ú-na líb-bra e tre ón-ce*, one pound and three ounces. It is also frequently a pronoun, having the definite articles *lo* and *la* before it signifying *the one* (masculine and feminine): for example, *l' ú-no dí-ce di sì*, *l' ál-tro di nô*, the one says yes, the other no; *l' ú-na è bêl-la*, *l' ál-tra è brút-ta*, the one (woman) is pretty, the other is ugly. These examples, I think, will be sufficient to show that it would only tend to mislead to call it an article.

When *ú-no* comes before a consonant which is not the *s* impure, we only say and write *un*: for example, *un lí-bro*, a book; *un ca-vál-lo*, a horse; *un véc-chio*, an old man. When it comes before the *s* impure *ú-no* must be always employed: for example, *ú-no spí-ri-to*, a spirit; *ú-no stre-gó-ne*, a sorcerer. When it comes before a noun of the masculine gender commencing with a vowel, the final *o* of *ú-no* is not pronounced, and in writing an apostrophe is not necessarily used instead: for example, *un ár-co*, a bow, arch; *un ec-cés-so*, an excess; *un in-gé-gno*, a genius; *un ór-so*, a bear; *un uô-mo*, a man. The feminine, *ú-na*, generally loses the *a*, and an apostrophe must be substituted before nouns commencing with a vowel; for example, *un' á-ni-ma*, a soul; *un' ér-ba*, an herb; *un' ó-ra*, an hour; *un im-pré-sa*, an undertaking; *un' ún-ghia*, a nail, hoof. In all other cases *ú-na* is written and pronounced in full. It is obvious that when *ú-no* and *ú-na* signify definite or indefinite unity, they can have no plural. The words *al-cú-ni*, some, pl. (for the masculine), and *al-cú-ne*, some, pl. (for the feminine), may be, however, considered as substitutions for the plural of *ú-no* and *ú-na* in such a case. *Al-cú-ni* and *al-cú-ne* are, strictly speaking, the plurals of the pronouns *al-cú-no* (masc.), and *al-cú-na* (fem.), somebody.

Singular.	*Plural.*
Un a-mí-co, a friend.	*Al-cú-ni a-mí-ci*, some friends.
D' un a-mí-co, of a friend.	*D' al-cú-ni a-mí-ci*, of some friends.
Ad ún a-mí-co, to a friend.	*Ad al-cú-ni a-mí-ci*, to some friends.
Un a-mí-co, a friend.	*Al-cú-ni a-mí-ci*, some friends.
Da un a-mí-co, from a friend.	*Da al-cú-ni a-mí-ci*, from some friends.
In un a-mí-co, in a friend.	*In al-cú-ni a-mí-ci*, in some friends.
Con un a-mí-co, with a friend.	*Con al-cú-ni a-mí-ci*, with some friends.
Per un a-mí-co, for a friend.	*Per al-cú-ni a-mí-ci*, for some friends.

Singular.

U-na gal-lí-na, a hen.	*Un' ó-ca*, a goose.
D' ú-na gal-lí-na, of a hen.	*D' un' ó-ca*, of a goose.
Ad ú-na gal-lí-na, to a hen.	*Ad un' ó-ca*, to a goose.
U-na gal-lí-na, a hen.	*Un' ó-ca*, a goose.
Da ú-na gal-lí-na, from a hen.	*Da un' ó-ca*, from a goose.
In ú-na gal-lí-na, in a hen.	*In un' ó-ca*, in a goose.
Con ú-na gal-lí-na, with a hen.	*Con un' ó-ca*, with a goose.
Per ú-na gal-lí-na, for a hen.	*Per un' ó-ca*, for a goose.

Plural.

Al-cú-ne gal-lí-ne, some hens.	*Al-cú-ne ó-che*,* some geese.
D' al-cú-ne gal-lí-ne, of some hens.	*D' al-cú-ne ó-che*, of some geese.
Ad al-cú-ne gal-lí-ne, to some hens.	*Ad al-cú-ne ó-che*, to some geese.
Al-cú-ne gal-lí-ne, some hens.	*Al-cú-ne ó-che*, some geese.
Da al-cú-ne gal-lí-ne, from some hens.	*Da al-cú-ne ó-che*, from some geese.
In al-cú-ne gal-lí-ne, in some hens.	*In al-cú-ne ó-che*, in some geese.
Con al-cú-ne gal-lí-ne, with some hens.	*Con al-cú-ne ó-che*, with some geese.
Per al-cú-ne gal-lí-ne, for some hens.	*Per al-cú-ne ó-che*, for some geese.

Singular.	*Plural.*
Tút-to il pó-po-lo, all the nation.	*Tút-ti i pó-po-li*, all nations.
Di tút-to il pó-po-lo, of all the nation.	*Di tút-ti i pó-po-li*, of all nations.
A tút-to il pó-po-lo, to all the nation.	*A tút-ti i pó-po-li*, to all nations.
Tút-to il pó-po-lo, all the nation.	*Tút-ti i pó-po-li*, all nations.
Da tút-to il pó-po-lo, from all the nation.	*Da tút-ti i pó-po-li*, from all nations.
In tút-to il pó-po-lo, in all the nation.	*In tút-ti i pó-po-li*, in all nations.
Con tút-to il pó-po-lo, with all the nation.	*Con tút-ti i pó-po-li*, with all nations.
Per tút-to il pó-po-lo, for all the nation.	*Per tút-ti i pó-po-li*, for all nations.

The words *tút-to* (masc.), *tút-ta* (fem.), all, entire, whole, and *am-be-dúe*, both, have this peculiarity, that the article is placed after them whenever they come before a noun; as, *tút-to il món-do*, all the world; *am-be-dúe i fra-têl-li*, both the brothers. *Am-be-dúe* is used for the masculine as well as for the feminine, and it is obvious, from its signification,

* The auxiliary letter, *h*, has been interposed between *c* and *e*, to preserve in the plural *ó-che* (ô-kai) the sound of *c* in the singular *ó-ca* (ô-kah). Without the *h*, the plural of *ó-ca* would be *-óce*, pronounced ô-tchai. This will be more fully explained hereafter.

that it can have no singular. The singular *tút-to* and *tút-ta* signifies the whole of, ALL THE; the plural *tút-ti* and *tút-te* merely signifies ALL. For example, *tút-to il clê-ro*, the whole clergy; *in pre-sên-za di tút-ti i cor-ti-giá-ni*, in the presence of all the courtiers; *tút-ta la cit-tà*, the whole town; *tút-te le nôt-ti*, all nights; *tút-ti gli uô-mi-ni*, all men; *di tút-ta la têr-ra*, of the whole earth; *di tút-te le dôn-ne*, of all the ladies.

Singular.

Quel giar-dí-no, that garden.	*Quest' uc-cêl-lo*, this bird.
Di quel giar-dí-no, of that garden.	*Di quest' uc-cêl-lo*, of this bird.
A quel giar-dí-no, to that garden.	*A quest' uc-cêl-lo*, to this bird.
Quel giar-dí-no, that garden.	*Quest' uc-cêl-lo*, this bird.
Da quel giar-dí-no, from that garden.	*Da quest' uc-cêl-lo*, from this bird.
In quel giar-dí-no, in that garden.	*In quest' uc-cêl-lo*, in this bird.
Con quel giar-dí-no, with that garden.	*Con quest' uc-cêl-lo*, with this bird.
Per quel giar-dí-no, for that garden.	*Per quest' uc-cêl-lo*, for this bird.

Plural.

Quei giar-dí-ni*, those gardens.	*Qué-sti uc-cêl-li*, these birds.
Di quei giar-dí-ni, of those gardens.	*Di qué-sti uc-cêl-li*, of these birds.
A quei giar-dí-ni, to those gardens.	*A qué-sti uc-cêl-li*, to these birds.
Quei giar-dí-ni, those gardens.	*Qué-sti uc-cêl-li*, these birds.
Da quei giar-dí-ni, from those gardens.	*Da qué-sti uc-cêl-li*, from these birds.
In quei giar-dí-ni, in those gardens.	*In qué-sti uc-cêl-li*, in these birds.
Con quei giar-dí-ni, with those gardens.	*Con qué-sti uc-cêl-li*, with these birds.
Per quei giar-dí-ni, for those gardens.	*Per qué-sti uc-cêl-li*, for these birds.

A full explanation of the two important pronouns *quél-lo* (masc.), *quél-la* (fem.), that, and *qué-sto* (masc.), *qué-sta* (fem.), this, will be given hereafter. It will be sufficient for the present to remark, that whenever these two pronouns come before nouns, *qué-sto* points out an object near to him who speaks (or writes), or an object just mentioned, while *quél-lo* points out an object at a smaller or greater distance from him who speaks (or writes), as well as from him who is spoken to: for example, *dá té-mi quel lí-bro*, give me that (yonder) book; *pren-dé-te-vi qué-sto lí-bro*, take this book. Before words commencing with the *s* impure, *quél-lo* is used. Before words commencing with vowels, the *final* *o*'s and *a*'s of *quél-lo*, *quél-la*, and *qué-sto*, *qué-sta*, are generally not pronounced, and in writing an apostrophe is placed instead: for example, *quél-lo sbír-ro*, that bailiff; *quél-lo scel-le-rá-to*, that wretch; *quell' uô-mo*, that man; *quell' ap-pa-rên-za*, that appearance; *quest' al-lô-ro*, this laurel; *quest' úl-ti-ma im-pré-sa*, this last enterprise. Before all other words of the masculine gender, *quel* must be used: for example, *quel lí-bro*, that book; *quel bel poê-ma*, that fine poem; *quel prô-de guer-riê-ro*, that brave warrior.

Singular.	*Plural.*
O-gni† sol-dá-to, each soldier.	*Cín-que sol-dá-ti*, five soldiers.
D' ó-gni sol-dá-to, of each soldier.	*Di cín-que sol-dá-ti*, of five soldiers.
Ad ó-gni sol-dá-to, to each soldier.	*A cín-que sol-dá-ti*, to five soldiers.
O-gni sol-dá-to, each soldier.	*Cín-que sol-dá-ti*, five soldiers.
Da ó-gni sol-dá-to, from each soldier.	*Da cín-que sol-dá-ti*, from five soldiers.
In ó-gni sol-dá-to, in each soldier.	*In cín-que sol-dá-ti*, in five soldiers.
Con ó-gni sol-dá-to, with each soldier.	*Con cín-que sol-dá-ti*, with five soldiers.
Per ó-gni sol-dá-to, for each soldier.	*Per cín-que sol-dá-ti*, for five soldiers.

VOCABULARY.

Panno, cloth.
Coltello, knife.
Tondo, plate.
Sale, salt.
Cibo, article of food, aliment.
Cortile, court-yard.
Cuoco, cook. (The plural of this noun requires the auxiliary letter *h* between *c* and *i*, in order to preserve the sound of *c* like *k*.)
Sogno, dream.
Teatro, theatre.
Ruscello, brook.
Polmone, lung.
Danaro, money.
Fazzoletto, pocket-handkerchief.
Cappello, hat.
Piacere, pleasure.
Mantello, cloak.
Giovane, young man, youth.
Ponte, bridge.
Quadro, picture.
Terra, earth.
Staffiere, footman.
Sposo, bridegroom.
Straniere, stranger.
Stramazzo, a quilted mattress.
Spiedo, *spiedo*, spit, broach.
Smeraldo, emerald.
Scrittore, author, writer.
Stampatore, printer.
Stato, state, condition. (After the four particles *con*, *in*, *non*, and *per*, and, generally speaking, after every word ending with a consonant, the vowel *i* is, for the sake of harmony, prefixed to any word commencing with the *s* impure, unless it be a proper noun: thus, *Stè-fa-no*, *Sci-pió-ne*; for it is not allowable to say *con Istefano*, *con Iscipione*, etc.)
Specchio, looking-glass.
Stivale, boot.
Studio, study.
Spirito, spirit.
Scultore, sculptor.
Strumento, instrument, tool.
Spaccalegna, wood-cleaver.
Spadajo, sword-cutler.
Scoglio, rock.
Scanno, bench.
Occhio, eye.
Uccello, bird.
Amico, friend.
Osso, bone.
Errore, error, fault.
Incisore, engraver.
Ingrato, ungrateful.
Albero, tree.
Onore, honour.
Anno, year.
Orecchio (pl. *orecchj*), ear.
Amore, love.
Abito, dress, coat.
Iniquo, wicked.
Inganno, deceit.
Operajo, day-labourer.
Adulatore, flatterer.
Edifizio, building, edifice.
Infelice, unhappy.

EXERCISE 1.

1. Il pán-no. 2. Del col-têl-lo. 3. Al tón-do. 4. Dal sá-le. 5. I cí-bi. 6. Dei cor-tí-li. 7. Ai cuô-chi. 8. Dai só-gni. 9. In teá-tro. 10. Nel ru-scêl-lo. 11. Nei pol-mó-ni. 12. Con da-ná-ro. 13. Col faz-zo-lét-to. 14. Coi cap-pêl-li. 15. Per pia-cé-re. 16. Pel man-têl-lo. 17. Pei gió-va-ni. 18. Sul pón-te. 19. Sui quá-dri. 20. Su qué-sta têr-ra. 21. Lo staf-fiê-re. 22. Dél-lo spô-so. 23. Al-lo stra-niê-re. 24. Dál-lo stra-máz-zo. 25. Gli spiê-di. 26. Dé-gli sme-rál-di. 27. A-gli scrit-tó-ri. 28. Dá-gli stam-pa-tó-ri. 29. In i-stá-to. 30. Nél-lo spêc-chio. 31. Né-gli sti-vá-li. 32. Con i-stú-dio. 33. Cól-lo spí-ri-to. 34. Có-gli scul-tó-ri. 35. Per i-stru-mén-ti. 36. Per lo spac-ca-lé-gna. 37. Per lo spa-dá-jo. 38. Súl-lo scô-glio. 39. Sú-gli scán-ni. 40. L' ôc-chio. 41. Dell' uc-cêl-lo. 42. All' a-mí-co. 43. Dall' ôs-so. 44. Gli er-ró-ri. 45. Dêgl' in-ci-só-ri. 46. Agl' in-grá-ti. 47. Dá-gli ál-be-ri. 48. In o-nó-re. 49. Nell' án-no. 50. Né-gli o-réc-chj. 51. Con a-mó-re. 52. Coll' á-bi-to. 53. Cógl' i-ni-qui. 54. Per in-gán-no. 55. Per l' o-pe-rá-jo. 56. Per gli a-du la-tó-ri. 57. Sull'e-di-fí-zio. 58. Sugl' in-fe-lí-ci.

The following forms one of the anticipatory exercises mentioned and commented on in my introductory remarks on the Grammar proper. In order to attain the object proposed, of familiarising the reader with conversational language by a more practical and quicker method than the theoretical explanations of grammar would allow, it will be necessary to read these exercises aloud, to translate them into English, and to retranslate them into Italian, that the words and phrases for this purpose constantly recurring may be firmly impressed on the memory. The ingenious will, moreover, not fail themselves to trace out important rules of grammar by a careful study of these exercises.

VOCABULARY.

Il pá-dre, the father.
La má-dre, the mother.
Il fra-têl-lo, the brother.
La so-rêl-la, the sister.
Buó-no (m.), *buó-na* (f.), good; *E*, *ed* (before a vowel), and; *è*, is.
Mí-o, *il-mí-o* (m.), *Mí-a*, *la-mí-a* (f.), my.
U-no (m.), *ú-na* (f.) a, an.
Tú-o (m.), *tú-a* (f.), thy.
Ha, has.
An-che, also, likewise, too.
Il lí-bro, the book.
La pén-na, the pen.
Grán-de, great, large.
Píc-co-lo, little, small, slender.

EXERCISE 2 (COLLOQUIAL).

1. Il pá-dre e la má-dre. 2. Il fra-têl-lo e la so-rêl-la. 3. Il pá-dre è buô-no, la má-dre è buô-na. 4. Il buôn pá-dre, la buô-na má-dre. 5. Il fra-têl-lo è buô-no, la so-rêl-la è buô-na. 6. Il buôn fra-têl-lo, la buô-na so-rêl-la. 7. Mí-o pá-dre; il mí-o buôn pá-dre. 8. Mí-a má-dre; la mí-a buô-na má-dre. 9. Mí-o pá-dre è buô-no, mí-a má-dre è buô-na. 10. Mí-o fra-têl-lo e mí-a so-rêl-la. 11. Il mí-o buôn fra-têl-lo e la mí-a buô-na so-rêl-la. 12. Mí-o fra-têl-lo è buô-no, mí-a so-rêl-la è buô-na. 13. Un pá-dre, ú-na má-dre, un fra-têl-lo, ú-na so-rêl-la. 14. Un buôn pá-dre, ú-na buô-na má-dre, un buôn fra-têl-lo, ú-na buô-na so-rêl-la. 15. Mí-o pá-dre è un buôn pá-dre, mía má-dre è ú-na buô-na má-dre. 16. Mí-o fra-têl-lo è un buôn fra-têl-lo, mí-a so-rêl-la è ú-na buô-na so-rêl-la. 17. Tú-o pá-dre è buô-no, mí-o pá-dre è án-che buô-no. 18. Tú-a má-dre è buô-na, mí-a má-dre è án-che buô-na. 19. Tú-o pá-dre ha ú-na buô-na so-rêl-la, tú-a má-dre ha un buôn fra-têl-lo. 20. Mí-o fra-têl-lo è tú-o pá-dre. 21. Mí-o pá-dre è án-che tú-o pá-dre, e mí-a má-dre è án-che tú-a má-dre. 22. Il lí-bro è buô-no, la pén-na è buô-na. 23. Il mí-o lí-bro è píc-co-lo, la mí-a pén-na è grán-de. 24. Túo pá-dre ha un buôn lí-bro, tú-a so-rêl-la ha ú-na buô-na pén-na. 25. Mí-o fra-têl-lo è grán-de, mí-a so-rêl-la è pic-co-la. 26. Il tú-o píc-co-lo fra-têl-lo e la tú-a píc-co-la so-rêl-la. 27. Tú-a so-rêl-la ha la mí-a pén-na, e tú-o fra-têl-lo ha il mí-o lí-bro. 28. Il tú-o píc-co-lo lí-bro è un buôn lí-bro.

* The masculine plural *quei* (also pronounced *quêi*) or *que'*, is a contraction of *quél-li*. Before vowels, or the *s* impure, *qué-gli* is used in the place of the plurals *quél-li*, *quei*, or *que'*: for example, *qué-gli óc-chi*, those eyes; *qué-gli spí-ri-ti*, those spirits. The feminine plurals *quél-le* and *qué-ste* cannot be marked with the apostrophe, but must always be pronounced and written in full.

† *O-gni* has no plural number, and can only be used before nouns.

LESSONS IN BOTANY.—XXXVII.

SECTION CXIV.—LOGANIACEÆ.

Characteristics: Corolla monopetalous, hypogynous, four to ten partite; stamens in number equal to that of the lobes of the corolla; ovary two to four-celled, each containing one or more ovules; leaves opposite, stipulate; fruit capsular, or drupaceous, or fleshy; seed dicotyledonous, albuminous.

The genus *Strychnos* contains the most remarkable species of this natural order. The greater number possess in their bark and seeds two alkaline principles termed respectively *strychnine* and *brucine*. The action of these on the animal organism is extremely violent. The *Strychnos Tieuté* is a climbing plant of the Javanese forests, with the juice of which the natives poison their arrows. It is the celebrated upas, and is often confounded with another Javanese vegetable poison, obtained from the *Antiaris toxicaria*, a tree belonging to the natural family *Artocarpeæ*.

The *Ourari*, or *Wourali*, is also a poison furnished by another member

274. (1) TABERNÆMONTANA LONGIFLORA. (2) ROUPELLIA GRATA. (3) DIPLADENIA ATROPURPUREA.

275. CERBERA AHOUAÏ, A POISON-PLANT OF BRAZIL.

276. TANGHINIA VENENIFLUA, A POISON-PLANT OF MADAGASCAR.

of the same natural family, the *Strychnos toxifera*, a native of Guiana. The Indians who dwell on the banks of the Orinoco, the Ipura, and the Rio Negro, employ this substance as a poison for their arrows.

The *Nux-vomica* tree, or koochla-tree of India (*Strychnos Nux-vomica*), is perhaps the most valuable of the tribe, furnishing an alkaloid (strychnine) very poisonous, but of great use in medicine.

SECTION CXV.—APOCYNACEÆ, OR DOGBANES.

Characteristics: Corolla hypogynous, monopetalous, regular, four or five partite; contorted in æstivation; stamens inserted upon the corolla, in number equal to the lobes of the former; pollen granular; ovary free, bi-carpelled; fruit capsular, or follicular, or fleshy; seed dicotyledonous, straight, ordinarily albuminous; leaves opposite or verticillate; juice milky.

The name of this order, *Apocynaceæ*, is derived from the genus *Apocynum*, which word is derived from the Greek απο (*ap'-o*), from, and κυων (*ku'-ōn*), a dog, and means the *dog-killer*, certain species being dangerous to animals. The *Apocynaceæ* are usually trees or shrubs, seldom herbs, and for the most part contain a milky juice.

This natural order is rather frequent in tropical climates, but the number of species is very inconsiderable in our latitudes. The milky, acrid, and bitter juice which flows from many of the species imparts to the family an emetic and purgative tendency, which in some species is deleterious. The bark of many of the dogbanes contains a bitter astringent principle; in other species a tinctorial matter predominates. The fleshy fruit of others is eatable. The seed of many genera is poisonous, whilst that of others is oily and inoffensive.

In Fig. 274 the student will find representations of three of the most beautiful members of the natural order *Apocynaceæ* or Dogbanes. Of these, the first takes its name from Tabernæmontanus, a celebrated botanist, and is one of a numerous family found chiefly in the East and West Indies and South America; like the second and third, it is a hothouse plant, requiring a temperature varying from 55° in winter to 80° in summer. The caoutchouc-tree, and the hya-hya or cow-tree of Demerara, are worthy of mention among the useful plants of this order, whose only representative in the indigenous flora of Great Britain is the periwinkle (*Vinca*).

Many species of the genus *Cerbera*, as well Asiatic as American, possess narcotic acrid seeds, sometimes poisonous, but useful as a remedy for the bites of serpents. The *Cerbera Ahouaï* (Fig. 275) secretes an exceedingly poisonous juice, which is employed in Brazil for the purpose of stupefying fish.

The poisonous tanghin (*Tanghinia veneniflua*, Fig. 276) is a native of Madagascar, about thirty feet in height, yielding a drupaceous fruit which contains an oily seed, and employed by the natives judicially in the trial by poison. The accuser makes his complaint to the judge, who refers it to an official denominated the *Ampananghin*, and whose office is the double one of priest and executioner. If sufficient presumptive evidence of crime be forthcoming, the *tanghin* is administered, and the guilt or innocence of the accused is judged of by the result. If he recover from the effects of the poison, he is proclaimed innocent; if he die, he is considered guilty, and his goods are forfeited.

LESSONS IN BOOKKEEPING.—XXVI.

INDEX TO LEDGER.

(1) LEDGER. (1)

STOCK.

Dr.				£	s.	d.	Cr.				£	s.	d.
1881.							1881.						
July	1	To Sundries	1	8753	15	0	July	1	By Sundries	1	32391	17	10
Dec.	31	„ Balance Account	11	25310	14	2	Dec.	31	„ Profit and Loss Account	11	1672	11	4
			£	34064	9	2				£	34064	9	2

UNION BANK.

Dr.				£	s.	d.	Cr.				£	s.	d.
1881.							1881.						
July	1	To Stock	1	2550	0	0	July	29	By Cash	1	1156	0	0
„	18	„ Cash	2	1375	0	0	Aug.	31	„ do.	2	375	0	0
Aug.	29	„ do.	3	1086	0	0	Sept.	30	„ do.	5	2608	0	0
Sept.	29	„ do.	5	5812	0	0	Oct.	29	„ do.	6	700	0	0
Oct.	23	„ do.	7	5160	0	0	Nov.	30	„ do.	8	2784	0	0
Nov.	24	„ do.	8	10100	0	0	Dec.	30	„ do.	10	469	0	0
Dec.	31	„ do.	10	5283	0	0	„	31	„ Balance Account	11	23274	0	0
			£	31366	0	0				£	31366	0	0

EXCHEQUER BILLS.

Dr.				£	s.	d.	Cr.				£	s.	d.
1881.							1881.						
July	1	To Stock	1	5310	0	0	Sept.	27	By Cash	5	1512	7	6
Dec.	31	„ Profit and Loss	11	500	0	0	Nov.	17	„ do.	8	2500	0	0
							Dec.	26	„ do.	10	1797	12	6
			£	5810	0	0				£	5810	0	0

BILLS RECEIVABLE.

Dr.				£	s.	d.	Cr.				£	s.	d.
1881.							1881.						
July	1	To Stock	1	7300	15	0	July	18	By Cash	1	1200	0	0
Sept.	6	„ R. O'Brien & Co.	6	2456	15	0	Sept.	8	„ do.	5	730	10	0
Oct.	28	„ Sundries	7	4051	17	6	Oct.	23	„ do.	6	5220	7	6
Nov.	1	„ T. Brown & Co.	9	260	0	0	Nov.	24	„ do.	3	4822	0	0
							Dec.	27	„ do.	10	2096	10	0
			£	14069	7	6				£	14069	7	6

(2) LEDGER. (2)

THREE PER CENTS.

Dr.				£	s.	d.	Cr.				£	s.	d.
1881.							1881.						
July	1	To Stock	1	5400	0	0	Sept.	21	By Cash	5	2846	5	0
Dec	31	„ Profit and Loss	11	322	10	0	Nov.	14	„ do.	8	2876	5	0
			£	5722	10	0				£	5722	10	0

DEBENTURES.

Dr.				£	s.	d.	Cr.				£	s.	d.
1881.							1881.						
July	1	To Stock	1	513	0	0	Aug.	29	By Cash	2	115	8	0
							Dec.	3	„ do.	10	397	12	0
			£	513	0	0				£	513	0	0

SHIP VICTORIA, *Our ⅛ Share.*

Dr.				£	s.	d.	Cr.				£	s.	d.
1881.							1881.						
July	1	To Stock	1	3000	0	0	July	6	By Cash	1	175	3	0
Dec.	31	„ Profit and Loss	11	475	3	0	Dec.	10	„ do.	10	300	0	0
							„	31	„ Balance Account	11	3000	0	0
			£	3475	3	0				£	3475	3	0

ADVENTURE IN SCOTCH LINEN.

Dr.				£	s.	d.	Cr.				£	s.	d.
1881.							1881.						
July	1	To Stock	1	2467	0	0	Aug.	21	By J. Roberts	4	808	6	0
Dec.	31	„ Profit and Loss	11	91	6	0	Sept.	9	„ Dawson & Hancock	6	1750	0	0
			£	2558	6	0				£	2558	6	0

*

Dr. **R. O'BRIEN AND CO.** Cr.

1881.				£	s.	d.	1881.				£	s.	d.
July	1	To Stock	1	3530	12	0	Sept.	20	By Cash	5	500	0	0
							,,	6	,, Bills Receivable . .	6	2456	15	0
							Oct.	28	,, do. . .	7	135	0	0
							Dec.	28	,, Cash	10	438	17	0
			£	3530	12	0				£	3530	12	0

(3) LEDGER. (3)

Dr. **P. HUTCHINSON AND CO.** Cr.

1881.				£	s.	d.	1881.				£	s.	d.
July	1	To Stock	1	1350	10	0	Sept.	1	By Cash	5	152	10	0
Dec.	27	,, Cash	10	32	7	6	Oct.	26	,, Bills Receivable . .	7	1230	7	6
			£	1382	17	6				£	1382	17	6

Dr. **T. BROWN AND CO.** Cr.

1881.				£	s.	d.	1881.				£	s.	d.
July	1	To Stock	1	970	0	10	Aug.	4	By Cash	2	970	0	10
Dec.	27	,, Cash	10	260	0	0	Nov.	1	,, Bills Receivable . .	9	260	0	0
			£	1230	0	10				£	1230	0	10

(3) LEDGER. (3)

Dr. **BILLS PAYABLE.** Cr.

1881.				£	s.	d.	1881.				£	s.	d.
July	12	To Cash	2	1145	10	0	July	1	By Stock	1	2350	10	0
Sept.	17	,, do.	5	905	0	0	Aug.	25	,, Sundries . . .	3	1360	0	0
Oct.	22	,, do.	7	73	15	0	Sept.	10	,, J. Henderson . .	6	1300	0	0
Nov.	19	,, do.	8	1892	10	0	Oct.	18	,, Sundries . . .	7	1057	7	0
Dec.	19	,, do.	10	900	0	0							
,,	31	,, Balance Account .	11	1151	2	0							
			£	6067	17	0				£	6067	17	0

Dr. **INSURANCE.** Cr.

1881.				£	s.	d.	1881.				£	s.	d.
July	8	To A. Lloyd . . .	2	25	2	3	July	1	By Stock	1	1880	15	0
Aug.	19	,, do. . . .	4	91	8	9	,,	4	,, N. Herschell . .	2	5	15	6
Nov.	12	,, Cash	8	1880	15	0	,,	8	,, J. Henderson . .	,,	19	6	9
,,	30	,, Sundries . . .	9	29	9	9	Aug.	7	,, Schofield, Halse, & Co.	4	33	18	9
							,,	21	,, J. Roberts . . .	,,	57	10	0
							Nov.	24	,, Import Goods . .	9	6	13	0
							,,	30	,, do. . .	,,	22	16	9
			£	2026	15	9				£	2026	15	9

(4) LEDGER. (4)

Dr. **N. HERSCHELL.** Cr.

1881.				£	s.	d.	1881.				£	s.	d.
July	4	To Sundries . . .	2	6	13	0	July	1	By Stock	1	1370	5	0
Aug.	25	,, Bills Payable . .	3	1300	0	0	Nov.	24	,, Import Goods . .	9	83	3	6
Dec.	31	,, Balance Account .	11	153	8	6	,,	30	,, Insurance . . .	,,	6	13	0
			£	1460	1	6				£	1460	1	6

Dr. **J. HENDERSON.** Cr.

1881.				£	s.	d.	1881.				£	s.	d.
July	8	To Sundries . . .	2	22	16	9	July	1	By Stock	1	720	5	0
Sept.	10	,, Bills Payable . .	6	1300	0	0	Nov.	30	,, Import Goods . .	9	569	16	1
							,,	,,	,, Insurance . . .	,,	22	16	9
							Dec.	31	,, Balance Account .	11	9	18	11
			£	1322	16	9				£	1322	16	9

Dr. **S. MORLEY.** Cr.

1881.				£	s.	d.	1881.				£	s.	d.
Sept.	12	To Cash	5	236	5	0	July	1	By Stock	1	960	15	0
Dec.	26	,, do. . . .	10	960	15	0	Aug.	1	,, Export Goods . .	3	236	5	0
			£	1197	0	0				£	1197	0	0

Dr. **SCHOFIELD, HALSE, AND CO.** Cr.

1881.				£	s.	d.	1881.				£	s.	d.
Aug.	7	To Sundries . . .	4	1444	10	0	July	1	By Stock	1	1150	10	0
Oct.	12	,, Bills Payable . .	7	175	10	0	Oct.	24	,, Bills Receivable . .	7	600	0	0
Dec.	31	,, Balance Account .	11	149	0	0	Dec.	31	,, Interest . . .	10	18	10	0
			£	1769	0	0				£	1769	0	0

Dr.		FOX, TENNANT, AND CO.											Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Aug.	2	To Cash	3	320	15	0	July	1	By Stock	1	320	15	0
Oct.	16	„ Bills Payable . .	7	73	15	0	Dec.	26	„ Cash	10	73	15	0
			£	394	10	0				£	394	10	0

(5) LEDGER. (5)

Dr.		CASH.											Cr.
1881.				£	s.	d.	1881.				£	s.	d.
July	29	To Sundries	1	2531	3	0	July	29	By Sundries . . .	2	2530	10	0
Aug.	31	„ do.	2	1460	8	10	Aug.	31	„ do. . . .	3	1460	8	0
Sept.	30	„ do.	5	8425	1	6	Sept.	30	„ do. . . .	5	8425	8	11
Oct.	29	„ do.	6	5948	15	7	Oct.	29	„ do. . . .	7	5948	4	7
Nov.	30	„ do.	8	13892	10	6	Nov.	30	„ do. . . .	8	13892	8	4
Dec.	31	„ do.	10	7572	7	8	Dec.	31	„ do. . . .	10	7572	13	6
							„	„	„ Balance Account .	11	0	13	9
			£	39830	7	1				£	39830	7	1

Dr.		PETTY CASH.											Cr.
1881.				£	s.	d.	1881.				£	s.	d.
July	29	To Cash	2	10	0	0	Dec.	31	By Profit and Loss . .	11	87	10	0
Aug.	31	„ do.	3	12	10	0							
Sept.	30	„ do.	5	15	0	0							
Oct.	29	„ do.	7	20	0	0							
Nov.	30	„ do.	8	10	0	0							
Dec.	30	„ do.	10	20	0	0							
			£	87	10	0				£	87	10	0

Dr.		A. LLOYD.											Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Dec.	24	To Cash	10	116	11	0	July	8	By Insurance	2	25	2	3
							Aug.	19	„ do.	4	91	8	9
			£	116	11	0				£	116	11	0

LESSONS IN FRENCH.—LIV.

§ 19.—Agreement of Adjectives with Nouns.

(1.) The adjective must agree, in gender and number, with the noun or pronoun which it qualifies:—

Masculine.		*Feminine.*	
Singular.	*Plural.*	*Singular.*	*Plural.*
le *beau* jardin,	les *beaux* jardins.	la *belle* maison,	les *belles* maisons.
the fine garden,	*the fine gardens.*	*the fine house,*	*the fine houses.*
le *grand* livre,	les *grands* livres.	la *grande* carte,	les *grandes* cartes.
the large book,	*the large books.*	*the large map,*	*the large maps.*

(2.) This agreement must take place, not only when the adjective immediately precedes or follows the noun or pronoun, but also when it is separated by other words:—

Masculine.

Singular.—Plaise à Dieu de te rendre assez *bon* pour mériter la vie heureuse! Fénelon.

May God render thee sufficiently good to deserve the blessed life!

Plural.—Jamais, en quoi que ce puisse être les méchants ne sont *bons* à rien de bon. J. J. Rousseau.

The wicked are never, in any circumstances, fitted (good) to perform anything good.

Feminine.

Singular.—L'honneur de passer pour *bonne* l'empêchait de se montrer *mauvaise.* Marivaux.

The honour of passing for good prevented her showing herself bad.

Plural.—Loin de nous raidir contre les inclinations qui sont *bonnes*, il faut les suivre pour servir Dieu. Mme. de Maintenon.

Far from resisting our good inclinations, we should follow them in order to serve God.

(3.) When an adjective relates to two or more substantives, whether in the singular or the plural, and all of the same gender, it must agree with the nouns in gender, and be put in the plural:—

Le riche et l'indigent, l'imprudent, et le sage, *sujets* à même loi, subissent même sort. J. B. Rousseau.	*The rich and the poor, the imprudent and the wise, being subject to the same law, experience the same fate.*

(4.) When the words which the adjective qualifies are of different genders, the adjective must be put in the masculine plural:—

Je tâche de rendre *heureux*, ma femme, mon enfant, et même mon chat et mon chien. Bernardin de St. Pierre.	*I try to render happy my wife, my child, and even my cat and my dog.*
L'ordre et l'utilité *publics* ne peuvent être le fruit du crime. Massillon.	*Public order and utility cannot be the fruits of crime.*

For special rules on this point, see § 83.

§ 20.—Determinative Adjectives.

There are four sorts of determinative adjectives—the demonstrative, the possessive, the numeral, and the indefinite.

§ 21.—Demonstrative Adjectives.

(1.) The demonstrative adjectives are used when an object is to be particularly specified or pointed out. They are never, in French, used substantively, that is, without the nouns which they determine:—

Singular.

Masculine.—**Ce**, *this* or *that*, used *before a word commencing with a consonant.*

Cet, *this* or *that*, used *before a word commencing with a vowel or an* h *mute.*

Feminine.—**Cette**, *this* or *that.*

Plural.

Ces, *these* or *those for both genders.*

Examples.

Masculine singular.		*Feminine singular.*	
Ce soldat,	*this* or *that soldier.*	Cette femme,	*this* or *that woman.*
Cet ami,	*this* or *that friend.*	Cette épée,	*this* or *that sword.*
Cet homme,	*this* or *that man.*	Cette harpe,	*this* or *that harp.*

Plural.

Ces hommes, *these* or *those men.* Ces femmes, *these* or *those women.*

Voyez *ce* papillon échappé du tombeau; Sa mort fut un sommeil, et sa tombe un berceau. Delille.	*See that butterfly escaped from the tomb; his death was a slumber, and his tomb a cradle.*

*

. . . . . *Cet* admirable don, L'instinct, sans doute est loin de l'auguste raison. (DELILLE.)	*That admirable gift, instinct, is doubtless far beneath majestic reason.*
Là, *cette* jeune plante en vase disposée, Dans sa coupe élégante accueille la rosée. (THE SAME.)	*There that young plant shaped as a vase, receives the dew in its elegant cup.*
Ces honneurs que le vulgaire admire, Réveillent-ils les morts au sein des monuments? (SOUIEL.)	*Do these honours admired by the vulgar awake the dead from their sepulchres?*

(2.) When it is necessary to make, in French, a difference similar to that existing between the English words *this* and *that*, the adverbs *ci* and *là* must be placed after the nouns :—

Ce livre-ci, *this book* (here).	Ce livre-là, *that book* (there).
Ces livres-ci, *these books.*	Ces livres-là, *those books.*

§ 22.—POSSESSIVE ADJECTIVES.

(1.) The possessive adjectives, which are always joined to a noun, express possession; they are :—

Singular.		*Plural.*	
Masculine.	*Feminine.*	*Both genders.*	
mon,	ma,	mes,	*my.*
ton,	ta,	tes,	*thy.*
son,	sa,	ses,	*his, her, its.*
notre,	notre,	nos,	*our.*
votre,	votre,	vos,	*your.*
leur,	leur,	leurs,	*their.*

(2.) In French these adjectives take the gender and number of the object possessed, and not, as in English, those of the possessor :—

Masc. sing.	*Fem. sing.*	*Pl. both genders.*
Mon frère, *my brother,*	Ma sœur, *my sister,*	Mes cousins, *my cousins.*
Ton livre, *thy book,*	Ta plume, *thy pen,*	Tes maisons, *thy houses.*
Son papier, *his* or *her paper,*	Sa table, *his* or *her table,*	Ses habits, *his* or *her clothes.*
Notre cheval, *our horse,*	Notre vache, *our cow,*	Nos prairies, *our meadows.*
Votre lit, *your bed,*	Votre chaise, *your chair,*	Vos crayons, *your pencils.*
Leur foin, *their hay,*	Leur paille, *their straw,*	Leurs fermes, *their farms.*

Sobriété dans toute chose, *Mon* ami, c'est l'art de jouir. DU TREMBLAY.	*Sobriety in all things is, my friend, the true enjoyment.*
Ma main de quelque fleur esquisse la peinture. CASTEL.	*My hand sketches the picture of some flower.*
Mes sens sont glacés d'effroi. J. B. ROUSSEAU.	*My senses are frozen with fear.*
De *son* propre artifice on est souvent victime. COLIN D'HARLEVILLE.	*One is often the victim of his own artifice.*
À *sa* vocation chaque être doit répondre. FR. DE NEUFCHATEAU.	*Every being should fulfil his vocation.*
Il faut de *ses* amis endurer quelque chose. MOLIÈRE.	*We must bear something from our friends.*
Notre vie est une maison, Y mettre le feu c'est folie. NIVERNAIS.	*Our life is a house; to set it on fire is folly.*
Vos mailles se romprout sous la charge pesante. CASTEL.	*Your meshes will break under the heavy burden.*
Leurs fleurs suivront mes pas, en récréant ma vue. (THE SAME.)	*Their flowers will follow my steps, and please my sight.*

(3.) The adjectives **mon**, *my;* **ton**, *thy;* **son**, *his* or *her*, are used instead of **ma, ta, sa,** before feminine words commencing with a vowel, or an *h* mute, in order to prevent the meeting of two vowels; thus we say :—

Mon épée, *my sword.*
Ton épouse, *thy wife.*
Son armée, *his army.*

C'en est fait, *mon* heure est venue. BOILEAU.	*All is over, my hour is come.*

(4.) The possessive adjectives must be repeated before every noun :—

Mon frère, ma sœur, et mes cousins sont à Paris.	*My brother, sister, and cousins are at Paris.*

§ 23.—NUMERAL ADJECTIVES.

(1.) There are two kinds of numeral adjectives: the cardinal and the ordinal.

(2.) The cardinal numbers indicate simply the number or quantity, without any reference to order; as, **un**, *one;* **deux**, *two*, etc.

(3.) The ordinal numbers mark the order or rank which persons and things occupy; as, **premier**, *first*, **second**, *second*, etc.

(4.) *Cardinal Numbers.*		(5.) *Ordinal Numbers.*	
un, *feminine* une,	1	premier, *feminine* première; unième,	1st.
deux,	2	deuxième; second, *f.* seconde,	2nd.
trois,	3	troisième,	3rd.
quatre,	4	quatrième,	4th.
cinq,	5	cinquième,	5th.
six,	6	sixième,	6th.
sept,	7	septième,	7th.
huit,	8	huitième,	8th.
neuf,	9	neuvième,	9th.
dix,	10	dixième,	10th.
onze,	11	onzième,	11th.
douze,	12	douzième,	12th.
treize,	13	treizième,	13th.
quatorze,	14	quatorzième,	14th.
quinze,	15	quinzième,	15th.
seize,	16	seizième,	16th.
dix-sept,	17	dix-septième,	17th.
dix-huit,	18	dix-huitième,	18th.
dix-neuf,	19	dix-neuvième,	19th.
vingt,	20	vingtième,	20th.
vingt et un,	21	vingt et unième,	21st.
vingt-deux, etc.	22	vingt-deuxième, etc.	22nd.
trente,	30	trentième,	30th.
trente et un,	31	trente et unième,	31st.
trente-deux, etc.	32	trente-deuxième, etc.	32nd.
quarante,	40	quarantième,	40th.
quarante et un,	41	quarante et unième,	41st.
quarante-deux, etc.	42	quarante-deuxième, etc.	42nd.
cinquante,	50	cinquantième,	50th.
cinquante et un,	51	cinquante et unième,	51st.
cinquante-deux, etc.	52	cinquante-deuxième, etc.	52nd.
soixante,	60	soixantième,	60th.
soixante et un,	61	soixante et unième,	61st.
soixante-deux, etc.	62	soixante-deuxième, etc.	62nd.
soixante-dix,	70	soixante-dixième,	70th.
soixante et onze,	71	soixante et onzième,	71st.
soixante-douze,	72	soixante-douzième,	72nd.
soixante-treize,	73	soixante-treizième,	73rd.
soixante-quatorze,	74	soixante-quatorzième,	74th.
soixante-quinze,	75	soixante-quinzième,	75th.
soixante-seize,	76	soixante-seizième,	76th.
soixante-dix-sept,	77	soixante-dix-septième,	77th.
soixante-dix-huit,	78	soixante-dix-huitième,	78th.
soixante-dix-neuf,	79	soixante-dix-neuvième,	79th.
quatre-vingts,	80	quatre-vingtième,	80th.
quatre-vingt-un,	81	quatre-vingt-unième,	81st.
quatre-vingt-deux, etc.	82	quatre-vingt-deuxième, etc.	82nd.
quatre-vingt-dix,	90	quatre-vingt-dixième,	90th.
quatre-vingt-onze,	91	quatre-vingt-onzième,	91st.
quatre-vingt-douze, etc.	92	quatre-vingt-douzième, etc.	92nd.
cent,	100	centième,	100th.
cent un,	101	cent unième,	101st.
deux cents,	200	deux centième,	200th.
deux cent un, etc.	201	deux cent unième, etc.	201st.
trois cents,	300	trois centième,	300th.
trois cent un, etc.	301	trois cent unième, etc.	301st.
mille,	1000	millième,	1000th.
deux mille,	2000	deux millième,	2000th.
deux mille cinquante,	2050	deux mille cinquantième,	2050th.
un million,	1,000,000	millionième,	1,000,000th.

zéro—0.

§ 24.—VARIATIONS OF THE CARDINAL NUMBERS.

(1.) The following cardinal numbers vary :—

(2.) **Un**, *one*, takes the gender of the noun to which it is prefixed :—

un livre, *one book;* **une** feuille, *one leaf.*

When used substantively, *un* may take the mark of the plural :—

Masc.	Les *uns* et les autres,	*These and those.*
Fem.	Les *unes* et les autres,	*(The ones and the others).*

*

(3.) **Vingt** and **cent**, when preceded and mnltiplied by a number, and not followed by another, take the mark of the plural:—

quatre-*vingts, eighty;*	six *cents, six hundred.*
L'homme vit *quatre-vingts* ans, le chien n'en vit que dix. BUFFON.	*Man lives eighty years, the dog only ten.*
On m'apporta chez moi, douze *cents* francs. J. J. ROUSSEAU.	*They brought me, at my house, twelve hundred francs.*

(4.) **Vingt** and cent, however, when preceded and multiplied by a number, and followed by another, and used to indicate a date of the Christian era, do not take the mark of the plural:—

quatre-*vingt*-cinq hommes,	*eighty-five men.*
cinq *cent* deux hommes,	*five hundred and two men.*
Charlemagne fut proclamé empereur d'Occident, le jour de Noël, en huit *cent.* VOLTAIRE.	*Charlemagne was proclaimed emperor of the West, Christmas-day, in the year eight hundred.*

(5.) **Mille**—*(thousand)*. For the date of the year of the Christian era the form *mil* alone is nsed:—

L'an **mil** huit cent cinquante,	*The year one thousand eight hundred and fifty.*

(6.) With regard to the years which have *preceded* the Christian era, and those which will *follow its first thousand*, the form *mille* is employed:—

La première irruption des Gaulois eut lieu sous le règne de Tarquin, environ l'an du monde trois *mille* quatre cent seize. VERTOT.	*The first irruption of the Gauls took place under the reign of Tarquin, about the year of the world* 3416.

(7.) **Million, billion,** etc., take the mark of the plural.

§ 25.—MISCELLANEOUS OBSERVATIONS ON THE CARDINAL NUMBERS.

(1.) In French, in compnting from twenty to thirty, thirty to forty, etc., the larger number must always precede the smaller. We may not say, as is often done in English, *one* and *twenty*, bnt always **vingt et un, vingt-deux,** etc.

(2.) The conjunction **et** is only used in the following numbers:—**vingt et un** (21), **trente et un** (31), **quarante et un** (41), **cinquante et un** (51), **soixante et un** (61), and **soixante et onze** (71).

With the exception of the six nnmbers mentioned above, the various components of compound nnmbers are connected by hyphens from **dix-sept** (17) to **quatre-vingt-dix-neuf** (99).

(3.) The word *one*, which frequently precedes in English the words *hundred* and *thousand*, must not be rendered in French. We say:—

mille hommes,	*one thousand men.*
cent francs,	*one hundred francs.*

(4.) When the words **cent** and **mille** are used substantively before the name of objects generally reckoned or sold by the hnndred or thonsand, in nnmber or in weight, the word **un** may be placed before them; the name of the object being preceded by the preposition **de**:—

Un cent, un mille de briques,
One hundred, one thousand (of) bricks.
Un cent (un quintal) de sucre,
One hundred (weight) of sugar.

(5.) The words **septante**, *seventy;* **octante**, *eighty;* and **nonante**, *ninety*, are now nearly obsolete, being nsed only in the sonthern provinces of France. They are, as may be seen in the preceding table, replaced by the expressions: **soixante-dix**, *sixty-ten;* **quatre-vingts**, *four twenties* (four score); **quatre-vingt-dix**, *four-score-ten*, &c.

(6.) Before the words **onze**, *eleven*, and **onzième**, *eleventh*, neither the article nor any other word is elided. We say **le onze, le onzième, la onzième.** In pronunciation, the *s* of the plural article les is silent when this article precedes **onze** or **onzième** [*see* § 143 (2)].

§ 26.—OBSERVATIONS ON THE ORDINAL NUMBERS.

(1.) It will be seen that the ordinal numbers, with the exception of **premier** and **second**, are formed from the cardinal by adding **ième** to the latter.

When the cardinal ends in *e*, that *e* is suppressed: **quatre, quatrième**; when the cardinal ends in *q*, *u* is inserted between it and the ending of the ordinal: **cinq, cinquième**; when the cardinal ends in *f*, that *f* is changed into *v*: **neuf, neuvième**; and, finally, when the cardinal ends with a consonant, **ième** is added to it without any other change: **dix, dixième.**

(2.) All ordinal adjectives, except **unième**, may take the mark of the plural.

(3.) **Premier** and **second** alone vary for the feminine, which is formed regularly by adding *e*: **première, seconde.**

(4.) **Unième** (*first*) is only used in composition with **vingt, trente, quarante, cinquante, soixante, quatre-vingt, cent,** and **mille.**

(5.) **Deuxième** is used in composition with the same nnmbers as **unième**, and also by itself. **Second** is only used by itself.

(6.) Hyphens are used in the same cases with ordinal as with cardinal adjectives [*see* § 25 (2)].

(7.) The following words, sometimes used substantively and sometimes adjectively, may be classed among ordinal adjectives:—

Trentenaire,		*of thirty years' duration.*
Quarantenaire,		*of forty* ,, ,,
Quinquagénaire,	*fifty years old,*	*of fifty* ,, ,,
Sexagénaire,	*sexagenarian,*	*of sixty* ,, ,,
Septuagénaire,	*septuagenarian,*	*of seventy* ,, ,,
Octogénaire,	*octogenarian,*	*of eighty* ,, ,,
Nonagénaire,	*nonagenarian,*	*of ninety* ,, ,,
Centenaire,	*centenarian,*	*of one hundred* ,,

Quadragénaire, *a person forty years old,* is a noun.

Trentenaire and **quarantenaire** are law terms:

Possession trentenaire, quarantenaire.	*Thirty, forty years' possession.*

Quarantenaire is also nsed in reference to qnarantine.

The following, **quadragénaire, quinquagénaire, sexagénaire, septuagénaire, octogénaire, nonagénaire,** and **centenaire,** are applied to persons:—

Un octogénaire plantait, etc. LA FONTAINE.	*A man eighty years old was planting trees.*

KEY TO EXERCISES IN LESSONS IN FRENCH.

EXERCISE 191 (Vol. III., page 165).

1. The meeting broke up late. 2. Being able to swim is useful. 3. Eating is necessary to all animals. 4. Look at your children amusing themselves in the garden. 5. We heard them coming. 6. Having learnt that my father was here, I started at once. 7. He was writing, while attentively listening to me. 8. I heard them coming up the stairs, singing. 9. From my window I saw her reading, watering her flowers, and embroidering. 10. Almost all the inhabitants of that town were suffering from ague. 11. We caught them stealing our cabbages. 12. His inclination for gambling will prove the ruin of him. 13. He is sleeping, do not awake him. 14. She is studying, wait. 15. Writing to him is easy. 16. Correcting his children is a father's right and duty.

EXERCISE 192 (Vol. III., page 165).

1. La chasse est un passe-temps salutaire et agréable. 2. Enseigner est difficile. 3. Le boire est nécessaire à l'homme. 4. J'attribue son succès à ce qu'il connait le ministre. 5. Nous les avons entendus rire. 6. Je lis souvent tout en me promenant. 7. Lui ayant donné son argent, je veux un reçu. 8. Nous la rencontrons quelquefois, se promenant toute seule. 9. L'avez-vous vue aller à la station? 10. On le prit grimpant sur un arbre et volant des fruits. 11. Le battant de la cloche est tombé. 12. Il est faible, il lui faut des stimulants. 13. Votre frère joue dans le jardin, pendant que ma cousine est à écrire ses exercices. 14. Les assiégeants reçurent des renforts. 15. C'est le devoir d'un honnête homme de dire la vérité. 16. Il est cruel de battre ce pauvre chien.

EXERCISE 193 (Vol. III., page 220).

1. Does not that young lady find herself much fatigued? 2. She is fatigued and disconraged. 3. Has your sister gone to church according to her custom? 4. My mother and sister have gone there (*thither*). 5. Did your sister return earlier than usual? 6. She returned later than usual. 7. Has that poor sick woman fallen? 8. She has fallen in the mud. 9. Did my mother succeed in deciphering my letter? 10. She (*in it*) has not succeeded. 11. What flowers have you

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gathered? 12. The flowers which I have found are more beautiful than those which you have sent me. 13. Has not your cousin been well? 14. She has been perfectly well. 15. What book have you used, Madam (*Miss*)? 16. I used yours. 17. We used ours (*our own*). 18. With what faults has your son reproached himself? (*lit.* What faults has your son reproached to himself?) 19. The faults with which he reproached himself are not serious (*lit.* The faults which he reproached to himself, etc.). 20. Have you seen them laugh (*laughing*)? 21. I saw them smile (*smiling*). 22. Have you seen them steal (*stealing*) fruit? 23. I saw them steal (*stealing*) apples. 24. Have you warned them of their faults? 25. I have (*warned them of them*). 26. I have not (*warned them of them*).

EXERCISE 194 (Vol. III., page 220).

1. Vos livres sont-ils bien reliés? 2. Ils sont bien reliés, et bien imprimés. 3. Votre petite fille ne s'est-elle point trouvée découragée? 4. Elle s'est trouvée fatiguée, mais non pas découragée. 5. Vos sœurs sont-elles tombées d'accord? 6. Elles ne sont pas tombées d'accord. 7. Mes frères sont tombés d'accord. 8. Qui est venu vous trouver? 9. Vos amis sont venus nous trouver. 10. Votre sœur n'est-elle pas allée à l'église? 11. Ma sœur est allée à l'église, comme de coutume. 12. Votre sœur est-elle revenue plus tôt qu'à l'ordinaire? 13. Ma sœur est revenue plus tard que de coutume. 14. Les champs que vous avez labourés sont-ils grands? 15. Les champs que j'ai achetés sont très grands. 16. Où sont les messieurs que vous avez vus passer? 17. Les dames que j'ai entendues chanter sont dans leur chambre. 18. Votre pauvre sœur est-elle tombée? 19. Cette pauvre malade est-elle tombée dans la boue? 20. Votre sœur est-elle parvenue à lire ce livre? 21. Elle est parvenue à le lire. 22. Avez-vous averti vos sœurs de leur danger? 23. Je les en ai averties. 24. Je ne les en ai pas averties. 25. De quelle plume Mme votre mère s'est-elle servie? 26. Elle s'est servie de la mienne. 27. Ces demoiselles ne se sont-elles pas servies de mon livre? 28. Elles ne s'en sont pas servies. 29. Mme votre mère s'est-elle bien portée? 30. Elle s'est portée à merveille. 31. S'est-elle souvenue de sa promesse? 32. Elle s'en est souvenue. 33. Avez-vous vu rire ces garçons? 34. Je les ai vus sourire. 35. Les avez-vous vus jouer? 36. Je les ai entendus jouer.

EXERCISE 195 (Vol. III., page 221).

1. What inn has been recommended to you? 2. The Golden Lion inn has been recommended to me. 3. What news have you brought? 4. I have brought agreeable news. 5. Are your neighbours dressed? 6. They are not yet dressed. 7. Did they sleep well last night? 8. They did not sleep well. 9. When did they arrive? 10. They arrived at half-past four. 11. Have they slept more than five hours? 12. The six hours which they slept have done them much good. 13. Have your sisters amused themselves? 14. In playing they have hurt their arm. 15. Did they relate our conversation to one another? 16. They related it to each other. 17. Have your friends disappeared. 18. They have not disappeared; they have returned home. 19. Have the soldiers returned, whom you saw going away? 20. They are dead; I saw them (*being*) buried (*saw their funeral*). 21. Have you not made them study? 22. I have made them read. 23. Have you brought silk goods? 24. I have not brought any. 25. The silk goods which I have brought from that place are very beautiful.

EXERCISE 196 (Vol. III., page 221).

1. N'avez-vous pas recommandé mes nièces? 2. Je les ai recommandées. 3. M'avez-vous apporté de bonnes oranges? 4. Je vous en ai apporté. 5. En avez-vous donné à mes deux filles? 6. Je leur en ai donné. 7. Je leur en aurais donné, si j'en avais eu beaucoup. 8. N'avez-vous pas négligé vos études? 9. Je ne les ai pas négligées; je ne les néglige jamais. 10. Les années que cette église a duré, parlent en faveur de l'architecte. 11. Les dix milles qu'il a couru, l'ont fatigué. 12. Vos sœurs se sont-elles nui? 13. Elles se sont flattées. 14. Mes amis se sont-ils présentés? 15. Il est venu trois de vos sœurs (*Trois de vos sœurs sont venues*). 16. Que se sont-elles imaginé? 17. Elles ont conçu l'idée de lire le Tasse. 18. Les avez-vous vus voler mes pommes? 19. Je les ai vus voler vos pêches. 20. Les avez-vous entendues chanter? 21. Je les ai entendues chanter. 22. Les chansons que j'ai entendu chanter ne sont pas nouvelles. 23. J'ai trouvé dans votre chambre les livres que je vous avais défendu de prendre. 24. Les pêches que je vous ai défendu de manger ne sont pas mûres. 25. Avez-vous vu ces soldats? 26. Je les ai vus passer la semaine dernière. 27. Je les ai vu porter à l'hôpital ce matin. 28. Avez-vous apporté des oranges de France? 29. J'en ai apporté. 30. Les oranges que j'en ai apportées sont bonnes. 31. Avez-vous apporté des soieries? 32. J'en ai apporté. 33. Je n'en ai pas apporté.

EXERCISE 197 (Vol. III., page 221).

1. The battle-field was covered with dead. 2. The sham general was soon arrested. 3. The minister's arrival astonished us. 4. It is a well-known fact. 5. The trenches were well guarded. 6. They buried the dead woman at once. 7. The convict appeared. 8. The little girls I patronise are very interesting. 9. You will find their receipts in your drawer.

EXERCISE 198 (Vol. III., page 222).

1. On ouvrit la tranchée malgré le feu de l'ennemi. 2. Vous trouverez de belles pensées dans cet ouvrage. 3. Son coupé est cassé. 4. Ces faits nous étonnèrent. 5. Le prétendu docteur fut bientôt mis à la porte. 6. Les morts et les blessés gisaient encore sur le champ de bataille. 7. Connaissez-vous ce parvenu? 8. Avez-vous vu la mariée? 9. Les exilées n'avaient pas de fortune.

LESSONS IN ARCHITECTURE.—XX.

DOMESTIC ARCHITECTURE IN ENGLAND.—II.

LEAVING castles and mansions, we have now to study domestic architecture as it relates to the wants of the body of the people, especially what are now known as the "great middle classes" of the country. The absence of anything like convenient plan and settled style even in the houses of the nobility, during two or three centuries after the Norman Conquest, has been shown in our previous paper; and while domestic comfort in the modern sense was a thing unknown to princes, their subjects were of course in the rudest possible stage of civilised life. The mean, low houses of the people were little more than huts, and even in the capital the dwellings of the citizens in the twelfth century were mere sheds of wood, of one, or at the most two storeys. So frequently were these buildings swept away by fire, that at the close of that century it was thought necessary to enact that in future the lower storey of all habitations in the City of London should be built of stone, and that the usual thatched roofs should give place to tile or slate.

We must come down to the fourteenth century, when trade and industry had arisen to improve the condition of all classes by increasing the general wealth of the country, before we can find the citizens of the towns occupying houses worthy of an intelligent community. In this and the following century many substantial buildings were erected, the remains of which are occasionally to be seen in the present day. The great merchants of the day frequently vied with the nobility in the stateliness of their town abodes; but it is not these, but the dwellings of the less wealthy citizens, that we have now under our consideration.

One characteristic form of house arose in England in the Middle Ages, and set a style which continued to be in vogue, with few modifications, for three or four hundred years. It was a narrow building with a pointed roof, and the gable overhanging the street; each storey, moreover, projecting over that immediately below. This is the kind of old-fashioned, middle-class house occasionally found in nearly all parts of the country at the present day, and which will be familiar to many of our readers. The material with which it was built was usually stone or brick, with a large quantity of timber, the latter ornamentally disposed in front of the house in a very striking manner. These half-timbered houses were in vogue alike for the shops of the citizens in the towns, the farmhouses in the country, and the residences of small landed proprietors. As an example, we give an illustration of a farmhouse of the fourteenth century, near Leicester. The style was more suitable to the country than to the town, for in the latter the projection of the overhanging storeys had an injurious effect, by excluding a great portion of the light and air which should have been admitted to the streets. On the other hand, it may be remarked that each storey sheltered that below from the weather; and to this fact, as well as to the solidity of the materials used, the enduring character of the buildings must be ascribed.

As far as regards internal accommodation, these houses could not boast of many conveniences. The lower floors were dark, the ceilings low throughout, and the apartments often disfigured by huge beams supporting the upper floors. They were very deficient in ventilation, not only by reason of their peculiar construction, but also from the fixity of the windows, which rendered the admission of a free current of air difficult even when it was most desired. To this cause must be attributed a great deal of the sickness which afflicted England during the long period when these houses were common. In the smaller houses built in this fashion, and packed closely together in towns, the faults essential to the style were particularly injurious to the health of the inhabitants.

Such as it was, this style held its ground until the rise of the era of plain square buildings built of brick, and, in the better class of dwellings, occasionally ornamented with flat columns or

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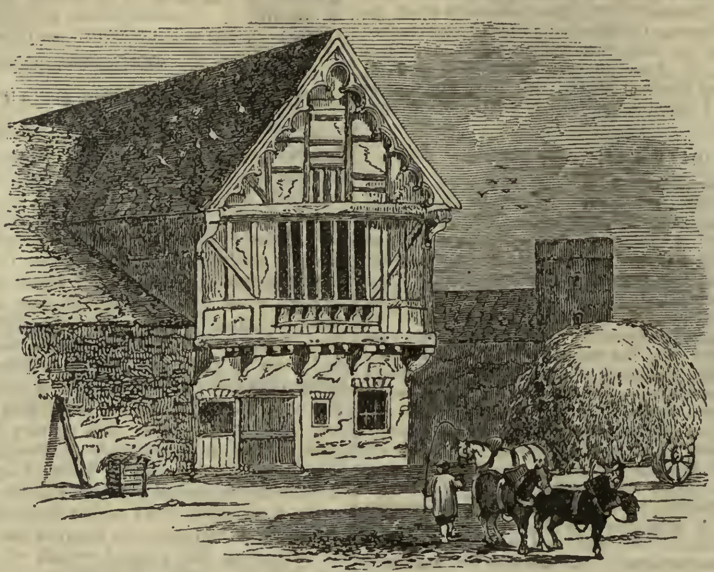
pilasters of stone. This style was a sort of degraded Italian, ugly enough, but at least possessing the advantage of throwing all parts of the building equally open to the influences of the air and sky. A greater contrast cannot well be found than that between the fanciful timber fronts of the gabled houses of former years, and those flat, unadorned habitations which arose to supersede them in the reigns of Queen Anne and the Georges, continuing common down to the present day.

A marked change, however, has, in the Victorian era, taken place in the domestic architecture of the country. The uniformity in which the generations immediately preceding seem to have delighted has been superseded by a tendency in the opposite direction, every man building in his own fashion, sometimes with a due regard to style, but at others setting all styles at utter defiance. Hence, in the case of town architecture, there may occasionally be seen in our chief cities a row of buildings, well and expensively constructed, but no two of which are alike in any essential feature.



FARMHOUSE OF THE FOURTEENTH CENTURY, NEAR LEICESTER.

In the case of suburban and country residences, the taste for variety and independence is still more frequently displayed. A class of building known as the *villa* has become common in recent years, supplying a want which is in itself singularly characteristic of our time. Our forefathers who were engaged in trade or in the professions for the most part inhabited, with their families, the houses in which their business was pursued. The rapid growth of commerce has in many cases rendered it necessary that the space formerly occupied by private lodgings should be given up to business purposes; and the simultaneous increase of wealth has enabled well-to-do citizens and professional men to consult their own health and tastes by residence at a distance from the scene of their daily toil. Hence, in many parts of the country there have sprung up clusters of residences inhabited by a class who occupy a position midway between that of the townsman and the country squire of former times. The residences themselves are a medium between the town house and the old country mansion; and to this class of house the old Roman name for a country house—*villa*—is applied by common usage.

These villa residences are for the most part detached, or standing each in its own grounds of greater or less extent; and thus they afford wide scope for the practice either of architectural science or caprice. We consequently see infinite diversity in their construction, and to classify them all under any recognised designations would be a matter of impossibility. But, so far as they are worth attention at all from an architectural point of view, they may mostly be grouped into two classes—those in which the design has more or less of the *classical* element, and those in which the *Gothic* prevails in a corresponding degree.

To afford the student a clue to guide him in his observations, we set before him an example of each of these grand divisions of style, as adapted to the domestic architecture of the middle classes. The *classical* element is displayed in the purely Roman style of the small villa in our second illustration. The *Gothic* is illustrated in the example of a small country house constructed after what we have previously described as the "Elizabethan" manner. As a supplementary illustration, we give an engraving of a highly popular kind of cottage or villa architecture, which, although not strictly in accordance with any recognised style, has so much about it that is attractive and meritorious as to constitute a type of its own, to which the name of "cottage" is commonly applied. So far as this can be identified with either of the other styles, it must be considered an adaptation of the classical, as shown in the modern Italian; but the gabled roof is a feature which connects it to a certain degree with the old English houses of the past, and still more nearly with the Swiss cottages of the present day.

VILLA RESIDENCE OF THE NINETEENTH CENTURY—CLASSICAL OR ROMAN STYLE.

In this manner the styles of architecture are frequently run one into the other in modern villa and other residences, sometimes, as in this case, to produce an attractive and harmonious whole, but more often with the contrary effect. Occasionally we may see examples in which either ignorance of style on the part of the builder, or daring indifference to it, has a grotesque result, and an edifice becomes the laughing-stock even of an uninformed beholder. The taste of the time, however, is tending more and more to the adoption of the most approved methods of former days, so far as they are consistent with modern habits; but at the present day a "battle of styles" may be said to be going on, the contest for predominance being between the classical and the old English or mediæval manner.

VILLA RESIDENCE OF THE NINETEENTH CENTURY—GOTHIC STYLE.

We cannot dwell npon the internal arrangements of onr domestic buildings further than to remark that the improvement during the present century in the interior has been, if possible, greater than that witnessed in the exterior. In light, ventilation, sanitary arrangements, and all matters of convenience and comfort, the residences of the middle classes have immensely improved during the Victorian age; and it is gratifying to remark that the improvement is surely, although perhaps slowly, extending to the abodes of the labonring classes also, both in town and country. The erection of model cottages, in which the late Prince Consort took a leading part, has done something to give builders generally, and the landowners who employ them, an idea of how necessary comfort and convenience may be attained without unusual expense. Similar efforts have been made to improve the condition of the labouring classes in other countries, particnlarly by the late Emperor Napoleon, from whose design model cottages were erected and exhibited during the Paris Exhibition of 1867. "Exhibitions of Domestic Economy" have also been held at Utrecht and other towns, in which a prominent place has been given to all matters relating to cottage architecture. All efforts in this direction must tend to the advantage not only of the country in which they may originate, but, sooner or later, of our own also. The lamentable condition of the labourers' cottages in many parts of the land is still a disgrace to a professedly civilised age.

SPECIMEN OF "COTTAGE" ARCHITECTURE OF THE NINETEENTH CENTURY.

It is gratifying to note the efforts which are being made to improve the dwellings of the labouring classes in our large towns. Many snch movements have now been set on foot by means both of private beneficence and commercial enterprise. As an example of the former, we may mention the buildings erected from the munificent gift of Mr. Peabody to the poor of London; and of the latter, the work of the Industrial Dwellings Association in the metropolis, by which it has been shown that such efforts may be made commercially remunerative, while at the same time they confer a great benefit upon the classes for whom they are designed. At present these movements are in their infancy, and there is yet very much to be done before any material improvement will have been effected by their means upon the condition of the poor. Mean and squalid habitations now ocupy large areas of gronnd, which would afford good and healthy accommodation to many times the number of people, if the system of erecting high houses, each replete with convenience for several families, were more generally adopted. This is the plan on which many cities have been built in Scotland and on the Continent, and there is no reason, beyond the force of custom and prejudice, why it should not be employed in many parts of England, where the evils of over-crowding are increasing year by year.

HISTORIC SKETCHES.—XL.

THE SICILIAN VESPERS.

"DEATH to the French! Down with the French!" Such was the cry at Palermo on the evening of Easter Tuesday, the 31st of March, 1282. It was a terrible cry, one that sounded the knell, not only of many hundred lives of Frenchmen, but the life also of French dominion in Sicily. It was a cry long remembered—a cry which became known as that of the Sicilian Vespers, a cry that made brave Frenchmen blench, and gave their enemies an opportunity of sneering without the possibility of being answered. Once Henry IV. of France said, when angry, in conversation with the Spanish ambassador, "If I am provoked, I will breakfast at Milan and dine at Naples," at that time under the Spanish crown. "And perhaps," said the Spanish ambassador, "your Majesty may reach Sicily in time for vespers."

But how came the French to have any interest in Sicily? What were the circumstances under which the historic facts known as the Sicilian Vespers took place?

The island of Sicily was early conquered by the Saracens, when they spread from their native confines of Arabia into Europe. In their hands it remained till the year 1058, when Roger Guiscard, a Norman chief, undertook to win it back to the Christians, and, overthrowing the Saracenic ruler, established himself in his place. Roger's brother Robert, also a Norman adventurer, had established himself in the kingdom of Naples, and on his death Roger united the two dominions under one crown. In Norman hands the crown of the Two Sicilies remained till the time of the Emperor Frederic Barbarossa. His son Henry married Constance, the only child and heiress of William II., who was the direct descendant of Roger Guiscard. Henry, upon his father's death, became Emperor of Germany, and of course, in right of his wife, King of Naples and Sicily. His reign was not a long one, and when Frederick II., his successor, came to the throne, a minor, there was a chance, which was not lost by enemies of the imperial house, to loosen the hold which the emperor had upon his Italian dominions.

For many years the factions of the Guelphs and Ghibellines—that is to say, the partisans of the Papal power (the Guelphs), and those of the emperor (the Ghibellines)—had divided all eastern Europe. The interest of the Pope was the interest of a large body of men who, in addition to the influence which their priestly office gave them over an ignorant and superstitious people, possessed an immense power by virtue of the monopoly which they exercised over the sources of secular learning. This influence they exerted in behalf of themselves and their master, and succeeded in forming a compact and well-organised party among the laity in opposition to the imperial power. Among their adherents were the inhabitants of the principal Italian cities, ever apprehensive of danger from their German suzerain; the kings of France, ever jealous of the power and predominance of the emperors; and an un-German following in Germany, known as the Saxon party. The Ghibelline or Imperial faction included those who strove to make the emperor supreme as in the older time he had been, and not only claimed for the emperor an entire independence of the Papal see, but asserted his right to appoint and control the Pope himself.

Of course, between these two factions the warfare was incessant. At times one prevailed, at times the other; but no opportunity was lost by either of injuring the enemy, whether in season or out of season. The so-called vice-gerent of Christ was no whit better, if so good, as his imperial foe, and means were taken to ensure the success of the Papal cause which it is hard to suppose the vice-gerent's Master would have approved. When Frederick II.* died in 1250, after a reign of 38 years, spent in ceaseless attacks upon the Papal power, he left two sons, Conrad, his heir, and Manfred, who was illegitimate.

Although Conrad had been elected King of the Romans, a title which usually assured the wearer of the imperial title, he was prevented by the arts of Pope Innocent IV. from succeeding to the purple. Strong efforts were also made to oust him from his kingdom of Naples, but there he established himself, and after a reign of two years died, leaving a young son, Conradin, whom, as his successor, he commended to the care of the boy's uncle Manfred, and of the Pope. As soon as Conrad was dead the Pope began an attempt to deprive the child for whom he was trustee of his birthright. He incited the Neapolitan nobles to throw off the kingly yoke, and to form an oligarchical republic under the protection of the Church; and in furtherance of his plan, he marched a body of troops into the Neapolitan territory. By his influence the Sicilians were induced to abjure their allegiance to Conradin and the Ghibelline house of Suabia, and to form themselves into a sort of republic in connection with Rome. But from the first it was apparent that the constituent parts of the state were too uncongenial to be welded into a veritable republic. The mixed races among the inhabitants, the aristocratic and popular interests, and the presence of a small minority yet favourable to royalty, were so many causes of disunion. After a few months of trouble and confusion, Manfred, who had raised men and money in Germany, appeared in arms in the southern provinces, and restored the royal authority on the mainland and in Sicily. For a short time he professed to act as regent for Conradin, his nephew, but at last he gave out that Conradin was dead, and caused himself to be crowned king at Palermo. He was at once recognised as head of the Ghibelline faction, and displayed an uncompromising and active hostility to the Papal court.

Under these circumstances, Innocent IV. looked about for some one whom he could pit against Manfred. Richard, Earl of Cornwall, brother to Henry III. of England, was first applied to; but on due consideration declined the honour of a kingdom which, though the Pope professed to give him, it was yet clear the earl would have to win and also to keep by his own good sword and his own broad pieces. Then it was offered to one of Henry III.'s own sons, but was declined after much money had been spent in backing up the title. In Charles, Duke of Anjou, brother of St. Louis, Alexander IV., who had succeeded Innocent, found a willing recipient of the kingdom of Naples, even on condition of winning it at the sword's point. To assist him, the Pope published a crusade against Manfred, and promised endless felicity to all who should die fighting in behalf of the French duke. At Benevento—where, in spite of terrible bravery, the Neapolitan army was routed, and Manfred, scorning to be taken, plunged into the thickest of the fight and there met death—Charles of Anjou at one stroke overcame all resistance, and found himself master of the kingdoms of Naples and Sicily. Conradin, who was not dead, though only a youth in his seventeenth year, put himself at the head of the remaining friends of his house, and marched to pluck the fruit which the Duke of Anjou had won. At Tagliacozzo he met the French troops, a bloody battle ensued, the Germans were routed, and Conradin fled to Astura, where he was given up to the vengeance of his enemy. That enemy, incapable alike of generosity and mercy, caused him to be publicly put to death, the vice-gerent of Christ consenting. Upon the scaffold, which was erected in the market-place of his own capital city, Conradin announced, before laying his youthful head on the block, that his rights survived in Peter III. of Aragon, who had married the daughter of Manfred. He slew many more at his death than he had done in his life, for by his sacrifice there was kindled in the breasts of his proper subjects such a hatred for the rulers who had assumed the mastery as was not extinguished till long after the Sicilian Vespers.

The brutality of the French usurper knew no bounds. All who had taken part against him in the late wars were put to death, their property was confiscated, their houses were razed to the ground. Subjection the most utter and complete, nothing short of it would satisfy the tyrant, who, "lacking nothing but the wrath of God," made his kingdom on the mainland a howling waste. But for Sicily his fierce fury was reserved. The Sicilians had risen very generally in favour of Conradine. Charles, therefore, sent over Guillaume l'Estendard, the cruellest man in his army, to be governor, and to root out the prevalent disaffection. This ruffian fully justified his master's choice. With fire, sword, and gibbet, he "quieted" the island; there was not a house where there was not one dead, and those who remained alive envied their brothers who had died. Those who had exclaimed against the severity of the Suabian government looked back sorrowfully to the days when Manfred ruled them. "We thought we had got a king from the Father of fathers, and we have gotten antichrist," said the clergy, who, curbed by Manfred, were utterly despoiled by

* This monarch was Frederick I. of Sicily from 1197 to 1250, and Frederick II. of Germany from 1212 to 1250.

Charles. The privileges Charles had sworn to the Pope he would restore were not only kept back, but the privileges that remained were also taken away. The revenues of the convents were seized by the champion of the church, and the wolf whom the Pope delighted to honour with a sheep's clothing, began to flesh his teeth in the bodies of the Church's lambs. The barons friendly to the Angevins were deprived of their property on the pretence that they had acquired it through Manfred, who had no power to confer it; and those barons who could not prove themselves free from all taint of treason were deprived as traitors. The French soldiery were enriched with Italian spoils, a new and alien nobility was created; feudalism in its harshest form was thrust upon the people; secret prison-houses sprang up in hateful abundance; the voice of justice was stifled, and the whole nation was ground down to misery under the iron heel of a foreign despot. The taxes were crushing, and most offensively levied; the currency was debased by the government, and then called in at the loss of the people; heiresses were compelled to marry needy Frenchmen; estates were made wildernesses that some French lord might hunt over them, while the owner was forbidden on pain of death to kill a head of game. In their domestic relations the poor people were fearfully insulted. Lawlessness, conscious of security, ran riot through the land, and respected neither rank nor condition in gratifying its lust. This was the rock on which the French dominion split, the rock on which royalty in old Rome was dashed to pieces, the rock on which the power of "the wicked ten" was ground to powder. There is a point beyond which human endurance will not go, and that point had been reached by Sicilian sufferers and French oppressors. Domestic outrage was the spark which fired the train of Sicilian anger.

Already the train was laid. The conduct of the French had been such that no one with a claim to manhood could endure it, and at the risk of their lives men plotted against the savage rule of the Duke of Anjou, trying by every means in their power to provoke his enemies into action against him. And his enemies were many. The Pope, who had enlisted him in his service simply and solely to do despite to the Ghibelline faction, supported him in his high-handed villanies till these became directed against himself, and till the ambitious duke sought by means of his Roman influence to over-ride even in Rome the authority of the Pontiff King. Nicolas III. was now (A.D. 1277) Pope, and seeing the drift of his predecessor's most obedient, humble servant, took part with the Frenchman's enemies to overthrow him. The Greek emperor, Michael Palæologus, was among Charles's direst foes, for the duke, fancying that he saw in the weakness of the Greek empire an opportunity of seizing the Greek crown, made no secret of his intention to win it if he could, and openly prepared the means of following up his pretensions by force. A third strong foe was Peter III., King of Aragon, in whom the right of Manfred and of Conradin survived. This prince, willing enough to win an additional crown, provided he had not to fight for it single-handed, but too prudent to risk what he had for sake of what he might not have, had hitherto turned a deaf ear to the suggestions of the Sicilian exiles who suggested action in support of his wife's claims. But now that the Pope and the Greek Emperor were disposed to be actively hostile, the Emperor of Germany passive, and the Neapolitans and Sicilians murderously revengeful—while the King of France, St. Louis, was so much weakened by the ruinous failure of his crusading expedition into Africa as to be no longer feared—Peter began to think of stirring himself, and arrived at the conclusion that Charles of Anjou was a consummate scoundrel and a robber. An alliance was made between Peter, the Greek Emperor, and the Pope, the last of whom confirmed, with authority at least as great as that which had given the Two Sicilies to Charles, the right of the Spaniard to the throne. The Sicilians were duly apprised of what was going forward, and means were taken by them to second the efforts of the allied sovereigns whenever the signal of revolt should be raised. But the plot which was thickening suddenly burst, not through any discovery on the part of the French, not through any treachery on the part of the Sicilians; but simply because it could be concealed no longer, because an act committed by a licentious French soldier was the last straw which broke the patient back of Sicilian forbearance.

On Easter Tuesday, the 31st of March, 1282, the *élite* of the Palermitans had gone to hear vespers at the Church of San Spirito on Morreale, a short distance from the town. The weather was fine, and after service the people walked in a pleasure-garden that was near to the church. Among the crowd were many officers of the viceroy, Herbert of Orleans, and a large sprinkling of French soldiery. An order of the viceroy had forbidden Sicilians to carry arms, so that the people were weaponless, while the French wore their usual arms. According to custom, the French swaggered, and jostled the unoffending islanders, uttering now and then insulting speeches to the men, and behaving insultingly by word and gesture towards the women. Provoked by their behaviour, some of the Sicilian young men remonstrated, and that so boldly that the French exclaimed, "They must have concealed arms, or they would not speak so." A search was made for arms upon the persons of the remonstrants, and one soldier, named Drouet, more brutal than his companions, walked up to where a beautiful girl was walking with her parents and her betrothed, and accusing her of carrying concealed weapons, forthwith began to search her by thrusting his hand into her bosom, attempting as he did so to kiss her. The maiden fainted; and before she could be brought to again a young man, whose name unfortunately is not known, had knocked the Frenchman down and killed him with his own sword, shouting as he slew him, "Death to the French! Down with the French!" A horrible scene ensued; the French defended themselves with courage and ability, and many a Sicilian fell; but of the foreigners a contemporary historian tersely says, "they numbered two hundred, and two hundred died."

Like a thunder-clap the voice echoed through the country, and roused the hearts of all. Every man's hand was against the aliens. Implements of husbandry, of household use, served the place and did the work of more warlike weapons.

Excited and bloody, with the dead men's swords in their hands, the Sicilians rushed into Palermo. The terrible shout of "Death to the French!" resounded in the streets, and ere night closed in upon Easter Tuesday 2,000 gashed corpses of Frenchmen who that day had insolently ruled, were flung out to be a prey to the beasts of the field. Palermo was seized by the insurgents, every foreigner was driven forth. Giovanni di San Remigio, the governor, escaped only by a miracle, and he escaped but to fall the next day in a sortie from the castle of Vicari upon men whose offer to send him and his followers by safe conduct to Provence he had scornfully rejected.

The ferocity of the outbreak left the Sicilians without hope of reconciliation. They had gone thus far, they must go yet farther. In a sort of parliament, hastily convened at Palermo, the regal form of government was renounced, and a commonwealth, under the protection of the Church, was declared to be the new constitution. The example set by Palermo and a few neighbouring places was quickly followed by the most important towns in the island, even Messina being obliged, in spite of the viceroy's presence, to follow suit. Flying columns scoured the country, killing every Frenchmen that was found; indeed, such was the fury, that Saba Malaspina says it seemed as if every man had a father, son, or brother to avenge, or was possessed with the belief that in slaying a Frenchmen he did God service. An oath was taken to die rather than serve the French, and in a week after Drouet insulted the Sicilian maiden the French dominion was an historical event in Sicily.

The allied sovereigns were fortunately able, although their action had been precipitated, to second with material help the efforts of the insurgents. A Spanish fleet, fitted out with the Greek emperor's money, swept the sea of the squadron which Charles of Anjou had reckoned on to carry his re-conquering army into the rebellious province; and Papal money supplied the Sicilians with the arms and munitions which only they wanted to enable them to keep what they had won. Repeated and strenuous efforts were made by the Duke of Anjou to recover his lost ground, and for a long while he besieged Messina in person with a powerful army and fleet; but his hour had struck with the vesper chime on Easter Tuesday. His fleet was destroyed, his army was terribly mauled, and he himself narrowly escaped capture at the hands of those he had come to subdue. Peter III. of Aragon reigned in his stead, and the island of Sicily knew him no more.

The point of the Spanish ambassador's reply to Henry IV. of France is no longer difficult to be seen.

LESSONS IN ARITHMETIC.—XLVIII.

THE METRIC SYSTEM.

THE advantage of adopting the Metric System of weights and measures in this country has become a question of considerable public interest. By an Act of Parliament passed in 1864, the use of the Metric System was rendered legal. In the session of 1868 a bill for rendering its use compulsory was read a second time in the House of Commons by a majority of 219 to 67, and was only withdrawn out of deference to a request on the part of the Government not to press it forward until the completion of the labours of a Royal Commission then sitting on the currency qnestion. Petitions in its favour have been presented to Parliament by the Associated Chambers of Commerce, and at several meetings of the International Statistical Congress, and of the British Association for the Advancement of Science, resolutions have been passed recommending its general adoption. Finally, it may be stated that the Metric System has been already accepted, either wholly or in part, by 360 millions of people, and that in every conntry there exists a strong and growing feeling that an international system, fonnded on rational principles, such as the metric, would be of inestimable advantage to science, commerce, and education.

Under these circumstances, it is proposed to give in the pages of the POPULAR EDUCATOR a familiar account of the Metric System. As the catechetical method of instruction presents many advantages in expounding the principles of a scientific system, the form of qnestion and answer has been adopted as follows:—

Q. What is the Metric System?—*A.* The Metric System is a rational system of measures and weights designed for the use of all civilised nations.

Q. Why do you call it a rational system?—*A.* For the following reasons:—*Firstly*, Because in all its multiples and subdivisions it follows the decimal arrangement. *Secondly*, Because all its parts, whether of length, surface, volume, or weight, being directly derived from the nnit of length, are mutually dependent. *Thirdly*, Because the names given to the measures and weights are well fitted for adoption into all civilised languages.

Q. Why is the system called Metric?—*A.* Because it is founded on the meter as the unit of length.

Q. What is the meter?—*A.* The meter is a line equal in length to the ten-millionth part of the earth's meridian, measured from the pole to the equator.

Q. Can you give an account of the names by which the various measures and weights of the Metric System are described?—*A.* Yes, very simply. There are four prefixes derived from the Greek language, and three from the Latin, which, placed before the unit of each denomination, constitnte the entire language of the Metric System. They are as follow:—

From the Greek—	Myria,	signifying	ten thousand times.
,,	Kilo,	,,	one thousand times.
,,	Hecto,	,,	one hundred times.
,,	Deka,	,,	ten times.
From the Latin—	Deci,	,,	one tenth part.
,,	Centi,	,,	one hundredth part.
,,	Milli,	,,	one thousandth part.

Q. Can you give an example of the application of these principles?—*A.* Yes, by repeating the

TABLE OF LINEAR MEASURE.

Myriameter =	10,000 meters.	METER =	1 meter.
Kilometer =	1,000 ,,	Decimeter =	$\frac{1}{10}$ of a meter.
Hectometer =	100 ,,	Centimeter =	$\frac{1}{100}$,,
Dekameter =	10 ,,	Millimeter =	$\frac{1}{1000}$,,

Q. Has the length of the meter ever been exactly determined in English measures?—*A.* Yes, by Captain Kater, in the year 1818, acting under the authority of a Royal Commission, and the permission of the French Government.

Q. What was the length thus found?—*A.* The length thus found was 39·37079 inches.

Q. Without reference to an exact standard, how would yon instruct a common carpenter to make a meter?—*A.* I would tell him to cut a slip of wood of the length 3 feet 3 inches, 3 eighths, then divide the whole into *ten* equal parts, and each of these into *ten* eqnal parts. I would then have a meter, sufficiently correct for all practical purposes, divided into decimeters and centimeters.

Q. Can you give a simple relation in whole numbers between the principal linear measures of the English and Metric Systems?—*A.* The following relations are very simple, and sufficiently exact for practical purposes, the latter especially:—10 meters = 11 yards; and 64 meters = 70 yards = 210 feet.

Q. Proceeding from linear measure, can you give an account of metric land measure?—*A.* Yes, the unit of land measure is the ar, and the table of land measure is formed in the same manner as before, by the addition of the metric prefixes.

Q. What is the ar?—The ar is a square standing on a dekameter, and is therefore equal to one hundred square meters or centiars.

Q. Repeat the table of land measnre.—*A.* The table repeated in full is as follows:—

TABLE OF LAND MEASURE.

Myriar =	10,000 ars.	AR =	1 ar.
Kilar =	1,000 ,,	Deciar =	$\frac{1}{10}$ of an ar.
Hectar =	100 ,,	Centiar =	$\frac{1}{100}$,,
Dekar =	10 ,,	Milliar =	$\frac{1}{1000}$,,

Q. Why do you say *repeated in full*?—*A.* Because in those countries which have adopted the Metric System, *three* denominations only are ever used in practice, land being always measured in hectars, ars, and centiars.

Q. What is the exact value of an ar and of a hectar?—*A.* An ar is eqnal to 119·60333 square yards; a hectar is equal to 2·47114 acres.

Q. Can you state the value of a hectar approximately in English measures?—*A.* Yes, a hectar is very nearly equal to 10 roods or $2\frac{1}{2}$ acres.

Q. Is this value of the hectar too great or too small?—*A.* It is too great. A more exact relation is the following:—40 hectars = 99 acres.

Q. This seems to furnish an easy rule for turning hectars into acres.—*A.* Yes; consider each hectar as 10 roods, and from the result deduct 1 per cent.

Q. Passing from land measure, can you give an account of cubic measure?—Yes; the unit of volume or cubic measure is the liter, and the table is formed in the usual way.

Q. What is the liter?—The liter is a volume equal to the contents of a cube each of whose sides is a decimeter.

Q. Repeat the table of cubic measure.—*A.*:

TABLE OF CUBIC MEASURE.

Myrialiter =	10,000 liters.	LITER =	1 liter.
Kiloliter =	1,000 ,,	Deciliter =	$\frac{1}{10}$ of a liter.
Hectoliter =	100 ,,	Centiliter =	$\frac{1}{100}$,,
Dekaliter =	10 ,,	Milliliter =	$\frac{1}{1000}$,,

Q. Have you any observations to make on these measures?—Yes; the first two—namely, the myrialiter and kiloliter—are rarely if ever used in practice. The hectoliter is practically the unit of corn measure.

Q. What is the exact valne of the liter to cubic inches?—*A.* The liter is equal to 61·02705 cubic inches.

Q. How do you prove this?—The length of a decimeter is 3·937079 inches; by calculating the cnbe of this number by continued multiplication, we arrive at the number 61·02705.

Q. Can you give any simple relation connecting the cubic measure of the Metric System with English liquid measnre?—*A.* The following is very nearly true, and is sufficiently correct for all practical purposes:—1 hectoliter = 22 gallons.

Q. Can you give any other?—*A.* Yes; the following is very simple, but not so exact as the last:—1 gallon = $4\frac{1}{2}$ liters.

Q. Passing from cubic measure, can you inform me as to the unit of weight of the Metric System?—*A.* The gram, the unit of weight of the Metric System, is the weight of a cubic centimeter of pure water taken at its greatest density.

Q. What do you mean by water at its greatest density?—*A.* The density of water, or weight which fills a given bulk, varies with its temperature or degree of heat. The greatest density corresponds to the temperatnre of 40 degrees.

Q. The unit of weight being thus determined, how do you state the table of metric weight?—*A.* As follows:—

TABLE OF WEIGHT.

Myriagram	= 10,000 grams.	GRAM	= 1 gram.
Kilogram	= 1,000 ,,	Decigram	= $\frac{1}{10}$ of a gram.
Hectogram	= 100 ,,	Centigram	= $\frac{1}{100}$,,
Decagram	= 10 ,,	Milligram	= $\frac{1}{1000}$,,

Q. Have you any observations to make on this table?—*A.* Yes; the myriagram is rarely if ever used, and although the gram is the metric unit of weight, the kilogram is practically the unit for all kinds of business and commerce.

Q. You have formerly stated that there is a simple mutual dependency between the different parts of the Metric System. Can you give an illustration of this?—*A.* Yes; the table of weight shows the natural dependence of weight on volume, and therefore on linear dimension. For instance, since a cubic centimeter of water weighs one gram, one thousand cubic centimeters, or one liter of water, weighs one kilogram; and a cubic meter of water, which is equal to one thousand liters, weighs one thousand kilograms, a commercial weight which is commonly called the metric ton.

Q. Has the weight of the kilogram been exactly determined in terms of English weights?—*A.* Yes, by Professor Miller, of Cambridge, acting under the authority of a royal commission, and with the permission of the French Government, in the year 1844. It is as follows:—1 kilogram = 15432·34874 grains (7000 grains = 1 lb. av.).

Q. Can you state in round numbers the relation between Metric and English weights?—*A.* Yes; for all practical purposes we may assume 10 kilograms = 22 lbs.

Q. Is the use of the pound weight consistent with the adoption of the Metric System?—*A.* Yes; in all those countries that have adopted the Metric System, the half-kilogram is invariably spoken of as a pound, and might be called by us the new pound.

Q. Does the half-kilogram differ much from a pound avoirdupois?—*A.* No, it exceeds the pound avoirdupois by about a tenth part.

Q. What are the principal weights for business and commerce in England?—*A.* The pound avoirdupois, the hundredweight of 112 lbs., and the ton of 20 cwt.

Q. What are the corresponding weights in the Metric System?—*A.* The half-kilogram, or new pound, which exceeds the pound avoirdupois by about $1\frac{1}{2}$ oz.; the centner of 50 kilograms, or 100 new pounds, which is less than our hundredweight by about $1\frac{3}{4}$ lbs.; the ton, of 1000 kilograms, which is less than our ton of 20 cwt. by about 35 lbs.

Q. Having explained the principles of the Metric System, can you state the advantages to commerce that would result from its general adoption?—*A.* A uniformity of measures and weights among civilised nations would enable merchants and dealers to see at a glance what now requires complicated and perplexing calculations, and whatever renders business easy tends always to its increase.

Q. Of what advantage would the Metric System be to engineers, architects, and artisans?—*A.* A uniform system would enable men of these professions to make use of plans and specifications of works constructed or projected in foreign countries directly, without the labour of previously reducing them to their own peculiar scales as at present.

Q. Would the adoption of the Metric System benefit these professions in any other way than that which you have just stated?—Yes; in consequence of its complete accordance with the principles of decimal arithmetic, and also the mutual dependence of all its parts, engineering and architectural calculations would be rendered much more simple.

Q. What advantages to education do you conceive would flow from the adoption of the Metric System?—*A.* The abolition of the "Table Book," which is a grievous load on the memory of children, and a great tax on the patience of teachers; a great simplification of the rules of arithmetic by the abolition of reduction, practice, and all the perplexing sums in compound addition, subtraction, multiplication, and division. Good books on arithmetic, as in the case of geometry and algebra, might be translated from foreign languages, which is now impossible.

Q. How would the study of physics, natural science, and the arts be benefited?—*A.* The difficulties which are at present felt by students in consulting foreign authors, in consequence of the use of various measures and weights, would be wholly removed.

Q. Have you any observations to make on the language of the Metric System?—*A.* Its language is extremely simple, as it consists of only *eleven words*, viz., the seven prefixes, *myria*, *kilo*, *hecto*, *deka*, *deci*, *centi*, and *milli*, together with the names of the four units, *meter*, *ar*, *liter*, and *gram*.

Q. Why are these words taken from the Greek and Latin languages?—*A.* As all civilised nations have an equal interest in these languages, so all cause for national jealousy in adopting them is removed.

Q. Have you any observation to make as to the mode of spelling them?—*A.* Each nation ought to spell them after the analogy of its own language: thus the Frenchman would spell the measure of road distance *kilomètre;* the Englishman or German, *kilometer;* the Italian, Spaniard, or Portuguese, *kilometro.*

KEY TO LESSONS IN ARITHMETIC.—XLVII.

EXERCISE 64.—MISCELLANEOUS EXAMPLES (*continued*).

53. A £20, B £40.
54. 8s.
55. £104 ready money; 110 per cent. per annum.
56. (1) The sum may thus be considered as expressed in the following denominations: — Sovereigns, 20d. pieces; and a fraction of 20d. pieces; 5 per cent. being $\frac{1}{20}$th, if we take $\frac{1}{20}$th of the sum so expressed, the truth of the rule becomes evident. (2) £31 1s. $8\frac{1}{5}$d. (3) £29 10s. $7\frac{10}{100}$d.
57. £135.
58. £26880.
59. 82·685 and £5·434 nearly (brokerage being supposed to be charged for the purchase, but not for the sale).
60. £131 15s. 6d.
    65 17 9
    43 18 7
    417 5 8
61. £4 19s. 10d.
62. 1·2407.
63. 25 per cent.
64. £436 1s.
65. 16 stone.
66. £330 of stock; he gains 2s. 3d., commercial discount being reckoned.
67. (1) £3 11s. $6\frac{965}{1073}$d.
    (2) 4 6 $11\frac{861}{1073}$.
68. £10000.
69. $26\frac{9}{15}$.
70. $10\frac{3}{7}$ hours.
71. 10 hours a day.
72. 14 pints.
73. $\frac{1}{10}$th.
74. $7\frac{1}{2}$ feet.
75. $16\frac{133}{187}$ per cent.
76. $35\frac{36}{715}$ min. past 12.
77. 44 per cent.
78. $16\frac{2}{3}$ per cent.
79. £19 7s.
80. £46.
81. 93·9375.
82. 689; $7\frac{2}{5}$ inches.
83. $2\frac{1}{2}$ per cent.; £1127 10s.
84. 4 and 5 per cent.
85. 2·53$\frac{1}{4}$ m. 12 36$\frac{3}{4}$ m.
86. Two coins of the first are equivalent to one of the second.
87. £1100.
88. $3\frac{1}{2}$ days.
89. £800.
90. £60.

READINGS IN GREEK.—I.

THE student having now learnt the formation of the words, and the construction of simple sentences, as set forth in the Greek Lessons, will find it desirable to become acquainted as early as possible with the works of the principal authors who wrote in that language. With this object, we propose to give a series of selections from the Greek classics, with a short account of the works from which they are extracted, accompanied by brief explanatory notes. It is not our intention to give much assistance in the mere translation of the extracts, as the student should learn as soon as possible to rely upon his own powers of interpretation, aided by his Greek Lexicon and the Greek Lessons. By this means he will not only be able to obtain a fair idea of the style and manner of the chief writers of Greece, but also to have a model on which to form his own Greek composition. For this purpose we should advise him first to translate each passage accurately, then render it into idiomatic English, and some days later endeavour to turn this free translation into Greek, which he can compare with the original and correct by it. There can be no doubt that there is no method by which he will so speedily acquire a sound knowledge of the language. At the same time, in order to assist the student in forming his style of translation, we shall in each successive set of readings give a translation of at least one of the extracts in the previous set, sometimes from original sources, sometimes from translations of acknowledged merit. Among the extracts given will be some from the New Testament, the grammatical difficulties in which we shall take especial care to explain. Certainly the most valuable practical result to be obtained from a study of the Greek language is the power we acquire of being able to read the New Testament in the language in which it was originally written, and very many men have carefully studied the language solely with this object. Owing to the alterations which have taken place in our language since the Bible was translated, our translation does not in every case convey to the mind an accurate idea of the force of the original, and the reader who is able to study the New Testament in Greek will find that he is able thereby to solve many difficulties, and throw a clear light upon passages which previously had been quite beyond his comprehension.

XENOPHON.

Xenophon was a writer who flourished B.C. 400—359. He was a pupil of the great philosopher Socrates, who once saved his life in battle. He was also a celebrated general; and the Anabasis, or expedition up the country (*ανα, up*), is the account of a campaign in which he took a very prominent part. Xenophon lived at a time when the Greek language was at its best, when dialects were dying out, and Greece was beginning to have a uniform speech (*κοινη διαλεκτος*), in which the Attic was the principal element. The "Anabasis" has always had a great charm for all classes of readers, on account of its minuteness of detail, picturesque simplicity of style, and the air of reality and truth which pervades it. Its plainness and simplicity make it the most desirable work for beginners to take up. It is an account of an expedition undertaken by Cyrus the Younger to overthrow his brother, Artaxerxes, King of Persia, and of the retreat of the Greek troops after the death of Cyrus under the command of Xenophon himself. Cyrus collected a large army, composed principally of Greeks, and marched across Asia Minor towards Persia. The Greek soldiers, who at first did not know the object of the expedition, when they suspected that they were marching against Artaxerxes, were inclined to be mutinous, and resolved to ask Cyrus what were his real intentions. It is at this point that we take our first extract.

XENOPHON.—"ANABASIS," Book I., Chap. 3.

Ἔδοξε ταῦτα,[1] καὶ ἄνδρας ἑλόμενοι[2] σὺν Κλεάρχῳ[3] πέμπουσιν, οἳ ἠρώτων Κῦρον τὰ δόξαντα τῇ στρατιᾷ. Ὁ δ' ἀπεκρίνατο ὅτι ἀκούοι[4] Ἀβροκόμαν, ἐχθρὸν ἄνδρα, ἐπὶ τῷ Εὐφράτῃ ποταμῷ εἶναι, ἀπέχοντα δώδεκα σταθμούς· πρὸς τοῦτον οὖν ἔφη βούλεσθαι ἐλθεῖν· κἂν[5] μὲν ᾖ ἐκεῖ, τὴν δίκην[6] ἔφη χρῄζειν ἐπιθεῖναι αὐτῷ, "ἢν δὲ[7] φεύγῃ, ἡμεῖς ἐκεῖ πρὸς ταῦτα βουλευσόμεθα." Ἀκούσαντες δὲ ταῦτα οἱ αἱρετοὶ[8] ἀναγγέλλουσι τοῖς στρατιώταις· τοῖς[9] δὲ ὑποψία μὲν[10] ἦν, ὅτι ἄγει πρὸς βασιλέα, ὅμως δὲ ἐδόκει ἕπεσθαι. Προσαιτοῦσι[11] δὲ μισθόν· ὁ δὲ Κῦρος ὑπισχνεῖται ἡμιόλιον[12] πᾶσι δώσειν οὗ πρότερον ἔφερον, ἀντὶ δαρεικοῦ[13] τρία ἡμιδαρεικὰ τοῦ μηνὸς τῷ στρατιώτῃ·[14] ὅτι δὲ ἐπὶ βασιλέα ἄγει, οὐδὲ ἐνταῦθα ἤκουσεν οὐδεὶς ἔν γε τῷ φανερῷ.[15]

NOTES.

1. Ἔδοξε ταῦτα, *these things seemed good, they determined on this course*, viz., to ask Cyrus the object of the expedition. The neuter plural ταῦτα is followed by the singular verb ἔδοξε, according to the rule that a neuter plural in Greek takes a verb in the singular.
2. Ἑλόμενοι, 2 aor. mid., from αἱρέω.
3. Κλεάρχῳ, the name of a general of the Greek forces.
4. Ἀκούοι, opt. mood, because independent sentence following a principal sentence, of which the verb ἀπεκρίνατο is in an historic tense.
5. Κἂν, contracted for καὶ ἐάν.
6. Δίκην ἐπιθεῖναι, *to lay a penalty upon, to punish*. So δίκην δοῦναι, *to pay a penalty, to be punished*. Compare the Latin *pœnas sumere*, *pœnas dare*.
7. Ἢν δὲ. Here the construction changes from the *oratio obliqua* to the *oratio recta*, giving Cyrus' own words: "and if" (said he) "he fly"—
8. Αἱρετοί, *chosen* by their comrades as spokesmen.
9. Τοῖς, the article used for the demonstrative pronoun τούτοις, *to them*. Note that the article originally was a demonstrative pronoun, and appears as such in Homer, etc. This old use of it is retained in expressions like the present one, and in ὁ μὲν—ὁ δὲ, etc.
10. Μὲν, *on the one hand*, followed by δὲ, *on the other*.
11. Προσαιτοῦσι. Προς, when compounded with a verb, has the sense of addition. *They ask additional pay.*
12. Ἡμιόλιον . . . οὗ, *half as much again as* (ἥμισυ, *half*; ὅλος, *whole*); οὗ genitive, because it is *attracted* into the case in which the demonstrative would be, if expressed. If put out at length, the sentence would run, ἡμιόλιον ἐκείνου ὃ πρότερον ἔφερον.
13. Δαρεικοῦ, *a dareik*, a Persian coin named after King Darius, as we speak of a napoleon, a sovereign, etc.
14. Τοῦ μηνὸς τῷ στρατιώτῃ. The article here has a distributive sense. *To each soldier per month.* Μηνὸς is genitive of time.
15. Ἔν γε τῷ φανερῷ, *at least openly*.

When in the plains near the Euphrates, they came upon some singular animals:—

XENOPHON.—"ANABASIS," Book I., Chap. 3.

Ἐν τούτῳ δὲ τῷ τόπῳ ἦν μὲν ἡ γῆ πεδίον ἅπαν ὁμαλὸν,[1] ὥσπερ θάλαττα, ἀψινθίου δὲ πλῆρες· εἰ δέ τι καὶ ἄλλο ἐνῆν ὕλης ἢ καλάμου, ἅπαντα ἦσαν εὐώδη, ὥσπερ ἀρώματα·[2] δένδρον δ' οὐδὲν ἐνῆν. Θηρία δὲ παντοῖα, πλεῖστοι μὲν ὄνοι ἄγριοι, πολλοὶ δὲ στρουθοὶ[3] οἱ μεγάλοι· ἐνῆσαν δὲ καὶ ὠτίδες καὶ δορκάδες·[4] ταῦτα δὲ τὰ θηρία οἱ ἱππεῖς ἐνίοτε ἐδίωκον. Καὶ οἱ μὲν ὄνοι, ἐπεί τις διώκοι, προδραμόντες ἕστασαν ἄν·[5] πολὺ γὰρ τῶν ἵππων ἔτρεχον θᾶττον· καὶ πάλιν, ἐπεὶ πλησιάζοιεν οἱ ἵπποι, ταὐτὸν ἐποίουν, καὶ οὐκ ἦν[6] λαβεῖν, εἰ μὴ διαστάντες οἱ ἱππεῖς θηρῷεν διαδεχόμενοι[7] τοῖς ἵπποις. Τὰ δὲ κρέα τῶν ἁλισκομένων ἦν παραπλήσια τοῖς ἐλαφείοις, ἁπαλώτερα δέ. Στρουθὸν δὲ οὐδεὶς ἔλαβεν· οἱ δὲ διώξαντες τῶν ἱππέων[8] ταχὺ ἐπαύοντο· πολὺ γὰρ ἀπέσπα[9] φεύγουσα, τοῖς μὲν ποσὶ δρόμῳ, ταῖς δὲ πτέρυξιν, αἴρουσα,[10] ὥσπερ ἱστίῳ χρωμένη. Τὰς δὲ ὠτίδας, ἄν τις ταχὺ ἀνιστῇ, ἔστι λαμβάνειν· πέτονται γὰρ βραχὺ, ὥσπερ πέρδικες, καὶ ταχὺ ἀπαγορεύουσι· τὰ δὲ κρέα αὐτῶν ἥδιστα ἦν.

NOTES.

1. Ὁμαλὸν (der. from ὁμοῦ, *together*), *even, level*.
2. Ἀρώματα, *spices*: hence our *aroma, aromatic*.
3. Στρουθοί, *ostriches*.
4. Δορκάδες, *gazelles* (δέρκω, *to look*), from the brilliancy of their eyes; ὠτίδες, *bustards*, so called from their large ears (οὖς, ὠτὸς, *an ear*).
5. Προδραμόντες ἕστασαν ἄν, *having run forward, would stop short.* Ἄν gives a frequentative sense to the verb.
6. Οὐκ ἦν, *it was not*; sc. *possible*.
7. Διαδεχόμενοι. Δια in composition has a sense of division and alternation. It means that they stood at different intervals, and thus caught them.
8. Οἱ δὲ . . . τῶν ἱππέων, *those of the cavalry who pursued them.* Called the partitive genitive.
9. Ἀπέσπα. The nom. to this is στρουθός.
10. Αἴρουσα, *raising them*; sc. πτέρυγας.

PARSING EXERCISE.

The student should parse προδραμόντες, ἕστασαν, θηρῷεν, ἀπέσπα, ἀνιστῇ.

The army of Cyrus met with Artaxerxes at Cunaxa, near Babylon, and a battle was fought in which Cyrus was slain by his brother, after which the chief Greek generals were treacherously killed by the Persians. Xenophon was left head of the helpless host, and he led them back through innumerable difficulties to Greece. When they came to the sea-shore, they broke out into transports of joy:—

XENOPHON.—"ANABASIS," Book IV., Chap. 7.

Ἐπειδὴ δὲ βοὴ πλείων τε ἐγίγνετο καὶ ἐγγύτερον, καὶ οἱ ἀεὶ ἐπιόντες ἔθεον δρόμῳ[1] ἐπὶ τοὺς ἀεὶ βοῶντας, καὶ πολλῷ μείζων ἐγίγνετο ἡ βοὴ, ὅσῳ δὴ[2] πλείους ἐγίγνοντο, ἐδόκει δὴ μεῖζόν τι[3] εἶναι τῷ Ξενοφῶντι. Καὶ ἀναβὰς ἐφ' ἵππον καὶ Λύκιον καὶ τοὺς ἱππέας ἀναλαβὼν παρεβοήθει·[4] καὶ τάχα δὴ ἀκούουσι βοώντων τῶν στρατιωτῶν, "Θάλαττα! θάλαττα!" καὶ παρεγγυώντων. Ἔνθα δὴ ἔθεον ἅπαντες καὶ οἱ ὀπισθοφύλακες, καὶ τὰ ὑποζύγια ἠλαύνετο καὶ οἱ ἵπποι. Ἐπεὶ δὲ ἀφίκοντο πάντες ἐπὶ τὸ ἄκρον, ἐνταῦθα δὴ περιέβαλλον ἀλλήλους καὶ στρατηγοὺς καὶ λοχαγοὺς[5] δακρύοντες. Καὶ ἐξαπίνης, ὅτου δὴ παρεγγυήσαντος,[6] οἱ στρατιῶται φέρουσι λίθους καὶ ποιοῦσι κολωνὸν μέγαν. Ἐνταῦθα ἀνετίθεσαν δερμάτων πλῆθος ὠμοβοΐνων[7] καὶ βακτηρίας καὶ τὰ αἰχμάλωτα[8] γέρρα, καὶ ὁ ἡγεμὼν αὐτός τε κατέτεμνε τὰ γέρρα καὶ τοῖς ἄλλοις διεκελεύετο.[9]

NOTES.

1. Ἔθεον δρόμῳ, *were running with* (*at full*) *speed*. Dative of manner.
2. Ὅσῳ δὴ, *by exactly as much as they grew more*; exactly as their numbers increased the shouting increased.
3. Μεῖζόν τι, *something greater* (*than usual*), *something important*.
4. Παρεβοήθει, *he ran to give aid*, or *to the noise*. Παρα means motion to. Βοηθεῖν is to assist, being literally *to run*; θέω, to a *shout*, βοή.
5. Λοχαγούς, captains (ἄγω) of a cohort (λόχος).
6. Ὅτου δὴ παρεγγυήσαντος, *some one or other having prompted them* (genitive absolute).
7. Ὠμοβοΐνων, *of raw ox-hides* (ὠμὸς, *raw*; βοῦς, *ox*).
8. Αἰχμάλωτα, *taken captive*; lit., *taken by the spear* (αἰχμή, *a spear*; ἁλωτός, *taken*).
9. Διεκελεύετο. Δία in composition has a distributive force. *Sent orders round to the rest.*

LESSONS IN GERMAN.—XLVI.

SECTION XCVIII.—IDIOMATIC PHRASES (*continued*).

Einen Tag um den andern, literally, one day about the other, *i.e.*, every other day; as:—Er geht einen Tag um den andern in die Stadt, he goes every other day into town. Einen Tag um den andern habe ich Unterricht in der deutschen Sprache, every other day I have instruction in the German language.

1. Vergleichen = to compare to *or* with; as:—Hierin ist ihr Nie-

mand zu vergleichen, in this there is no one to be compared to her. Mit Gott, dem Vollkommenen, können wir schwachen, gebrechlichen Menschen uns nicht vergleichen, we, weak and fragile creatures, cannot compare ourselves with God, the all-perfect. Wem ist das Reich Gottes gleich, und wem soll ich es vergleichen? unto what is the kingdom of God like, and whereunto shall I resemble it? (Luke xiii. 18.) Vergleichen Sie gefälligst diese Probeblätter mit dem Manuscripte, please to compare these proof-sheets with the manuscript. Sich vergleichen signifies "to accord, to come to an agreement," as:— Beide Parteien haben sich schon verglichen, both parties have already compounded. Die Gläubiger haben sich mit dem Schuldner verglichen, the creditors have compounded with the debtor.

VOCABULARY.

Auf'schlagen, to rise.	Gläu'biger, *m.* creditor.	Schreien, to cry.
Beträcht'lich, considerably.	Händel, *pl.* quarrel.	Schuldner, *m.* debtor.
Confect', *n.* comfit, comfiture.	Held, *m.* champion, hero.	Thurm, *m.* tower.
Durch'kommen, to come through, "get through," survive.	Heldin, *f.* heroine.	Verblü'hen, to fade, decay.
Gasthaus, *n.* hotel, inn.	Herein'bringen, to bring in.	Verglei'chen. (See R. 1, above.)
Gebie'ten, to command, bid.	Leicht'sinnig, light, light-minded.	Werkzeug, *n.* implement, tool.
	Nachtisch, *m.* dessert.	Wiederho'len, to repeat, reiterate.

Résumé of Examples.

Der Kaufmann war nicht im Stande, sich auf mehr als fünf und zwanzig Procent' mit seinen Schuldnern zu verglei'chen.	The merchant was not able to settle with his debtors at more than twenty-five per cent.
Es wundert mich, daß er dieses Jahr, ohne Schulden zu machen, durch'gekommen ist.	It surprises me that he has come (got) through this year without making (any) debts.
Der Preis einer Waare pflegt nach Um'ständen auf- und ab'zuschlagen.	The price of wares is accustomed to rise and fall according to circumstances.
Einen Tag um den andern hatte ich bei meinem kranken Bruder zu wachen.	Every other day I had to watch with my sick brother.
Man muß sich wundern, daß so etwas noch im neun'zehnten Jahrhun'dert gesche'hen kann.	One must be surprised that such a thing can happen in the nineteenth century.
Der Gesand'te hielt eine lange Rede an die Versamm'lung.	The ambassador delivered (held) a long address to the assembly.

Exercise 190.

1. Die Gläubiger haben sich mit dem Schuldner auf fünfzig Procent verglichen. 2. Die beiden Kaufleute konnten sich wegen des Preises nicht vergleichen. 3. Ich habe Beides mit einander verglichen. 4. Er hat ihm das Haus auf fünf Jahre vermiethet. 5. Der junge Mann vermiethete sich als Knecht. 6. Man muß sich wundern, daß so etwas noch in unsern Zeiten geschehen kann. 7. Es wundert mich, daß er durchgekommen und nicht gestorben ist. 8. Cicero hielt eine Rede gegen Catilina. 9. Derselbe hielt auch Reden über die Freundschaft, über das Greisenalter und über verschiedene andere Gegenstände. 10. Cäsar hielt eine Rede an seine Soldaten. 11. Der Schüler wiederholte zu Hause noch einmal, was er in der Schule gehört hatte. 12. Wir hörten ein wiederholtes Schreien. 13. Der Preis dieser Waare ist bedeutend aufgeschlagen. 14. Die Früchte sind durch den Krieg beträchtlich aufgeschlagen. 15. Die Klugheit gebietet zuweilen auch dem tapfern Manne, einen Feind, der Händel an ihm sucht, zu meiden. 16. Der politische Flüchtling muß sein Vaterland meiden. 17. Die Gesellschaft eines verdorbenen Menschen soll man meiden. 18. Der Arzt besucht den Kranken einen Tag um den andern. 19. Einen Tag um den andern geht er auf die Jagd. 20. Er handelte noch als Mann so leichtsinnig, wie er als Jüngling gehandelt hatte. 21. Als die ungarische Heldin Jagella und andere ungarische Helden in New-York ankamen, kehrten sie in einem Gasthause ein. 22. Bei der Tafel wurde als Nachtisch ein mit kriegerischen Werkzeugen geschmückter Thurm aus Confect hereingebracht, worauf in deutscher Sprache die Worte standen: „Es leben die ungarischen Helden und Heldinnen!"

Exercise 191.

1. The creditor has compounded with his debtor at twenty per cent. 2. I could not compound with my creditors respecting the price. 3. Please to compare one with another. 4. I have let my house for five years. 5. A diligent scholar repeats what he has heard at school. 6. In war time the price of provisions rises considerably. 7. It surprises me that he does not avoid the society of such people. 8. We should avoid the society of those who have no good principles. 9. I visit my sister every other day. 10. He acts just as he did in his youth. 11. All the goods have been taken from the merchant, as he could not compound with his creditors. 12. Youth, arm thyself day by day with more wisdom, as the flower of youth decays.

SECTION XCIX.—EXAMPLES ILLUSTRATING THE VARIOUS USES OF SOME CONJUNCTIONS AND ADVERBS.

Aber, allein, sondern.

Es ist bald gespro'chen, aber schwer gethan' (Schiller).	It is soon said, but done with difficulty.
Noch ist er nicht da, aber kommen wird er gewiß'.	He is not yet there, but he will certainly come.
Die Zeichen werden gege'ben, daß das Fest geen'det sei; allein' weder Wagen, noch Masken, noch Zu'schauer weichen aus der Stelle (Göthe).	The signs are given that the festival is over; but neither the carriages, nor masks, nor spectators leave their places.
Nicht die Sprache an und für sich ist richtig, tüchtig und zierlich, sondern der Geist ist es, der sich darin' verkör'pert (Göthe).	Not the language itself is correct, powerful, and elegant, but the spirit which is embodied throughout.

Als.

Loui'se ist mein Liebling, denn sie hat ein ed'leres Gemüth' und einen fe'steren Charak'ter, als viele junge Damen; nichts als Sanftmuth spricht aus ihren Augen.	Louisa is my favourite, for she has a mind more noble, and a character more firm than many young ladies: nothing but gentleness speaks from her eyes.

Also.

Euch also soll ich trauen, Ihr nicht mir? (Schiller.)	To you then shall I trust; not you to me?
Er hat es selbst gethan', und kann also Niemand tadeln.	He has done it himself, and, consequently, can blame no one.

Auch.

Sie sind davon' heute Nacht, die Jäger auch (Schiller).	They are off to-night, and the rifles also.
So gut er auch ist, so kann ich mich doch nie mit ihm befreun'den.	How good soever (Sect. LXII.) he may be, I shall never become intimate with him.

Außerdem.

Alle diese Fürsten wuchsen in keiner höhern Erwar'tung auf als über eine Republik' zu gebie'ten, und keines ihrer Länder konnte ihnen eine an'dere Erfah'rung geben; außerdem' besa'ßen diese Fürsten nichts, als was die Nie'derlande ihnen gaben (Schiller).	All these princes grew up with no higher expectation than that of governing a republic, and none of their states could afford them any other experience; besides, these princes possessed nothing but what the Netherlands gave them.

Da.

Da du hier bist, will ich mit dir aus'gehen.	Since you are here, I will go out with you.
Da der Wind aus Westen kommt, wird es regnen.	As the wind comes from the west, it will rain.

MECHANICS.—XVIII.

ILLUSTRATION OF PRECEDING PRINCIPLES (*continued*).

Now turn to another common thing. A ladder, A B (Fig. 87), leans against a wall. What are the forces acting on it? Its own weight acts vertically downwards through G, and the other forces which keep it at rest are the reaction of the wall and the ground at A and B respectively. Now there is but little friction at A, and we may therefore consider the reaction to be in the direction A P perpendicular to the wall. G W and A P, then, represent two of the forces acting on the ladder; but, as it is at rest, all three forces must act through the same point. Now the only point in which W G and A P meet is that found by producing W G till it cuts A P. Let R be this point; the force at B must act in the direction B R. This force is the resultant of two others—the resistance of the ground acting vertically upwards, and the force of friction which acts along the ground and towards the base of the wall; and we easily see that the more nearly vertical the ladder is, the greater is the former as compared with the latter, and therefore the less the amount of friction which is required to keep it in its place.

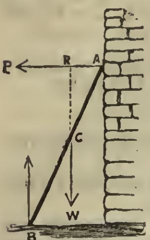


Fig. 87.

Here is another case, involving the same principle. A bracket, A B (Fig. 88), projects from a wall, to which it is fastened by a screw. A strut, A C, supports the outer end, and a weight, W, rests on it. In what direction is the strain on the screw? The three forces here are, gravity acting along W G, the thrust of the beam, A C, and the strain on the screw. The two former act through the point o, and the direction of the third is found by drawing a line from this point to the screw. We may take a line, $o\ c$, of such a length as to represent the weight, and resolve it into $o\ b$ and $o\ a$, one acting along the strut, the other perpendicular to the wall. These will represent two forces, which are together equivalent to $o\ c$, and of these $o\ b$ will be overcome by the pressure of the strut, and the other force, $o\ a$, tends to draw the screw from the wall A portion, however, of the pressure of the strut will be borne by the screw, and these two forces combining produce the resultant, which acts on the screw towards the point o.

It is frequently very important to be able thus to tell in what direction a strain will act, as the strength of our materials must be proportionate to it. In this way the direction of tie-beams and king and queen posts of a roof are determined. We know, too, where to apply struts and braces to the framework of a building, so as to gain the greatest benefit from them.

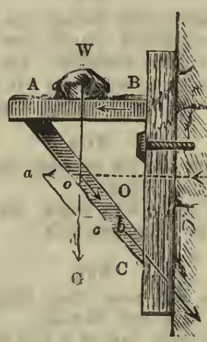


Fig. 88.

Now there are one or two cases of the composition and resolution of forces that are frequently given as illustrations, and if we clearly understand them we shall be able to master most others. The first is that of a kite.

Let K (Fig. 89) represent a kite. The forces which act on it are, the force of the wind, acting, we will suppose, in the direction of the arrow, the tension of the string, acting along it in the direction K S, and the weight of the kite; and by the action of these three forces it is kept at rest. We will consider them singly; the first, we will take the force of the wind. Take K W, of such a length as to represent this force. The kite is always so made as to present a large surface to the wind in proportion to its weight, and the string is fastened to the loop in such a way that it does not hang vertical, but inclined at an angle; the tail, however, prevents its being so acted on by the wind as to come

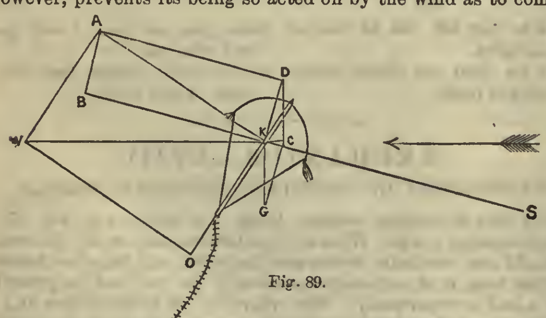


Fig. 89.

in the same straight line with the cord. Let us, then, resolve the force of the wind into two, one acting edgewise on the kite, the other perpendicular to its surface. We draw the parallelogram K O W A, and thus have the two forces, K O and K A, instead of K W. K O has no effect, as it acts on the edge, and we need, therefore, only consider the part K A.

Now we will introduce a second force, that of the string. Produce S K backward, draw A B perpendicular to B K, and complete the parallelogram D K B A. We can again resolve K A into K D and K B. The latter will be expended in stretching the string, and have no tendency to move the kite, and thus we have K D left as the effective resultant of these two forces. We now consider the third, which is the weight of the kite. Draw K G of such a length as to represent this, and complete the parallelogram D C G K. We have then K C the resultant of K D and K G, and therefore of all the forces which act on the kite, and this is the direction in which the kite will move, but as it does so, the angle at which it is inclined varies till K D and K G become opposite and equal, and then the kite will remain at rest as long as the force of the wind remains unaltered.

The other case we will consider is that of a ship, which will sail within a few points of the wind. Let C O (Fig. 90) represent the direction and intensity of the wind, and S V the direction in which it is desired that the vessel should advance. The sail is placed in the direction A B, which is midway between that of the wind and that of the vessel. We must, as before, resolve C O into two forces, E O and F O. The part E O, which acts along the direction of the sail, has no effect in moving the vessel; F O, which acts perpendicularly to the sail, is the effective portion. We must now again resolve this force along two directions, one being that in which the boat moves, the other at right angles to it. We make G O equal to F O, and about it describe the parallelogram H G I O, and thus have two forces, represented by O H and O I, in the place of the original force C O. Now, of these, O I has no tendency to cause the vessel to advance; it acts sideways on the vessel, usually inclining it, and causing a slight motion, but it is resisted by the pressure of the water against the side; the other portion, O H, represents the portion of the force of the wind which is effective, and produces motion.

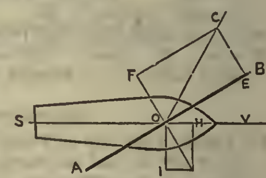


Fig. 90.

In the same way you can calculate what portion of the force of the wind is effective in turning a windmill. The vanes are always set at an inclination with the plane in which they turn, and you must resolve the force along two directions, one perpendicular to the surface, the other along it. The former you again resolve, and thus find what part of it produces rotation, and what part presses against the face of the mill.

Examples.

1. Forces of 9 and 12 act at right angles; what is their resultant?
2. The resultant of two forces which act at right angles is 10 pounds. One of the forces is 6; find the other.
3. Two men, one on each side of a stream, tow a barge. The angle the two ropes make is 60°, and each pulls with a force of 100 pounds. What is the total force exerted on the barge?
4. The tension of a wire in a piano is 100 pounds, its length is 5 feet. What force is required to draw its middle point 2 inches out of its position?
5. A weight of 90 pounds rests on a plane inclined at an angle of 30°. The co-efficient of friction is $\frac{1}{3}$. What force is required to keep it at rest?

ANSWERS TO EXAMPLES IN LESSON XVII.

1. The forces acting at the longer end are the power of 10 pounds acting at a distance from the fulcrum of $6\frac{3}{4}$ feet, and the weight of the lever, which is also 10 pounds, and acts through its middle point, or $2\frac{3}{4}$ feet from the fulcrum. The moments on this end are thus $10 \times 6\frac{3}{4}$, or $67\frac{1}{2}$, and $10 \times 2\frac{3}{4}$ or $27\frac{1}{2}$. These make 95 pounds. As W acts at a distance of $1\frac{1}{4}$ feet, it must be $\frac{95}{1\frac{1}{4}}$ or 76 pounds.

2. Since $\frac{1}{5}$ is lost by friction, we may regard the weight as 12 pounds only. Now $\frac{1}{2}$ of the weight of the first pulley is supported by the power, $\frac{1}{4}$ of the next, and $\frac{1}{8}$ and $\frac{1}{16}$ of the other two; and since each weighs 2 pounds, these amounts are 1 pound, $\frac{1}{2}$ pound, $\frac{1}{4}$ pound, and $\frac{1}{8}$ pound, together $1\frac{7}{8}$. Take this from 12, and we have an effective power of $10\frac{1}{8}$ remaining; and as the gain is 16, the weight raised is $16 \times 10\frac{1}{8}$, or 162 pounds.

3. Friction requires a strain of 9×20, or 180 pounds, to overcome it, and $\frac{1}{100}$ of the weight has to be borne. The strain, therefore, is $180 + 448$, or 628 pounds.

4. Friction is here $\frac{1}{30}$ of 27 cwt., which equals $\frac{9}{10}$ cwt. The amount of the weight sustained by the horse is $\frac{1}{70}$ of 27 cwt., or $\frac{27}{70}$ cwt. The total strain is thus $1\frac{2}{7}$ cwt., or 144 pounds.

5. The weight of the carriage is 25×80, or 2,000 pounds.

6. The co-efficient of friction is $\frac{116}{3360}$, or nearly $\frac{1}{29}$.

*

LESSONS IN ASTRONOMY.—II.

EARLY ASTRONOMICAL INSTRUMENTS — HISTORY OF THE SCIENCE (*continued*) — COPERNICUS AND HIS SYSTEM — TYCHO BRAHE—KEPLER.

In judging of the various systems devised by the ancients to account for the grand mechanism of the heavens, we must bear in mind, and make allowance for, the very imperfect nature and construction of the instruments they possessed; and when this is done, instead of wondering at the errors they made, we shall often be surprised at the accuracy of their observations; some of these which still exist being sufficiently accurate to be at times of service to astronomers in the present day.

The simplest and probably the most ancient astronomical instrument consisted of a vertical pillar set upon an even surface, so that, by observing the shadow, the direction of the sun and its altitude at any period might be measured; by noticing, also, the direction in which the shortest shadow was cast by the pillar, they could ascertain the north and south points of the heavens. It is believed by many that the obelisks and stone pillars which were common among Eastern nations were constructed for some such purpose, and that they were frequently surmounted by a ball, in order that the position of the shadow might be more easily marked. Some of these obelisks were afterwards removed to Rome for the same purpose. These instruments were called gnomons.

The telescope, which has made such astounding revelations to men of modern times, and which has so greatly extended their knowledge of the universe, was quite unknown in early ages. Instruments for measuring time were also very imperfect, although, as will be seen further on, the importance of noticing the exact moment of the occurrence of any of the celestial phenomena is very great. Various forms of the sun-dial were in use, but these could only be of service when the sun was shining, and even then could not give very accurate indications. Other instruments were therefore planned, and the one most commonly employed was the clepsydra, or water-clock, in which the hour was shown by the amount of water that had passed through an aperture. Sand was afterwards used in the place of water, as its flow was found to be more regular and even.

Rather strangely, we have come back very recently to a method of measuring minute intervals of time similar to this old plan. A vessel is provided with a small aperture from which a fine stream of mercury is issuing, and when it is required to note any brief interval—as, for instance, that occupied in the passage of a planet between two lines situated in the field of view of a telescope—the mercury is diverted into a separate vessel at the moment of the disc of the planet coming into contact with the first line, and allowed to flow on until it has passed the second, when the stream is allowed to flow as at first. The amount of mercury in the vessel is then accurately weighed, and by comparing it with the amount which is known to flow out in a given interval—say, for instance, five seconds—the exact duration of the passage can be noted.

A few other rude instruments were also occasionally employed, but their construction was very imperfect, and we are not therefore surprised at the slow progress of the science. Among the Romans, too, science never found a congenial home; glory in war being the object of their ambition, rather than the peaceful yet glorious triumphs achieved by intellect. After the age of Ptolemy little progress appears to have been made, and even known truths were to a great extent forgotten. His system was indeed universally received for many centuries, more especially as it was supported by the authority of Aristotle; and fresh additions to it, in the shape of eccentrics and epicycles, were made; but few, if any, new discoveries appear to have been effected, and no noteworthy name appears on the pages of history.

After the fall of the Roman empire the science found a home among the Arabians, who, in the eighth century, seem to have devoted much attention to its study, and to have made considerable advances in it. By them the length of the solar year was calculated to within a very little of its true amount; the obliquity of the ecliptic was also measured; and at a place in the desert, near Palmyra, the length of a degree was ascertained with very creditable accuracy. The Ptolemaic system was, however, firmly received, though many of the more thoughtful and careful observers seem to have been far from satisfied with it, and expressed their wonder at its manifest disproportions. Still such is the hold that preconceived notions obtain over the human mind, especially when those views are supported by priestly authority and made matters of religion, that for centuries no one seems to have referred to the old theory of Anaxagoras, or proposed any new one to clear up the difficulty.

At length, however, about the year 1472, there was born one, Nicholas Copernicus, who, leaving all the speculations of former observers, inquired for himself into the motions of the celestial bodies. He first examined all the ancient observations he could find, and then commenced for himself a system of close and careful study of the heavens. He compared the actual places occupied by the sun and planets with those which, according to former theories, they ought to occupy, and thus obtained a better knowledge of their irregularities and variations than any astronomer before his time. He continued this course for many years, and at length arrived at the conclusion that Mercury and Venus revolved around the sun, instead of round the earth. He gradually extended his reasoning further, and at last started his celebrated theory, which regarded the sun as the centre of the system, with the earth and the other planets all revolving in regular order around it. By this grand idea all the complicated and bewildering schemes which had puzzled so many observers were at one stroke swept away. Instead of the cumbrous machinery of crystal spheres revolving one within the other, the utmost simplicity is seen to prevail; order and regularity take the place of almost inextricable confusion; and as the observer transfers his station of observation from the earth to the sun, the planets, which had previously appeared to wander on in ever-varying directions among the stars—now retracing their steps, and then, after an interval of rest, starting afresh—are seen to be steadily moving on in elliptic orbits around the central luminary of the system. The movements of the inferior planets Mercury and Venus, the reason why they were never seen very far removed from the sun, the retrograde motions of the planets, and their irregular movements, were all clearly explained by this grand yet simple theory.

We can with difficulty form an idea of the prejudice with which this scheme would be received; the earth was by it degraded from its central place, and reduced to the rank of one of the planets; and that which men had always been wont to regard as fixed and immovable, was now declared to be in rapid flight around the sun, and, at the same time, to be ever whirling round on its own axis. He himself foresaw the effects of this prejudice, and hence he seems to have been long before he fully accepted the theory, and then to have waited still longer before he ventured to make it public. His work on the subject, entitled "On the Revolution of the Heavenly Bodies," was finished in the year 1530, but he delayed publishing it for several years, although a few friends, to whom he had communicated and explained his views, at once adopted them and urged him to do so. At last, however, he gave his consent to its being printed, but his dedication almost takes the form of an apology for venturing to suggest such views, and his ideas were put forward rather in the shape of an hypothesis than of a definite system.

We must not, however, suppose that Copernicus formed a complete system to account for all the motions of the planets; his life was too short for this task. His work was rather to indicate the true theory of the universe, leaving it for others to trace out more accurately the exact curves in which the planets moved, and to ascertain their various distances, sizes, and rates of motion. This work was taken up by Kepler, who has sometimes been called the "Legislator of the Heavens," as it was he who first laid down the laws and rules which govern the movements of the heavenly bodies. We shall notice more about this celebrated astronomer shortly, but must first look at the labours of another distinguished man who preceded him—Tycho Brahe. He was of Danish extraction, and was born very shortly after the death of Copernicus. It is said that his attention was first directed to the science of astronomy by an eclipse which happened at the time predicted, in the year 1560, and incited him to learn something of the wonderful science which enabled such predictions to be made. When at the University of Leipsic much of his night was often devoted to observation of the stars, and thus he soon attained considerable proficiency; but there is one thing which tends rather to lower him in our estimation, and that is his partial rejection of the Copernican system, and the proposal of a new one, in which the earth occupied the central place, with the moon and sun revolving round it, while all the planets revolved round the sun.

The Copernican system, however, was, we must remember, at this time a mere theory unsupported by proof, and the main reason of Brahe's rejection of it was that, if the earth revolved in a large orbit, he thought the fixed stars ought to appear in a different position when seen from one extremity of the orbit to that which they occupied when seen from the other extremity; and not being able to observe this change, he concluded that the earth must be at rest. The principle of this argument was right, and in reality there is a minute difference in the appearance of the stars; it is, however, too minute to be observed, except by the most delicate instruments. The reason why it is not more clearly seen is that, great as is the diameter of the earth's orbit, the distance of even the nearest fixed star is so immensely greater that the change produced is scarcely visible. We may notice this same effect as we are carried rapidly along in a train; the objects situated near to the line of railway seem to move past us very rapidly, those further off have a less apparent speed, while lofty objects in the distance scarcely seem to move at all. Every minute changes the apparent position of those which are near, while it is only after the lapse of some little time that we perceive the motion of those at a distance; and, supposing the line of rails were perfectly straight, we might travel on for hours, and not be able to detect the slightest alteration in the apparent position of the sun. We see thus that the conclusion which Brahe arrived at was wrong, though his premises were right; and we shall find further on the great importance which is attached to this change of position, or "parallax," as it is called, all the distances of the heavenly bodies being determined by means of it.

His fame, however, as an astronomer rests upon the care and accuracy of his observations. A new star which appeared in the year 1572, and continued visible for about a year and a half, was specially observed by him, and he recorded a large number of very careful observations on the planets and stars, some of which are of great use for reference at the present time. To him, too, we are indebted for a catalogue of many of the fixed stars, which, though it contained a much smaller number than that of Hipparchus, was greatly superior to it in accuracy.

A table showing the allowance to be made in the apparent position of the heavenly bodies, on account of the effect produced by the refraction of the air, was also calculated by him. The nature of this refraction will be fully explained further on. We may mention, however, that it causes all bodies near the horizon to appear at a greater altitude than they really have attained; and hence, in important observations, allowance must be made for its action.

About the year 1575 Tycho Brahe attracted the attention of Frederick II. of Denmark, who gave him a small island on the Baltic, and an annual allowance. Here he built himself a large house and observatory, which he called Uraniborg, the "Castle of the Heavens," and in this he lived for years, occupied with his favourite science, and assisted by the best instruments which could be procured. After the king's death, some of those who were envious of his honours succeeded in depriving him of his allowance and his observatory. He did not, however, despair, for soon after he was received at Prague by the emperor, and an observatory erected for him and his pupils. Here he remained until his death, which happened a few years later.

Among his pupils was Kepler, to whom we have already referred. He acquired from Brahe the habit of accurate observation, and was far more successful than his master in the theories which he formed. Naturally he was possessed of a quick and lively imagination. He commenced with careful observation, and then formed his theories in accordance with the facts; and proceeding in this way, he soon made several important discoveries.

The task to which he now devoted his time and energies was to discover the nature of the paths described by the planets. Starting with the hypothesis of the sun being in the centre of the system, he began to watch attentively their places, and, to simplify matters, he confined himself at first to the motions of the planet Mars.

He calculated the place it ought to occupy according to the theory of its revolving in a circular orbit, and soon found that the place it really occupied in the sky differed considerably from that assigned to it. This theory was thus at once shown to be incorrect, and he had therefore to form a fresh one by the combination of several circular movements; and again he diligently calculated its position, till, just as he seemed to be on the verge of success, the planet once more wandered away from the path which he had assigned to it; and once more he had to commence his observations from the beginning. In this way he continued to try one hypothesis after another, submitting each to the test of most careful observation, till at length no fewer than nineteen different theories had been proposed, and the movements of the planets compared with those which were calculated by these theories; and yet the true solution of the problem was still unfound. His perseverance, however, never failed, and he toiled on, though eight long years had been occupied in the task. One important negative result he had, however, arrived at, and this was that, whatever was the nature of the curve the planets described, it was not a circle, nor a combination of circles. This was one great step towards the solution of the task. From the very earliest ages it had been assumed that, as the circle seemed the perfection of form, all the heavenly bodies must move in circles; but Kepler now cast off this trammel, and then applied himself afresh to his task.

In looking at the greatness of his work we must remember that the difficulty is much increased by the fact that our station of observation is itself in rapid motion. Could we view the planets from the sun, we should easily see their courses; but as we cannot do this, allowance has to be made in every calculation for the movement of our standpoint, and this motion was not then clearly understood.

Having discarded the theory of motion in circles, Kepler now proceeded to try other forms, testing them as before, and the first that occurred to him was the ellipse. The same series of calculations was accordingly gone through again, and this time the motion of the planet was found to agree with that assigned to it by the theory. The great problem of the heavens was now solved, and the joy with which Kepler enunciated the first of the laws which bear his name can scarcely be imagined. This law may be stated as follows:—*The planets revolve around the sun in elliptical orbits, the sun being situated in one of the foci.*

As this is one of the fundamental laws of astronomy, we must explain it rather more fully. In every circle there is a point called the centre, such that all straight lines drawn from it to the circumference are equal. No such point is to be found in an ellipse; but in the longest diameter two points can be found so situated that, if straight lines be drawn from one to any point in the circumference, and thence to the other, the sum of these lines will always be equal. These points are called the foci.

Explanations of the practical methods by which the curve of an ellipse may be traced from any two points as foci, have already been given in Problem LVIII. of "Lessons in Geometry"—"How to trace the curve of an ellipse by mechanical contrivances" (see Vol. II., page 252); it is therefore unnecessary to repeat them here in detail. It will be needful, however, to call the reader's attention to what is termed the "eccentricity" of an ellipse, as it is a term that is constantly used in speaking of the orbits of the heavenly bodies. In Fig. 84 (Vol. II., page 252), G is the centre, and the fraction of which the numerator is G A and the denominator is G C—or, in other words, the proportion between G A and G C, which is the half of the major axis—is called the eccentricity. In the figure, however, this is represented very much greater than it is in orbits of any of the planets, and their paths therefore differ less from a circle.

The consideration of the remaining two laws of Kepler must be deferred till our next lesson.

READINGS IN LATIN.—II.

VIRGIL.

VIRGIL was a Roman poet who was born in the year 70 B.C. and died 19 B.C. He flourished in the period which is known as the "golden age" of Latin poetry, of which he was one of the most brilliant ornaments. The works by which he is best known are (1) the Bucolics, a book of pastoral poetry, consisting of ten eclogues, as they are called; (2) the Georgics, four books of what is known as "didactic" poetry, containing instructions in the art of agriculture and similar occupations; and (3) the Æneid, an epic poem in twelve books, each of considerable length, the subject of which is the wanderings of the Trojan hero, Æneas, after the taking of Troy by the Greeks, his landing in Italy, his wars with the native tribes, and final settlement. All these are written in the Heroic or Hexameter rhythm; and in addition to them Virgil composed several other short pieces in different metres which have come down to us, but are not so generally read. The chief characteristics of Virgil's style are his polish, ingenuity, and skill. He cannot lay claim to any great originality, for both his subjects and his method of treatment are alike taken from Greek models, though his writings contain passages of great beauty and true poetical sentiment; but, like our English Pope, he remodelled and put into shape the metre he employed, which up to his time had been rugged and unpolished. The Bucolics, or Eclogues—for by the latter name they are more generally known—may be described as scenes of pastoral life taken from the poetical point of view, and though very beautiful, they are totally unnatural, and the characters in them have been cleverly compared to the ladies and gentlemen in the garb of shepherds and shepherdesses that we see sometimes in English family pictures. While they speak in many cases the sentiment of Italians of Virgil's day, all the scenery and surroundings are most distinctly Greek, and the poems are, in fact, very close copies of the pictures of life found in some of the Greek writers, the very names employed being Greek. Our first extract is taken from the seventh Eclogue, which represents an improvisatorial trial of musical skill between two shepherds.

VIRGIL.—EC. VII. 1—19.

Forte sub argutâ consederat ilice Daphnis,
Compulerantque greges Corydon et Thyrsis in unum,
Thyrsis oves, Corydon distentas lacte capellas,
Ambo florentes ætatibus, Arcades ambo,
Et cantare pares, et respondere parati.
Hic mihi, dum teneras defendo a frigore myrtos,
Vir gregis ipse caper deerraverat; atque ego Daphnim
Aspicio. Ille ubi me contra videt, "Ocius," inquit,
"Huc ades, o Melibœe; caper tibi salvus et hædi;
Et si quid cessare potes, requiesce sub umbra.
Huc ipsi potum venient per prata juvenci;
Hic virides sacrâ prætexit arundine ripas
Mincius, eque sacrâ resonant examina quercu."
Quid facerem? Neque ego Alcippen nec Phyllida habebam,
Depulsos a lacte domi quæ clauderet agnos;
Et certamen erat, Corydon cum Thyrside, magnum.
Posthabui tamen illorum mea seria ludo.
Alternis igitur contendere versibus ambo
Cœpere, alternos Musæ meminisse volebant.

NOTES.

(*The numbers refer to the lines.*)

1. Argutâ, *shrill*. The epithet has reference to the sound of the wind in the branches, and may be translated *whispering*.
2. In unum, *together*, or *into one* place; supply *locum*.
3. Oves governed by compulerat understood, from compulerant in the previous line.
4. Arcades. Arcadia was looked upon as the land of pastoral poetry, and so Arcades is used as synonymous with poetæ.
5. Pares goes with parati, *both equally prepared to*, or it may be construed with cantare, *equals in singing*, an irregular construction, as if it were "pares in cantando." Vir gregis, *the monarch of the herd*.
6. Mihi. This is called the *dativus ethicus*, or dative of reference. Here it is used in much the same sense as the possessive meus, and may be construed with caper. Defendo is used in Latin in two senses —(1) *to defend*, as here; (2) *to ward off*. Defendit æstatem is used by Horace to mean *wards off the heat*.
7. Atque is generally used to express some sudden change: *and lo! on a sudden I see Daphnis*.
9. Tibi, used as mihi in line 6.
11. Ipsi, *of their own accord*; a frequent use of this pronoun.
14. Quid facerem? *What could I do?*
16. Et, etc. *And on the other hand there was a contest—Corydon against Thyrsis—a great one.* The sentence Corydon cum Thyrside is put in apposition with certamen, which it explains.
19. Alternos. *Their Muses wished to remember alternate strains*, and therefore to recall them to the minds of the shepherds.

Our next extract is from the 2nd Georgic, which treats of the culture of trees.

VIRGIL.—GEORG. II. 109—117.

Nec vero terræ ferre omnes omnia possunt.
Fluminibus salices, crassisque paludibus alni
Nascuntur, steriles saxosis montibus orni;
Littora myrtetis lætissima; denique apertos
Bacchus amat colles, Aquilonem et frigora taxi.
Adspice et extremis domitum cultoribus orbem,
Eoasque domos Arabum, pictosque Gelonos.
Divisæ arboribus patriæ; sola India nigrum
Fert ebenum; solis est thurea virga Sabæis.

NOTES.

110. Fluminibus, paludibus, ablatives of place, *by streams, in marshes*.
112. Lætissima. Lætus, *glad*, is here used, as it often is, in the sense of *abounding*. There is a similar allusion to the locality of the myrtle in Georg. IV. 124, where Virgil speaks of "amantes littora myrtos."
113. Bacchus. The god of the vine, used here for *the vine itself*; so we find Ceres used for *corn*, Vulcanus for *fire*, Mars for *war*, and Minerva for *intellect*.
115. Geloni, a tribe inhabiting the neighbourhood of the Dneiper; their country is the modern Ukraine.
116. Divisæ, etc., *countries are divided among trees—i.e.*, each tree has its own country.
117. Solis. *To the Sabæans alone the frankincense tree belongs.* The Sabæans inhabited part of Arabia.

The third extract is from the Æneid, and is the celebrated description of Fama (Rumour).

VIRGIL.—ÆN. IV. 173—188.

Extemplo Libyæ magnas it Fama per urbes,
Fama, malum, qua non aliud velocius ullum;
Mobilitate viget, viresque acquirit eundo;
Parva metu primo, mox sese attollit in auras,
Ingrediturque solo, et caput inter nubila condit.
Illam Terra parens, irâ irritata deorum
Extremam ut perhibent Cœo Enceladoque sororem
Progenuit, pedibus celerem et pernicibus alis;
Monstrum horrendum, ingens, cui quot sunt corpore plumæ
Tot vigiles oculi subter, mirabile dictu,
Tot linguæ, totidem ora sonant, tot subrigit auras,
Nocte volat cœli medio terræque, per umbram
Stridens, nec dulci declinat lumina somno;
Luce sedet custos, aut summi culmine tecti,
Turribus aut altis, et magnas territat urbes,
Tam ficti pravique tenax quam nuncia veri.

NOTES.

173. Libyæ. The ancient name for the northern part of Africa.
179. Cœus and Enceladus were two of the giants of the Greek mythology.
180. Pedibus, an ablative of reference, *swift of foot and untiring of wing*. "The ablative denotes that part of the subject with regard to which something is predicated of the subject: ager pedibus, *weak in the feet*." (Madvig, "Latin Grammar," 253.)
181. Cui quot sunt, etc., *who has, for every feather on her body, a watchful eye beneath, for every eye*, etc.
184. Cœli medio terræque, *midway between heaven and earth*; so we find "locum medium utriusque," *a place midway between both* (Cæsar, *Bel. Gal.* I. 34).
186. Luce, *in the daylight, by day*; opposed to nocte, both ablatives of time.

We subjoin a translation of Extract 3, from Cæsar, in our last Readings in Latin:—

CÆSAR.—"ON THE WAR IN GAUL," Book IV., cap. xiv.

And when Cæsar observed this he gave orders to move the war-galleys some little distance from the transports, and to row them up and station them opposite to the exposed side of the enemy, as their appearance was somewhat strange to the barbarians and their movements more handy for his purpose, and with slings, arrows, and engines to attack the enemy and drive them from the position. And this manœuvre was a great help to our men, as the barbarians, amazed at the shape of the galleys and the motion of the oars, and the strange nature of the engines, halted, and gradually retreated. And as our soldiers hung back, chiefly on account of the depth of the sea, the standard-bearer of the tenth legion, having prayed to the gods that what he was about to do might have a prosperous issue, called out, "Leap, comrades, unless you would betray the standard to the enemy: I at least will surely do my duty by the state and our general!" And having spoken thus in a loud voice, he leaped from the vessel and went, standard in hand, against the enemy. Then our men, having admonished one another not to allow of such a disgrace, leaped down in a body from the vessel, and when the men on the ships next them saw them, they also followed them and approached the enemy.

MECHANICS.—XIX.

ELEMENTS OF MACHINERY—PRIME MOVERS—ANIMAL FORCE, WATER, WIND, STEAM.

As it is our object to make these lessons as practical as possible, it will be well to look at a few of the simpler modes of altering and transmitting power. Sometimes this is advanced to the rank of a separate science, and called kinematics, or the science of motion, but it should be referred to here as a part of practical mechanics.

We seldom have our power available for use in the exact way we desire. Sometimes we have an alternate motion, like that of the piston-rod of an engine, and we want to derive from it a rotatory or progressive motion; or we want to transmit it along a direction making some angle with its course, or to make many other alterations in its mode of action.

In large factories there is frequently a long shaft running along the building, and driven by an engine. From this it is required to drive all the machines in the place. This is accomplished by fixing wheels on the shaft, and letting endless straps pass over these and then over the driving pulleys of the machines. The motion may often be greatly altered in this way. The strap itself merely transmits the power, and whether there is a gain or loss in speed or power depends on the comparative size of the sheaves. Frequently there are several of these wheels of different sizes fixed on the axle and on the machine, and thus the speed may be altered at pleasure. If the strap passes over a large one on the shaft and a small one on the machine, there will be an increase of speed, and if we reverse the condition there will be a loss. A common illustration of a similar arrangement is seen in a watch. The spring when fully wound up exerts a much greater power than it does when the watch has run nearly down. Now this would make it go irregularly, and therefore the fusee is introduced. When the force of the spring is greatest the chain acts on the smallest part of the fusee, and therefore has only a short leverage, but as it unwinds and loses its force the chain acts at a greater leverage, and a uniform rate of motion is thus maintained.

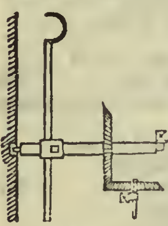


Fig. 91.

Sometimes toothed wheels are used instead of straps, especially when the distance through which the power has to be transmitted is small. The advantage is that they do not slip, as straps are liable to do; the friction with them is, however, greater. If we want to transmit motion from a shaft to another placed at an angle with it (Fig. 91), we employ what are known as bevelled wheels. The action of these will be clear from the figure, without any explanation.

Often it is required to change a rotating motion into a progressive one, and we can accomplish this by means of a rack and pinion. A number of notches are cut in a bar of metal (Fig. 92*a*), of such a size and at such distances that the teeth of the wheel exactly fit into them, and as the wheel is turned the rack is moved onwards. This is very frequently employed when a slow and regular motion is required, as in the adjustment of the tube of a microscope. Instead of a rack a chain is sometimes used (Fig. 92 *b*), the links being made of a peculiar shape, so that the teeth of the wheel may catch in them.

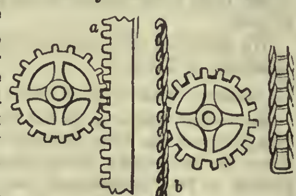


Fig. 92.

The crank (Fig. 93) is, perhaps, one of the most common of these elements of machinery. The piston-rod of an engine is usually jointed, and the end of the jointed part fixed to an arm projecting from the axle to be turned, and called a crank. Sometimes it is fixed to a pin in one of the spokes of the wheel, but the action is just the same. The force, however, with which it drives the wheel is continually varying. When the piston is at the bottom of the cylinder the crank and piston-rod are in one straight line, and therefore all the power presses on the bearing of the axle, and is lost. As the wheel turns the power acts with a leverage which increases till the wheel has made nearly one-fourth of a revolution; it is then at its maximum, and diminishes till the piston-rod reaches its highest point, when it is all again lost. Now it is clear that unless we have some means of regulating the speed, the machine will work very unevenly, and at times stop altogether. To obviate this, a large and heavy wheel, called the *fly-wheel*, is fixed on the axle of the crank. This, when once started, acquires an amount of momentum or moving force which carries it over the dead points when the power is lost. On account of the weight of the wheel, its motion is but slightly accelerated when the piston acts at its greatest leverage, but the additional force is stored up in it, and thus ensures a steady motion. The heavy wheel of a foot-lathe serves precisely the same purpose. The power is here applied during rather less than one-half of the revolution, but the momentum then acquired carries it through the remaining part.

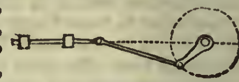


Fig. 93.

PRIME MOVERS.

Having seen a few of the principal ways of transmitting and modifying motion, we will now notice the most important of the prime movers or causes of motion, and then pass on to Dynamics.

As already stated, no machine can create force, there must be some original source whence it proceeds; and on examination we shall find that nearly all sources of power may be divided into these four classes: muscular action, whether of men or animals; the force of water; the power of the wind; and the expansive power of gases or vapours. There are a few other prime movers, as electricity, heat, and chemical action; these, however, are not used at all in practice, but merely for the sake of experiment, their cost being at present too great to allow of their employment.

Muscular action, the first of our four kinds, is the one earliest employed and most frequently used, when no very great exertion is required. The reason of this is, that it can always be employed without previous arrangement, and can readily be applied in almost any way that may be needed; it is, however, one of the most uncertain of the prime movers, as it is both limited in its power and irregular in its action. The two divisions of it are, the force of men and that of animals. But before noticing these we must decide what unit of work we are to adopt. In our second lesson we saw that the unit of force is that which is required to cause a round ball, equal in weight to a cubic inch of water, to move through one foot in one second, and that this unit is equal to 7·85 grains. This is, however, far too small for practical purposes, and the unit of work which has been fixed on and universally adopted in this country in calculations like those we are about to make, is the force required to raise a weight of 1 pound through a space of 1 foot. We call this the unit of work, and not of force, as time is not taken into account. The same amount of work is done in raising 100 pounds to a height of 50 feet, whether a minute or an hour be occupied; the force required would, however, be much greater in the former than in the latter case. This unit of work is called a foot-pound. In the example just taken, 50×100, that is, 5,000 units or foot-pounds, are required to raise the weight. The same force would also raise 5,000 pounds 1 foot, or 5 pounds 1,000 feet, the product of the numbers which represent the pounds raised and the feet passed over being the same in each case. Thus we can find the work done in any machine, and we have another way of putting the principle of virtual velocities, the work done by the power being always equal to that done by the weight. By reducing to this unit the work done by the same force applied in different modes, we can discover which is the most advantageous, and what is their comparative efficacy.

We will now inquire into the different ways of applying human power. In spade labour there is a very great loss. When merely used for turning up the ground, the spade is a lever of the first kind, and the power acts at the longer arm; but when the earth is lifted or thrown to any height, the spade becomes a lever of the first or third kind, according to which hand we consider the fulcrum and which the power; but either way, the weight acts at the longer arm, and thus causes a great waste of power. In turning a winch, though a larger portion of the force employed is utilised, there is still great loss and irregularity. When the handle is being pulled upwards and towards the person who is turning it, his force produces the greatest effect; the next greatest effect is produced when it has passed the highest point, and is being pressed downwards, but evidently the pressure is now limited to his own weight. When the handle is being pushed or pulled horizontally, still less is accomplished. If we raise any weight by a winch, we shall easily feel these differences in the strain.

In some modes of applying force nearly all the muscles of the body are set to work, and the strain is distributed, while in others only a few act, and hence fatigue soon follows. When a boat is propelled by oars, the force exerted is applied very advantageously; nearly all the body helps, and the strain is in the most favourable direction. When the foot is firmly planted against the foot-board, the strong muscles of the back and thighs exert their force; the hands, too, pull in a direction nearly at right angles with the oars. Hence we find that the amount of work a man can accomplish this way is half as great again as he can by turning a winch.

The mode of employing human power by which the greatest advantage is gained is by ascending a ladder, and then allowing the weight of the body to act, and, by descending, raise a weight nearly equal to itself. An interval of rest is gained in this way while descending, and experience shows that more work can be accomplished if frequent short intervals of rest are thus taken between short periods of work. The body being specially framed for walking, nearly all the force expended is effective.

When a large amount of heavy matter, such as building material, or earth for an embankment, has to be raised to a height, human power is sometimes thus applied:—A bucket in which a man can sit, or the material to be raised can be placed, is fixed at each end of a rope, which passes over a pulley fixed a little above the level to which the material has to be raised. The length of the rope is so adjusted, that when one bucket is on the ground, the other shall be at the required height. The lower bucket is then loaded, and one or more men ascend a ladder or incline and enter the upper one; their weight causes it to descend, and thus the material is raised. Nearly all the labour is thus expended in raising themselves to the top of the ladder, and while they are descending, and the material is being removed from the upper bucket, they have an interval of rest. In the treadmill the power is applied in a very similar way. This consists essentially of a large and very broad wheel, with steps fixed all round it; the men hold on to a fixed bar, and attempt to ascend the steps. The wheel, however, turns with their weight as fast as they ascend, and thus they do not raise themselves at all; but still the principle is the same, and nearly as much effect is gained from the power in this way as in the former, the slight difference arising mainly from the fact that the intervals of rest are less frequent.

In some quarries the mineral is raised in a similar way, by men climbing on cross-pieces fixed through the rim of a very large wheel, round the axle of which the rope winds. This is an example of the employment of the wheel and axle; the power, however, does not act at the circumference of the large wheel, for the men are not on a level with the axle, but at a radius which varies with the weight to be raised.

To calculate the gain, we must imagine a vertical line to pass through the centre of gravity of the men; this line will meet the spoke which is horizontal in some point, and the distance of this point from the centre is the radius at which the power really acts. Hence, when the weight to be raised is greater, the men are higher up on the wheel, and thus their weight acts at a greater leverage. Animal power is sometimes applied in a similar way, the animal being made to walk round the inside of a large cylinder, and thus to turn it.

The following table, which is the result of many experiments and calculations by different scientific men, shows approximately the effect produced by human power when employed in different ways, and gives us a good idea of their comparative efficacy. The average duration of the labour may be reckoned at eight hours per day.

UNITS OF WORK DONE BY A MAN IN A DAY.

Raising his own body	2,000,000
Rowing a boat	1,900,000
Working at a treadmill . . .	1,870,000
Pushing or drawing a carriage . .	1,500,000
Turning a winch	1,250,000
Working a pile engine by hand . .	1,000,000
Throwing earth with a spade . .	500,000

We now pass to the power of animals, which is much more frequently applied than that of man—it being found better to employ man where skill and thought, and not mere mechanical labour, are required; hence skilled labour is always more highly paid than unskilled. The animal most commonly employed in this country is the horse, and Watt estimated the amount of work it was capable of performing at 33,000 foot-pounds per minute. This amount was accordingly adopted as a unit of measurement, and is called a horse-power. Thus, when we speak of a steam-engine of 12 horse-power, we mean one capable of raising 12 times 33,000, which is 396,000 pounds, 1 foot high in 1 minute, or 1,000 pounds 396 feet, for each requires the same amount of power. Though this unit of measurement is still retained, it is more than a horse can accomplish continuously, and in practice its power is not found to be more than 22,000 units, or $\frac{2}{3}$ of the nominal amount. The power of a mule is about $\frac{2}{3}$ that of a horse, while that of an ass is only $\frac{1}{4}$.

The most common way of employing animal power is in drawing or carrying a load, and it is clear that if this load be increased, the speed with which it is carried must be diminished. Hence it is an important question to decide at what rate of motion the greatest effect can be obtained, and the best way of determining this is by experiment. There are two extreme cases: the animal may sustain so heavy a load that it can scarcely move; or, on the other hand, it may travel very rapidly, but without being able to carry any load at all. The greatest effect is at some intermediate speed, and the weight that can be carried varies inversely as the speed. The useful effect is the product of the numbers which represent the speed and the load. Thus, if a horse can carry 12 hundred-weight 6 miles an hour, or 15 hundred-weight 5 miles an hour, the greatest advantage is obtained by letting him take the heavier load, the useful effect then being 15×5, or 75, while in the other case it is 12×6, or 72 only.

Now, it is found by practical experience that the largest amount of work is done by giving such a load that the animal can travel about three miles an hour; if the speed be increased much beyond this, the weight must be diminished in a more than equal proportion.

The second prime mover is the force of water. Of this, however, we shall treat more fully when we pass on to Hydrostatics, and need, therefore, say little now. We may have the force of a running stream, or that of the ebb and flow of the tide. The latter of these is a source of power very little used, but which might often be well employed. Water has always a tendency to obey the law of gravity and sink to the lowest point; in doing this it presses against or moves any obstacle that opposes its motion, and this pressure may in many different ways be employed to drive machinery. The simplest mode of applying it is seen in the common water-mill, where the stream presses against the floats of the wheel, and thus turns it.

We can calculate the force of a stream or waterfall by measuring the distance through which the water falls, and multiplying the weight of the water by this, we thus obtain the number of units of work it is capable of effecting. If, for instance, 1,000 gallons of water pass every minute, and the fall is 6 feet, then, since a gallon of water weighs 10 pounds, we have a moving force of $1{,}000 \times 10 \times 6$, which is 60,000 foot-pounds. But even in the best modes of employing this, there is a very great loss.

The remaining prime movers, the force of the wind, and the expansive force of gases and vapours, must be considered in another lesson.

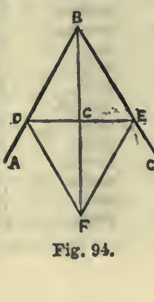


Fig. 94.

ANSWERS TO EXAMPLES IN LESSON XVIII.

1. The resultant is 15 pounds.
2. The second force is 8 pounds.
3. Let B be the point at which the ropes A B and B C act on the barge. Take B D and B E each to represent 100. Complete the parallelogram and join D E. Since D B E is 60°, and D B and B E are equal, the triangle is equilateral, and therefore D E is equal to 100, and G E to 50. Now B F is the resultant of B D and B E, and B G is evidently $\frac{1}{2}$ B F. But $BG^2 + GE^2 = BE^2$, that is $= 10{,}000$; for B E $= 100$, and $GE^2 = 2{,}500$; BG^2 must, then,

be 7,500, and B G is the square root of this, or 86·6. The whole resultant is therefore 86·6 × 2, or 173·2.

4. If the wire be pulled in the middle, each half will exert a tension of $100 \frac{2}{\sqrt{30^2+2^2}}$, or nearly $6\frac{2}{3}$ pounds. The total force will therefore be a little over 13 pounds.

5. A force of $\frac{1}{2}$ the weight, or 15 pounds, is required.

LESSONS IN ENGLISH.—XXXVII.

FRENCH STEMS.

THE words which the English owes to the Romance languages are very numerous. Of this number, by far the largest portion comes from the French. This portion is too large to be here enumerated, though a few specimens may be given. Before, however, we proceed to set down instances, let it be observed that we shall prefer those which retain some marked resemblance to their originals, or still appear in their native form.

ENGLISH WORDS FROM THE FRENCH.

From CHEVAL, *a horse* (Lat. caballus), come

Chevalier, *a knight.*
Chivalry, *knighthood.*
Cavalier, *a knight* or *horseman.*
Cavalry, *horse-troops.*

From CHARTRE or CHARTE, *a charter* (Lat. charta), come

Chart, *a sea-map.*
Charter, *a writing bestowing privileges.*
Chartist, *a person desirous of a new charter.*
Cartel, *a writing containing stipulations,* etc.
Cartoon, *a drawing on large paper, a painting.*
Cartouch, *a case for balls or cartridges.*
Cartrage or Cartridge, *a case for gunpowder.*
Cartulary, *a register, a monastic record.*

From BARRE, *a bar* (the same word), come *to bar, to hinder.*

Barricade, *a fence or temporary fortification.*
Barrier, *a boundary* or *obstacle.*
Barring-out, *a boyish game.*

The following are a few separate instances:—Bottle, brilliant, escape, engagement, flask, forage, flank, guarantee, guard, garnish, grimace, hash, harangue, hardy, lodge, marquis, mason, packet, robe, wardrobe, saloon, supper, dinner (breakfast is Saxon), tirade, troubadour. The words which denote the various officers in civil government are mostly Norman-French, as might be expected from the conquest of England by William the Norman; *e.g.*, king and earl are Saxon, but prince, duke, marquis, baron, count, mayor, etc., are of French origin, at least so far as the English is concerned.

The ignorance of older philologists may be exemplified in the derivation which they gave of parliament. *Parlia*ment is a word of French extraction, from the word parler, *to speak;* the *ment*, as the student now knows, is merely the terminational suffix. But the wisdom of our forefathers made *ment* into *mind*, and stated that the parliament was so called because men there freely spoke their mind! The history of this derivation is no better than the philology, for in the French parliament liberty of speech was not predominant.

French words have been a medium by which Latin words have come into the English: the extent of our obligation to both those languages can be known only when we have seen specimens of this transference.

FRENCH WORDS AS A MEDIUM FROM THE LATIN TO THE ENGLISH.

Latin.	*Meanings.*	*French.*	*English.*
Ala	*a wing*	aile (of old, aisle)	*aisle.*
Auctor	*originator*	auteur	*author.*
Bonitas	*goodness*	bonté	*bounty.*
Bos	*an ox*	bœuf	*beef.*
Brevis	*short*	brief	*brief.*
Calefacere	*to warm*	échauffer	*chafe.*
Canalis	*a pipe*	chenal	*channel.*
Canna	*a reed*	canne	*cane.*
Caput	*the head*	chef	*chief.*
Carmen	*a song*	charme	*charm.*
Catena	*a chain*	chaine	*chain.*
Computare	*to reckon*	compter	*count.*
Cooperire	*to cover*	couvrir	*cover.*
Cultellus	*a knife*	coutelas	*cutlass.*
Diabolus	*Satan*	diable	*devil.*
Dignari	*to think worthy*	daigner	*deign.*
Ebur	*ivory*	ivoire	*ivory.*
Extraneous	*outward*	étranger	*strange.*
Feretrum	*a bier*	bière	*bier.*
Ferox	*fierce*	féroce	*fierce.*
Fidelitas	*fidelity*	feodalité, feaulté	*fealty.*
Gigas	*a giant*	géant	*giant.*
Gubernari	*to govern*	gouverner	*to govern.*
Gula	*the throat*	goulet	*gullet.*
Incantare	*to enchant*	enchanter	*enchant.*
Inimicitia	*enmity*	inimité	*enmity.*
Lectarium	*a bed*	litière	*litter.*
Levare	*to lift*	lever	*to lift.*
Lex	*a law*	loi	*loyal.*
Macer	*lean*	maigre	*meagre.*
Magister	*master*	maitre	*master.*
Magnus	*great*	magne	*main.*
Medietas	*the middle*	moitie	*moiety.*
Mirabile	*wonderful*	merveille	*marvel.*
Nomen	*a name*	nom	*noun.*
Numerus	*a number*	nombre	*number.*
Nutrix	*a nurse*	nourrice	*nurse.*
Oleum	*oil*	huile	*oil.*
Paganus	*a villager*	paysan	*peasant.*
Panarium	*a basket*	panier	*pannier.*
Passus	*a step*	pas	*pace.*
Pauper	*needy*	pauvre	*poor.*
Peregrinus	*a stranger*	pèlerin	*pilgrim.*
Populus	*the people*	peuple	*people.*
Prepositus	*placed over*	prévost	*provost.*
Presbyter	*an elder*	prêtre	*priest.*
Probare	*to make good*	prouver	*prove.*
Pullus	*a chicken*	poulet	*poultry.*
Puppis	*the stern*	poupe	*poop.*
Ratio	*reason*	raison	*reason.*
Recipere	*to receive*	recevoir	*receive.*
Regnare	*to rule*	régner	*reign.*
Rotundus	*round*	rond	*round.*
Sapor	*taste*	saveur	*savour.*
Supernus	*supreme*	souverain	*sovereign.*
Tegula	*a tile*	tuile	*tile.*
Traditor	*a traitor*	traitre	*traitor.*
Visus	*sight*	vue	*view.*

A careful survey of a French dictionary on the part of one who is skilled in derivation, would bring to light an extent of obligation owing by the English to the French language, of which ordinary students have no idea. A few words are subjoined by way of specimen, taken under several letters of the alphabet.

FRENCH WORDS IN THE ENGLISH LANGUAGE.

French.	*English.*	*Latin.*
Adage	adage	adagium.
Aigle	eagle	aquila.
Aile	aisle	ala.
Amour	amour	amor.
Angle	angle	angulus.
Antre	antre (Shakespeare)	antrum (a cave).
Arc	arc	arcus.
Bâton	batoon	baculus.
Baume	balm	balsămum.
Bile	bile	bilis.
Bourg	burgh	purgos (Greek).
Boutique	booth	apothēkē (Greek).
Bulle	bull	bulla.
Cage	cage	
Caisse	case	capsa.
Campagne	champagne	campania (open country).
Cap	cape	caput.
Coche	coach	
Cendre	cinders	cinis.
Cerise	cherry	cerăsus.
Chaise	chair	
Chaloupe	sloop	
Char	chariot	carrus.
Cheminée	chimney	caminus.
Clé or clef	clef	clavis.
Coin	coigne	cuneus.
Comté	county	comitatus.
Corps	corpse	corpus.
Couple	couple	copula.
Duel	duel	duellum.
Empire	empire	imperium.
Épouse	spouse	sponsa.

Étain	tin	stannum.
Fable	fable	fabula.
Face	face	facies.
Faim	famine	fames.
Fardel	fardeau	phortos (Greek).
Fibre	fibre	fibra.
Figue	fig	ficus.
Flûte	flute	
Foi	faith	fides.
Front	front	frons.
Fruit	fruit	fructus.
Gai	gay	gaudium.
Geai	jay	
Gingembre	ginger	zinziber.
Golfe	gulf	kolpos (Greek).
Goût	gout	gustus.

Many French terms are employed in English either in their native form or slightly altered, and of these some even in France are of modern origin. We have *dragoon* from the name of the soldiers with whom Louis XIV. carried on the war, which received the name of his *dragonades*, against his French Protestant subjects in order to compel them to become Catholics. From the noun *dragoon* we have the verb to *dragoon into*. A roué, in slang language, *a black-leg*, is literally a wretch who deserves to be broken on *the wheel*—metaphorically one who has the same manners as the courtiers of the profligate Duke of Orleans, Regent of France, who is said to have given the name to his abandoned associates. Guillotine, a term which we derive from France, is the name of an instrument for decapitating political offenders; it received its name from the inventor, and was first used amidst the early horrors of the first revolution in that country. Translations from the French have led to the incoming amongst us of many French terms and phrases, greatly to the corruption of our mother English. Formerly, translations were said to be "done into English." The phrase is not inappropriate, for many translations from the French are miserably done, a large portion of every page consisting of French words and idioms in an English dress—resembling a Frenchman aiming to speak English by putting on an English costume. Commonplace novels, too, have brought into vogue many Gallicisms. Most blameworthy is this defacement and corruption of our language, when they are perpetrated by historians, of whom better things might be expected. This practice has been well taken off by the *Spectator*, in No. 185 of that work, which is strongly recommended to the perusal of those who possess it or can readily borrow it.

Having read the remarks in the *Spectator*, and read also what has been written in this lesson, let the student proceed to write an essay on

THE FRENCH ELEMENT IN THE ENGLISH LANGUAGE.

Words with their proper Prepositions.

Words.	F. R.
Disqualify for,	qualis, *of what kind.*
Dissatisfied with,	satis, *enough.*
Dissent from,	sentio, *I feel.*
Distinct from,	tinctus, *dyed, coloured.*
Distinguish from, between,	tinguo, *I dye, colour.*
Distrustful of,	trauen, *to trust.*
Divested of,	vestis, *a garment.*
Divide between (two), among (many),	divido, *I divide.*
Dote on,	
Doubt of,	dubito, *I doubt.*
Dwell in, at, on,	
Eager in,	begierig, *desirous of.*
Embark in, on board of, for,	embarquer, *to go into a barque.*
Embellished with,	bellus, *beautiful.*
Emerge from,	mergo, *I dip.*
Employ in, on, about,	employer, *to put to use.*
Emulous of,	emulus, *a rival.*
Enamoured of,	amor, *love.*

COMPOSITION.

Report the following extracts in the same manner as before :—

ON THE CHOICE OF AUTHORS.

If we are to read, it is a very important rule in the conduct of the understanding, that we should accustom the mind to keep the best company, by introducing it only to the best books. But there is a sort of vanity some men have, of talking of, and reading obscure, half-forgotten authors, because it passes as a matter of course that he who quotes authors which are so little read, must be completely and thoroughly acquainted with those authors which are in every man's mouth. For instance, it is very common to quote Shakespeare; but it makes a sort of stare to quote Massinger. I have very little credit for being well acquainted with Virgil; but if I quote Silius Italicus, I may stand some chance of being reckoned a great scholar. In short, whoever wishes to strike out of the great road, and to make a short cut to fame, let him neglect Homer, and Virgil, and Horace, and Ariosto, and Milton, and, instead of these, read and talk of Fracastorius, Sannazarius, Lorenzini, Pastorini, and the thirty-six primary sonnetteers of Bettinelli; let him neglect everything which the suffrage of ages has made venerable and grand, and dig out of their graves a set of decayed scribblers, whom the silent verdict of the public has fairly condemned to everlasting oblivion. If he complains of the injustice with which they have been treated, and call for a new trial with loud and importunate clamour, though I am afraid he will not make much progress in the estimation of men of sense, he will be sure to make some noise in the crowd, and to be dubbed a man of very curious and extraordinary erudition.—*Sydney Smith.*

THE BIBLE.

The Bible is the only book which God has ever sent, the only one he will ever send, into this world. All other books are frail and transient as time, since they are only the registers of time; but the Bible is durable as eternity, for its pages contain the records of eternity. All other books are weak and imperfect, like their author, man; but the Bible is a transcript of infinite power and perfection. Every other volume is limited in its usefulness and influence, but the Bible came forth conquering and to conquer, rejoicing as a giant to run his course, and like the sun, "there is nothing hid from the heat thereof." The Bible only, of all the myriads of books the world has seen, is equally important and interesting to mankind. Its tidings, whether of peace or of war, are the same to the poor, the ignorant and the weak, as to the rich, the wise, and the powerful. The Bible indeed is the only universal classic, the classic of all mankind, of every age and country, of time and eternity.—*Grimké.*

GEOMETRICAL PERSPECTIVE.—XIV.

IN Problem XXXIX., page 24, it was stated that the door at the side was at an angle of 40° with the wall upon which it hung, and that the wall was perpendicular with the PP. The rule for finding the VP in this particular case was explained. We wish now to say more upon this part of the subject. It very frequently happens that the angle of the given line or object is stated as being at an angle with *another plane*, or with *another object either parallel or at a right angle with the* PP. For example, the wall of a building may retire at an angle of 30° with the PP, and some other projection may extend from it at a given angle with this wall, which it can do either from a horizontal or a perpendicular connection. We must then know how to determine its angle with the PP. It is true it is not always necessary to know the angle of the PP *for the sake of executing the drawing*, as the given angle can be in some cases constructed upon the vanishing line of the plane with which the projection is connected instead of the PP; but we cannot pass over this way of stating the question, as many have imagined a difficulty without any substantial reason for doing so. It may be necessary *to know the angle the projection makes with our position* for reasons altogether independent of the drawing; it may be to answer the inquiry of an employer; or the draughtsman, knowing how the parts of a building *are placed with each other*, may wish to satisfy himself as to the appearance the whole will have when viewed from some particular point. But what is of more immediate importance to us now is, that it opens out a new way to explain the difficulties that arise sometimes from a confusion in the mind respecting the treatment of vanishing lines, vanishing planes, and vanishing points, all these being so closely combined in the principles and practice of construction. Thus, by considering them under every possible connection, we become more familiar with them, and they are more readily comprehended in their details, however numerous they may be, and also when united together as a whole.

1st. Suppose a retiring wall A forms an angle of 30° with the PP, and there is a projection from this wall at a right angle with A, the projection will then be at an angle of 60° with the PP, or with our position.

2nd. Suppose a retiring wall at an angle of 30° forms an angle of 120° with a projecting wall, the projecting wall will also be at an angle of 30° with our position in the opposite direction.

3rd. Suppose the retiring wall at an angle of 30° with the PP forms an angle of 30° with the projecting wall, the latter will be at an angle of 60° with the PP (see Fig. 66). We do not say at an angle of 120°, because we always prefer to make use of the angle formed by the nearest approach of the projection to the line of our position, or the picture plane.

4th. Again, suppose an inclined shutter, or a roof which is united horizontally with a wall, is said to be at an angle of 40° with the wall, the shutter or roof would be at an angle of 50° with the ground.

All this will be very evident if we consider that "*if any number of straight lines meet in a point in another straight line on one side of it, the sum of the angles which they make with this straight line, and with each other, is equal to two right angles.*" (See Lessons in Geometry, V., Vol. I., page 156.) Therefore (Fig. 67), if A is 30° with the PP, and B 90° with A, then B will be 60° with the PP, the whole making two right angles. With regard to the last *supposition*, we shall see that the lines of the wall, the roof or shutter, and the ground, form a right-angled triangle, the three interior angles of which are together equal to two right angles. Therefore, as the angle of the wall with the ground is 90°, and the shutter or roof 40° with the wall, the shutter will be at an angle of 50° with the horizon (Fig. 68). Consequently, this angle of 50° must be constructed for the vanishing line, and the subject treated as an inclined plane. (See Problems XXXI., XXXII., and XXXIII.) From all this we deduct a rule for finding vanishing points for lines or planes which are stated to be at given angles with other lines or planes not parallel with the picture plane:—*When the sum of the two angles of the given objects is greater than a right angle, it is subtracted from the sum of two right angles, and the remainder is the extent of the angle sought.* This will explain the results of the first, second, and fourth *suppositions* above.

Fig. 70.

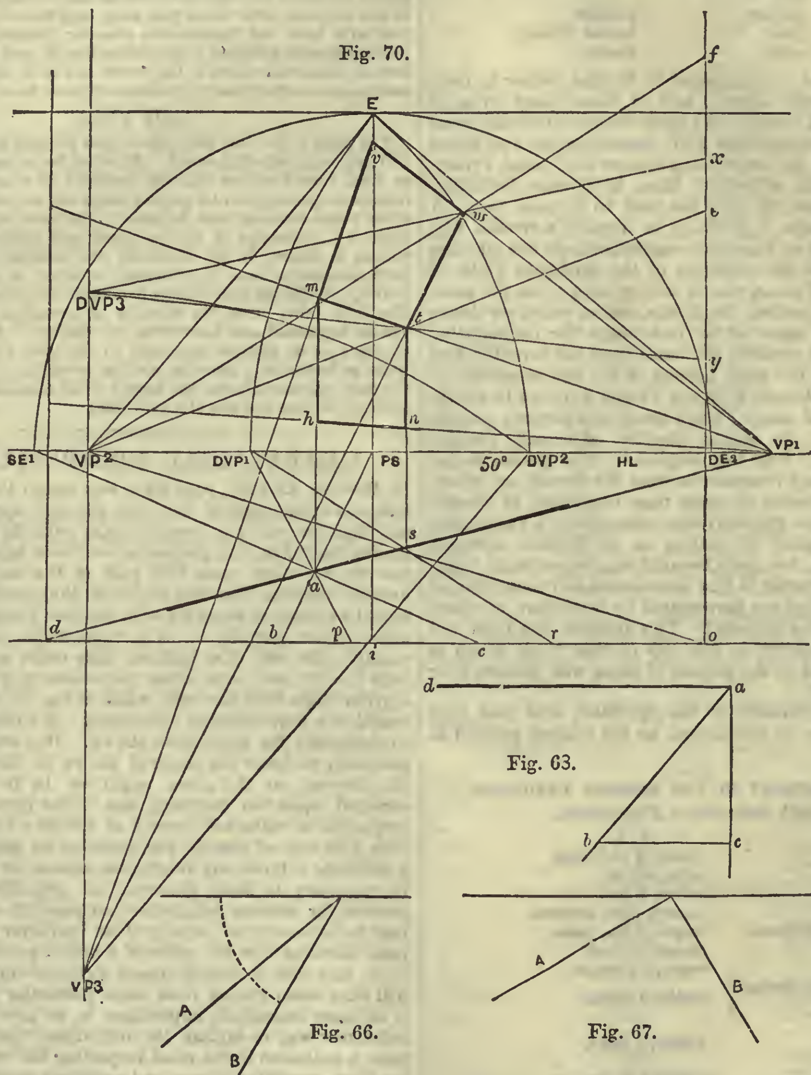


Fig. 66.

Fig. 63.

Fig. 67.

When two angles of the given objects are together less than a right angle, the sum will be the angle sought. This answers to the third supposition. We now propose a problem to illustrate our remarks about the wall and the shutter.

PROBLEM XLI. (Fig. 69).—*A wall at an angle of 40° with our position is pierced by a window of 4 feet 3 inches high and 4 feet broad; a shutter projects from the top of the window at an angle of 40° with the wall; the window is 5 feet from the ground, and its nearest corner is 4 feet within the picture; other conditions at pleasure. Scale of feet* $\frac{1}{48}$.

Before proceeding to work this problem, we wish to give the student some directions about the scale. In this case we have given the *representative fraction* of the scale, and not the number of feet to the inch. It is a common practice with architects and engineers to name the proportion of the scale upon which the drawing is made, in the manner we have done here, leaving the scale to be constructed if necessary. The meaning of the fraction $\frac{1}{48}$ is that *unity* is divided into the number of equal parts expressed by the denominator. Thus a scale of feet $\frac{1}{48}$ signifies that one standard foot is divided into 48 equal parts, each part representing a foot on paper, the result is $\frac{1}{4}$ inch to the foot. It also means that the original object, whether a building or piece of machinery, is 48 times larger than the drawing which represents it. If the scale had been written, yards $\frac{1}{48}$, it would be the same as $\frac{3}{4}$ inch to represent a yard. The way to arrive at this is as follows:—

$\frac{1}{48}$ of $\frac{12}{1}$ inches $= \frac{1}{4}$ inch to the foot.

$\frac{1}{48}$ of $\frac{36}{1}$ inches $= \frac{3}{4}$ inch to the yard.

The above method of stating the scale ought to be understood by every one engaged upon plan-drawing.

To return to the problem. The principal consideration relates to the shutter. The inclination may be upwards, at an angle of 40° with the wall, or it may be downwards at the same angle. We will represent both cases. First, when inclined downwards. Draw the HL, which is 4 feet from the ground-line; from PS draw a perpendicular to E; this will be the radius for drawing the semicircle meeting the HL to determine DE^1 and DE^2. Find the vanishing point for the wall VP^1, and its distance point DVP^1; also find the VP^2 by drawing a line from E to VP^2 at a right angle with the one from E to VP^1, because if the shutter had projected from the wall in a horizontal position, it would have vanished at VP^2; that is, if it had been perpendicular or at right angles with the wall. In short, the vanishing point for the horizontal position of a line must always be found whether the line retires to it horizontally or not, because the VP for an inclined retiring line is always over or under the VP (according to the angle of inclination) to which it would have retired if in a horizontal position. (See Prob. XXXI., Fig. 53.) Consequently, the vanishing point for an inclined retiring line is found by drawing a line from, in this case, the DVP^2, according to the angle of inclination, to where it cuts a perpendicular line drawn through the VP²; thus we find its vanishing point, whether its inclination be downwards or upwards; therefore draw a line from DVP², at an angle of 50° with the HL, cutting the perpendicular from VP² at VP³, the vanishing point. We have made the nearest corner of the window 2 feet to the left of the eye, represented by the distance *i* to *b*; a line from *b* must be ruled to PS, upon which we wish to cut off 4 feet to find *a*, the nearest point within; a line from *c*, which is 4 feet from *b*, must be drawn to DE¹, and where it cuts the line *b* PS in *a* is the point required. Draw the perpendicular *a h m*. Draw from DVP¹ through *a* to *p*; make *p r* equal to the width of the window. Draw back again from *r*, cutting DVP¹ in *s*; draw the perpendicular *s t*; the base of the window is drawn from *f*, on the line of contact, ·5 feet from the ground, to the VP¹; the height of the window, 4 feet 3 inches, is marked from *f* to *e*; a line from *e* to VP¹, cutting the perpendiculars from *a* and *s* in *m* and *t*, will give the top of the window. The opening of the window is *m t h n*. Now we must draw the shutter; the corner nearest us is *v*, consequently it *inclines upward towards the wall, but downwards from it*; therefore, the VP for the shutter must be above the HL, which we have explained. To measure or set off the length of the shutter, we have raised *a line of contact* for that purpose from *o*, found by drawing from VP² through *s* to meet the ground-line. From *t* directed from VP³ draw a line through *w*; this will be the further side of the shutter; its length must be determined thus:—From *t* directed from DVP³ draw a line to the line of contact, meeting it in *y*; make *y x* equal to the length of the shutter, the same as the length of the window; draw from *x* back again to DVP³, cutting *t w* in *w*; draw *w v*, directed by VP¹, and *v m* directed by VP³.

Fig. 71.

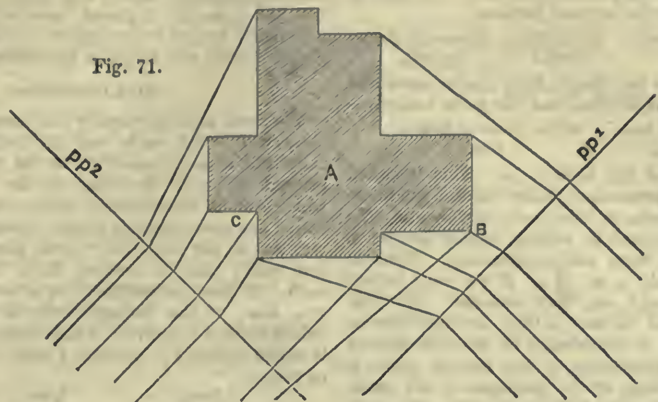
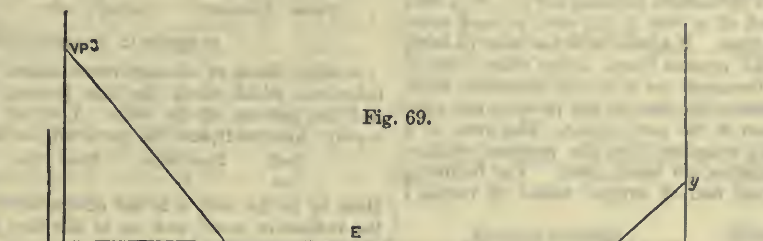


Fig. 69.



We will now draw the shutter at the same angle with the wall, but inclined upwards from it (Fig. 70). The important difference in working the problem under these conditions arises from the upward inclination of the shutter *from* the wall, *but inclined downwards to meet the wall.* This last view of the position of the shutter is the proper one for our purpose, because after a little consideration we shall perceive that it is a *retiring plane*, but *downwards*; therefore its VP is below the eye or HL. (In the former case the shutter was a retiring plane, but upwards, establishing its VP *above* the eye or HL.) Consequently, we must draw the vanishing line for the VP³ downwards from DVP². The sides of the shutter, *t w* and *m v*, must be drawn in the direction of VP³, and cut off from DVP³, first by drawing a line through *t* to *y*; make *y x* equal to the length of the shutter; draw from *x* to DVP³, producing *w*. All the early part of the problem, relating to the wall and windows, and the remaining lines *w v* and *t m*, will be but a repetition of the shutter under the first position. We can prove the truth of this method of drawing the perspective inclination of a plane by another method. Draw the right angle *c a d* (Fig. 68); make *a b* equal to the length of the shutter, and at an angle of 40° with *a c* or 50° with *a d*; draw *b c* parallel to *a d*; *a c* will be equal to the height of *b* above *a*. This must now be applied to Fig. 70. Draw a line from VP² through *t* to *e* on the line of contact; make *e f* equal to the height of *b* above *a*, viz., *c a* (Fig. 68). Draw from *f* back to VP²; it will be found to cut the corner of the shutter in *w*, proving by both methods that *t w* is the perspective length of the further side of the shutter.

A plan of a building may be made, having all its proportions, angles, and other measurements arranged and noted, yet nothing may be said as to its position with the picture-plane, and from this plan several perspective elevations may be raised. When such is the case, all that is necessary will be to draw a PP across the paper in such a position with the plan, that by drawing visual rays, the picture-plane we have chosen may receive the view we wish to take of it. Suppose A (Fig. 71) is the plan of a building, and we wished to have two views of it—one taken with an end and front in sight, the other with a view of the front and the opposite side—we should then place the PP at such an angle with the side or front as might be considered to be the best for our purpose. PP¹ would receive the visual rays from the front and the end B; PP² would receive those from the front and the end C. In short, any line may be drawn which represents the PP at any angle with the plan, or opposite any side we may wish to project. This will give a very useful illustration of the way to treat a subject when its proportions are given, as is frequently the case, without any reference to the view to be taken of it; in other words, the angle it forms with the picture-plane.

LESSONS IN GREEK.—XXV.

CONJUGATION.—PRELIMINARY NOTIONS.

Let us take the word ελυσαμην to illustrate what was said in the last lesson. The word signifies *I loosed myself,* I untied or unbound myself. Now suppose that *I unbound myself* was written as though it formed one word, as thus:—Iunboundmyself. If we mark off the several elements of this compound by hyphens, and assign names to the several parts—

Personal Prefix.	*Adverbial Prefix.*	*Verbal Stem.*	*Personal Suffix.*
I	un-	bound	myself,

we may have some idea how the Greek form above presented has been produced. Here it is divided, and the parts named:—

Augment.	*Root.*	*Aorist Stem.*	*Middle Personal Ending.*
ε-	λυ-	σα-	μην.

It is thus seen that the root of the form is λυ. This is called the *root,* because it remains permanent under all the modifications. Thus it is found in λυσω, in λυσομενος, ελυθην, etc. By prefixing certain letters to λυ, and by adding certain letters to λυ, we get all the varieties of form and signification. Thus, if we want to say *I loose,* we add ω, as λυ-ω; if we want to say *they loosed,* we prefix ε and add σαν, thus, ε-λυ-σαν. The prefixes and suffixes by whose aid the root is thus modified may be termed formative syllables. A knowledge of these formative syllables, combined with a knowledge of the several roots, is necessary for a correct knowledge of the grammar of the verbs. It is necessary to make a distinction between the root of a verb and the stem. The root of a verb is the verb reduced to its ultimate or most simple form. It agrees with the stem in being generally the stem of the present tense, active voice. But it differs from the stem, inasmuch as it is one primitive form, and there are several stems—the stem of the present, the stem of the imperfect, the stem of the perfect, etc. The stem of a tense is that form which remains when the personal endings and the mood characteristics are taken away. The following are the stems of the root and of several tenses of τυπτω, *I strike.*

	STEMS.	PERSONAL ENDINGS. *Third Person.*		*Second Person.*	
Root,	τυπ-				
Present Stem,	τυπτ-	-ει,	he strikes;	-εις,	thou, etc.
Imperfect Stem,	ετυπτ-	-ε,	he was striking;	-ες,	„
First Aorist Stem,	ετυψ-	-ε,	he struck;	-ας,	„
Perfect Stem,	τετυφ-	-ε-	he has struck;	-ας,	„
Pluperfect Stem,	ετετυφ-	-ει,	he had struck;	-εις,	„

That is to say, if to the present stem ει be added, we get τυπτει, which means *he strikes;* if to the pluperfect stem εις be added, we get ετετυφεις, which means *thou hadst struck.* So, if from τετυφας we take away ας, we get the perfect stem τετυφ. If we want to make the perfect stem into the pluperfect stem, we prefix the augment ε, and make ετετυφ. If, again, we wish to resolve τετυφ into the root, we have to cut off the augment τε, and change the aspirate φ into the corresponding soft π, and so obtain τυπ. This, the root, can be raised into the present stem by affixing τ—thus, τυπτ. And τυπτ may be changed into the imperfect stem by prefixing the augment of that tense, namely, ε.

THE AUGMENT.

First of all, we must consider the augment or temporal prefix. We call the augment temporal, because its function is to denote past time; and we call it a prefix, because it is put at the beginning of the root or stem. The augment is of two kinds: first, syllabic; second, temporal. It is syllabic when it adds a syllable to the verb; it is temporal when it lengthens the initial vowel of the verb. The syllabic augment is of two kinds, it is simple or reduplicative. For instance, it is simple when it merely prefixes a vowel, as in ελειπον, *I was leaving;* it is reduplicative when it doubles the initial consonant, as λελυκα: here ε is called the simple syllabic augment, and λε the reduplicative. The syllabic augment is employed when the verb begins with a consonant. If the verb begins with a vowel, the temporal augment is used, the vowels α and ε being changed into η or ει, and ῐ and ῠ (*iota* short and *upsilon* short) being changed into ῑ and ῡ: ο is changed into ω. In the same way, in verbs beginning with the diphthongs αι, ει, οι are changed into η, ῳ, the first vowel being changed into its corresponding long one, and the ι written underneath; αυ becomes ηυ. If a verb begins with ρ, the ρ is generally doubled, as ῥιπτω, *I throw,* ερῥιπτον. The simple syllabic augment is found in only the indicative mood; the reduplicative extends through all the moods. The simple syllabic augment is used with the imperfect tense and with the aorist. The reduplicative augment is used with the perfect tense, the pluperfect tense, and the third future, sometimes called the paulo-post-future. If, however, the verb begins with a vowel, the perfect and the pluperfect have, instead of the reduplicative, merely the temporal augment. The pluperfect has a double augment, inasmuch as it prefixes the simple augment ε to the reduplicative τε, etc.; for instance, ετετυφειν. Fuller details will be given hereafter.

CHARACTERISTIC LETTERS.

We have used previously the terms *pure verbs.* This is one class into which verbs are divided. Verbs are divided generally into classes, according to the characteristic letters of the present tense, or the stem of the present tense. The letter which stands immediately before the ω of the present tense is called the characteristic letter: thus, in λυω, the υ is the characteristic of the verb; in τυπτω, the τ is the characteristic of the verb; and in στελλω, the λ is the characteristic of the verb. If the characteristic is a vowel, the verb is called *pure, e.g.,* λυω; if the characteristic is a consonant, the verb is called *mute, e.g.,* τυπτω; if the characteristic is a liquid, the verb is called *liquid, e.g.,* στελλω, *I send.* Thus there are three kinds of verbs.

Pure.	*Mute.*	*Liquid.*
τιμαω, *I honour.*	τριβω, *I rub.*	φαινω, *I show.*

FLEXIONAL TERMINATIONS.

Another kind of characteristic letters or syllables are the inflexions, which mark the time (tense), the manner (mood), and the persons of the verb. Look at λυσομαι, *I will loose myself.* Analyse it, and the parts will be found to stand thus:—

Root.	*Tense Sign.*	*Mood Sign.*	*Person Sign.*
λυ-	σ-	ο-	μαι.

Here λυ is the root, σ is the characteristic of the future, ο of the indicative mood, and μαι of the first person singular. Let us vary these forms a little.

Root.	*Tense Sign.*	*Mood Sign.*	*Person Sign.*
λυ-	σ-	οι-	μεθα.

Here the sign of the indicative mood, ο, has become οι, to indicate the optative, and μαι of the first person singular is changed into μεθα of the first person plural. Again, take ελυσαντο.

Augment.	*Root.*	*Tense Sign.*	*Mood Sign.*	*Person Sign.*
ε-	λυ-	σ-	α-	ντο.
βε-	βουλευ-	σ-	ο-	μαι.
ε-	βουλευ-	σ-	α-	μην.

Augment.	*Root.*	*Voice Sign.*	*Person Sign.*
ε-	βουλευ-	θ-	ην.

The tense sign, in union with the person sign, is termed the tense-ending. Thus in λυσω the σ is the tense sign, being the sign of the future, and σω is the ending of the future tense, active voice, commonly called the first future active. The stem of the verb, in connection with the tense sign and with the augment, is called the tense-stem. Thus, in εβουλευσα the tense-stem is εβουλευσ—that is, the stem of the first aorist active.

GENERAL TABLE OF THE TENSE-ENDINGS.

	Active.	*Middle.*	*Passive.*
Present,	-ω,	-ομαι.*	
Imperfect,	-ον,	-ομην.*	
Perfect,	-α,	-μαι.*	
Pluperfect,	-ειν,	-μην.*	
Aorist First,	-σα,	-σαμην,	-θην.
Future First,	-σω,	-σομαι,	-θησομαι.
Aorist Second,	-ον,	-ομην,	-ην.
Future Second,			-ησομαι.

This arrangement places under the middle voice some tenses, those marked with an asterisk, which are commonly ascribed to the passive voice. If the student bears in mind what was said in the last lesson of the intimate relation of the two, he will see a ground for this diversity of view.

PERSONAL ENDINGS AND VOWEL SIGNS.

The personal endings are the terminations by which the variations of person are indicated. They are closely connected with the mood-signs, which are the vowels that indicate the several moods: for example:—

1 Per. Sin. Ind. Pres. M.,	βουλευ-ο-μαι.	Subj.,	βουλευ-ω-μαι.
3 Pers. Sing. Ind. Fut.,	βουλευ-σ-ε-ται.	Opt.,	βουλευ-σ-οι-το.
1 Pers. Plur. Ind. Pres.,	βουλευ-ο-μεθα.	Subj.,	βουλευ-ω-μεθα.
2 Pers. Plur. Ind. Pres.,	βουλευ-ε-σθε.	Subj.,	βουλευ-η-σθε.
1 Pers. Sing. Ind. Aor. 1,	εβουλευ-σ-α-μην.	Subj.,	βουλευ-σ-ω-μαι.
3 Pers. Sing. Ind. Aor. 1,	εβουλευ-σ-α-το.	Opt.,	βουλευ-σ-αι-το.

In these instances βουλευ is the root, and εβουλευσ is the stem of the first aorist, while βουλευσ is the stem of the future. The personal endings are μαι, ται, μεθα, το, etc.; and the mood-signs are the vowels ο ω, ε η, α αι. It may be noticed that the short vowels represent the indicative, and that these short vowels are changed into their corresponding long ones for the subjunctive; also that ι enters as an essential into the optative forms, as in βουλευσοιτο and βουλευσαιτο. These two tenses are, you see, very near in form, differing in this only, that the latter has an α where the former has an ο.

The personal endings join on immediately to the mood-signs, and unite so closely with them that they are blended together, and may appear as one: for example, βουλευσ-ῃς, instead of βουλευση-ις, and βουλευ-ῃ instead of βουλευ-ε-αι.

The distinction between the principal tenses and the historic tenses is important. The principal tenses of all moods but the optative—that is, the present, the perfect, and the future—form the second and the third person of the dual in ον, as βουλευ-ε-τον, βουλευ-ε-τον, βουλευ-ε-σθον, βουλευ-ε-σθον; while the historic tenses of all the moods and all the tenses of the optative mood form them in ην, as εβουλευ-ε-την, εβουλευ-ε-την, εβουλευ-ε-σθην, εβουλευ-ε-σθην, though, according to some grammarians, the second person of the dual in all these tenses ends in ον. Further, the principal tenses form the third person plural, active voice, with the termination σι (which is altered for the sake of euphony from ντι, νσι), which before a vowel becomes σιν, and the third person plural middle with νται; but the historic or secondary tenses have in the active ν, and in the middle ντο; as—

βουλευ-ο-νσι = βουλευ-ουσι(ν),	ε-βουλευ-ο-ν.
βουλευ-ο-νται,	ε-βουλευ-ο-ντο.

Lastly, the principal tenses in the singular of the present middle run thus, μαι, σαι, ται; but the historic tenses thus, μην, σο, το, as—

βουλευ-ο-μαι,	ε-βουλευ-ο-μην.
βουλευ-ε-σαι = βουλευ-ῃ,	ε-βουλευ-ε-σο = ε-βουλευ-ου.
βουλευ-ε-ται,	ε-βουλευ-ε-το.

The person-endings of the subjunctive of the principal tenses correspond to those of the indicative of the principal tenses, and those of the optative to those of the indicative of the historic tenses, as—

2 & 3 Dual Ind. Pres. Act.	βουλευε-τον.	Subj.	βουλευη-τον.
Mid.	βουλευε-σθον.		βουλευη-σθον.
3 Plural, Act.	βουλευου-σι(ν).		βουλευω-σι(ν).
Mid.	βουλευο-νται.		βουλευω-νται.
1 Sing.,	βουλευο-μαι.		βουλευω-μαι.
2 —	βουλευ-ῃ.		βουλευ-ῃ.
3 —	βουλευε-ται.		βουλευη-ται.
2 & 3 Dual Imp. Ind., Act.	ε-βουλευε-την.	Opt.	βουλευοι-την.
Mid.	ε-βουλευε-σθην.		βουλευοι-σθην.
3 Plural Imp. Ind., Act.	ε-βουλευο-ν.		βουλευοι-εν.
Mid.	ε-βουλευο-ντο.		βουλευοι-ντο.
1 Sing. Imp. Ind., Mid.	ε-βουλευο-μην.		βουλευοι-μην.
2 —	(ε-βουλευε-σο), ε-βουλευ-ου.		(βουλευοι-σο), βουλευοι-ο.
3 —	ε-βουλευε-το.		βουλευοι-το.

As already intimated, the mood-vowel of the subjunctive of the historic tenses differs from that of the indicative in its being lengthened; thus, ο is lengthened into ω, ε and α into η, and ει into η; as—

Indicative,	βουλευ-ο-μεν,	βουλευ-εις,	βουλευ-ε-σθε.
Subjunctive,	βουλευ-ω-μεν,	βουλευ-ῃς,	βουλευ-η-σθε.

The mood-vowel or mood-sign of the optative is ι, in connection with the preceding mood-vowel of the first person singular indicative: the pluperfect forms an exception, since its optative assumes the mood-vowel of the present; for example:—

1 Sin. Imp. Act. Ind.,	ο; Opt., οι.		ε-βουλευ-ο-ν,	βουλευ-οι-μι.
Plural Aorist 1,	α; —	αι.	ε-βουλευσ-α-μεν.	βουλευσ-αι-[μεν.
1 Sin. Plup. Act. Opt.,	οι;			
Present,	οι; —		βε-βουλευκ-οιμι.	βουλευ-οιμι.

GENERAL TABLE OF MOOD-VOWELS IN THE ACTIVE AND MIDDLE VOICES.

	Singular.			Dual.			Plural.		
Indicative.	1	2	3	1	2	3	1	2	3
Pres. Fut., Act.	-ω	-ει	-ει	—	-ε	-ε	-ο	-ε	-ο
Pres. Fut., Mid.; Imp. Aor. 2, Act. and Mid.	-ο	-ε	-ε	-ο	-ε	-ε	-ο	-ε	-ο
Aor. 1, Act.; Perf., Act. and Mid.	-α	-α	-ε	—	-α	-α	-α	-α	-α
Aor. 1, Mid.	-α	-α	-α	—	-α	-α	-α	-α	-α
Pluperf.	-ει	-ει	-ει	—	-ει	-ει	-ει	-ει	(-ει)ε
Imperative.									
Pres. and Perf. Aor. 2, Act.	—	-ε	-ε	—	-ε	-ε	—	-ε	-ε
Aor. 1, Act.	—	-ο	-α	—	-α	-α	—	-α	-α
Aor. 1, Mid.	—	-α	-α	—	-α	-α	—	-α	-α
Subjunctive	-ω	-η	-η	-ω	-η	-η	-ω	-η	-ω
Optative.									
Pres. Fut. Perf., 2 Aor., Act. and Mid.	-οι	-οι	-οι	-οι	-οι	-οι	-οι	-οι	-οι
Aor. 1, Act. and Mid.	-αι	-αι	-αι	-αι	-αι	-αι	-αι	-αι	-αι

Infinitive.
Pres. Fut. Act., 2 Aor. -ει. 1 Aor., Act. and Mid. -α.
Pres. Fut. Perf. Act., Perf. Mid. -ε.

Participle.
Pres. Fut. Perf., Act. Mid., 2 Aor., Act. -ω. Pres. Fut., 2 Aor., Mid. -ο.
1 Aor., Act. and Mid. -α.

GENERAL VIEW OF THE PERSON-ENDINGS OF A VERB IN ω.

	ACTIVE FORM. *Indic. & Subj., Principal Tenses.*	*Indic. & Opt., Historic Tenses.*	MIDDLE FORM. *Indic. & Subj., Principal Tenses.*	*Indic. & Opt., Historic Tenses.*
Sing. 1.		-ν,	-μαι,	-μην.
2.	-ς,	-ς,	-σαι,	-σο, -ο.
3.	—	—	-ται,	-το.
Dual 1.	—	—	-μεθον,	-μεθον.
2.	-τον,	-τον,	-σθον,	-σθον.
3.	-τον,	-την,	-σθον,	-σθην.
Plur. 1.	-μεν,	-μεν,	-μεθα,	-μεθα.
2.	-τε,	-τε,	-σθε,	-σθε.
3.	(-ντ) -σι,	-ν, σαν.	-νται (-αται),	-ντο (-ατο).

Imperative.		*Imperative.*	
Sing. 2.	3. -τω.	Sing. 2. (-σο)-ο;	3. -σθω.
Dual 2. -τον;	3. -των.	Dual 2. -σθον;	3. -σθων.
Plur. 2. -τε;	3. -τωσαν.	Plur. 2. -σθε;	3. -σθωσαν, -σθων

Infinitive.		*Infinitive.*
Pres., Future and Aorist 2,	-ν;	-σθαι.
Perf. Act. and Aor. 1 and 2 Pass.,	-ναι.	
Aorist 1 Active,	-αι.	

Participle.	*Participle.*
Stem, ντ; except the Perfect, whose	μενος, μενη, μενον.
Stem ends in οτ;	μενος, μενη, μενον, Perf.

KEY TO EXERCISES IN LESSONS IN GREEK.—XXIV.

EXERCISE 72.—GREEK-ENGLISH.

1. The file consisted of (*was*) a hundred men. 2. The time was (literally, *it was of time*) a little before sunset. 3. The laws are the punishments of transgressors. 4. The punishment for these things (or, *for these men*) is death. 5. Corn failed, and could not be purchased. 6. You may see the mountain. 7. The valour of Agesilaus was a pattern. 8. We have no breakfast. 9. I will be the convener. 10. This man is the victor. 11. I am one of these. 12. The king thinks that you are his (subjects). 13. The planting of trees, therefore, is part of (*belongs to*) the art of agriculture. 14. They have a market. 15. We were in extremities. 16. Cyrus was in this condition. 17. This shall be in your power. 18. There is no little good in harmony. 19. To violence belong enmities and dangers. 20. I wish to be superior to my friends in (or *by*) care. 21. Agesilaus was present bringing gifts. 22. Ships had come (literally, *were present*) to Cyrus from the Peloponnesus.

EXERCISE 73.—ENGLISH-GREEK.

1. Τουτο επ' εμοι [επι εμοι] εστιν. 2. Οἱ νομοι επι σοι εισιν. 3. Επι σοι εστι σιτου πριασθαι. 4. Επι τοις πολεμιοις ην παρειναι. 5. Επι παισιν αγαθοις εστι περιειναι. 6. Επ' εμοι εσται τῃ πολει προσειναι. 7. Αἱ ζημιαι τοις ἁμαρτωλοις προσεισιν. 8. Ἡ επιμελεια σῃ των φιλων πασιν εστι παραδειγμα. 9. Αἱ νηες τῳ βασιλει προσεισιν.

LESSONS IN GEOGRAPHY.—XXXVI.

NORTH AMERICA.

North and South America form but one vast irregularly-shaped continent, being connected with each other by the Isthmus of Panama or Darien; it occupies a part of four zones, extending from the north frigid zone, across the north temperate and the torrid zones, and stretching into the south temperate zone.

Boundaries.—North America is bounded on the north by the Arctic Ocean; on the south by the Gulf of Mexico and the Pacific Ocean; on the east by the Atlantic Ocean; and on the west by the Pacific Ocean. The mainland of this continent extends from about the parallel of 72° N. lat. to nearly 7° N. lat., and from about 53° W. long. to 168° W. long. The most northerly point of the mainland of North America is considered to be Murchison Promontory, in Boothia Felix, in 72° N. lat. and about 95° W. long.; the most southerly is Mariato Point, in the Bay of Panama, in 7° 15′ N. lat. and about 81° W. long.; the most easterly point is Cape Charles, Labrador, in 52° 18′ N. lat. and 55° 30′ W. long; and the most westerly point is Cape Prince of Wales, in the part formerly called Russian America, but which now belongs to the United States, and is called Alaska, in lat. 65° 16′ N. and long. 168° W. The latter point, situated in Behring Strait, is said to approach the easternmost point of Asia within a distance of 36 miles, a short enough sail for men migrating eastward from Asia, or even Europe, supposing them to have traversed Siberia, to accomplish even in an open boat, and, having done so, to people the New World.

Length, Breadth, Area, etc.—The greatest length of North America, in a straight line from north-west to south-east, from Cape Lisburn, in Alaska, to the extremity of the Isthmus of Panama, is about 5,600 miles; while its greatest breadth, from east to west, from Cape Canso, in Nova Scotia, to the mouth of the Oregon River, is about 3,125 miles. The superficial area of this continent, including that of the West Indies and other islands belonging to it, may be reckoned about 8,350,000 square miles, and the population about 50,000,000; thus giving on an average about six inhabitants to every square mile.

The great *inland seas* and *gulfs* of North America are the following:—Hudson Bay, which communicates with the Atlantic Ocean by Hudson Strait, and runs far into the British territory, being connected with the Arctic Seas by Fox Channel, Fury and Hecla Straits, Prince Regent Inlet, Barrow Strait, and Wellington Channel; it is also connected with Baffin Bay by Lancaster Sound; it terminates in James Bay, to the south. Baffin Bay is connected with the Atlantic Ocean by Davis Strait, and affords immediate access to Lancaster Sound, Smith Sound, and other sounds and inlets on the north. The Gulf of St. Lawrence is the broad estuary of the river of the same name, having the large island of Newfoundland, with other smaller ones, at its mouth. The area of Hudson Bay is reckoned at 350,000 square miles; its length from north to south being about 1,000 miles, and its breadth about 500 miles. Baffin Bay is about 1,500 miles long, and about 300 miles broad; its surface, including Davis Strait, is not less than that of Hudson Bay, being at least 400,000 square miles. The Bay of Fundy runs from the Atlantic between Nova Scotia and New Brunswick. It is remarkable for its high tides, which have been known to rise 90 feet. The Gulf of Mexico, which is about 1,100 miles long, and about 500 miles broad, washes the southern shores of the United States, and the western shores of Mexico; it is connected with the Caribbean Sea, which washes the shores of the West India Islands, and of the northern part of South America; the last-named sea is about 1,800 miles, and on an average about 1,000 miles broad. The Bay of Campeachy, or Campeche, is the southern part of the Gulf of Mexico. The warm Gulf Stream rushes from the Gulf of Mexico through the Strait of Florida, between Cuba and the peninsula of Florida, and crosses the Atlantic in an easterly direction, preserving its higher temperature in the middle of the ocean, and being sensible in this respect when it reaches the Azores: the stream continues its course to the shores of England and Ireland, and is one of the chief causes of the temperate climate and mild winters of the United Kingdom. In the Caribbean Sea, to the south-east, are the Gulf or Bay of Honduras, the Mosquito Gulf, and the Gulfs of Darien and Maracaibo, of which the last-named enters the north coast of South America. On the western side of North America are the Gulfs of Panama, Tehuantepec, and California, large inlets of the Pacific, and a variety of small bays and sounds stretching to Behring Strait, and even beyond that strait into the Arctic Ocean. The most important *straits* have been already mentioned in the preceding remarks. Besides these there are: Frobisher Strait, leading from Davis Strait to Fox Channel; Sir Thomas Roe's Welcome, between Southampton Island and the mainland; the Strait of Belle Isle, between Newfoundland and Labrador; the Gut of Canso, between Cape Breton Island and Nova Scotia; and others of less importance.

The *peninsulas* and *capes* in North America are the following: —*Peninsulas*—Melville Peninsula and Boothia Felix, in the Arctic Regions; East Main and Labrador, in the British territory; Nova Scotia, east of New Brunswick; Florida, in the United States; Yucatan, forming part of Mexico, in Central America; Lower California; and Alaska. *Capes:* In the northern regions, projecting into the Arctic Ocean, Icy Cape, and Point Barrow, in Alaska; Cape Bathurst, Murchison Promontory, Cape Parry, and Cape Felix, in the British territory; also Cape Rennel, Cape Clarence, Cape Hay, Cape Adair, Cape Roper, Cape Walsingham, and Cape Enderby; Cape Chudleigh and Cape Charles, in Labrador; Cape Sable, in Nova Scotia; Cape Cod, Cape Hatteras, Cape Look-out, etc., all on the east coast of the United States; Sable Point, in Florida; Cape Catoche, in Yucatan; Cape Gracios à Dios, on the Mosquito coast; Cape Blanco, Central America; Cape Corrientes, Mexico; Cape St. Lucas, Lower California; Cape Mendocino and Cape Blanco, on the west coast of the United States; with Capes Romanzoff, Prince of Wales, and Lisburn, in higher latitudes. To these may be added Cape Farewell, in Greenland, and Cape Race, in Newfoundland.

Isthmuses.—The principal *isthmus* in North America is that called the Mexican Isthmus, which separates the waters of the Atlantic and Pacific Oceans. At three different points do these waters approach each other. The Isthmus of Panama or Darien, already mentioned, is the narrowest portion of this region; and at the narrowest point of this isthmus the breadth of the land is only about 28 miles across, from ocean to ocean. The next isthmus in point of narrowness is that of Tehuantepec, which is reckoned 125 miles across the land from ocean to ocean; and the last, which is the broadest, is that of Guatemala, or Chiquimula, which is reckoned about 170 miles across the land between the Gulf of Honduras and the Pacific. The isthmus which connects California and Lower California is upwards of 100 miles broad. The Isthmus of Florida is about 150 miles broad; that of Alaska, in the southern part of the territory of Alaska, stretching out to the south-west, towards the Aleutian Islands, may be about 50 miles, and that of Nova Scotia about the same.

The *mountains* and *plateaux* of North America are on a grand scale. The most extensive chain of mountains is that called the Rocky Mountains, next the Pacific, which extend in parallel ranges from north to south, or from the shores of the Arctic Ocean to Lake Nicaragua, in Central America, a distance of nearly 5,000 miles; and which vary in height from 3,000 feet to nearly 18,000 feet above the level of the sea. The principal plateaus are the great basin of Utah, the highlands of Oregon, and the mountain range of California. The next chain is that of the Appalachian or Alleghany Mountains, on the eastern side of the continent, next the Atlantic, and within the United States; these mountains extend from about the parallel of 34° N. lat. to the shores of the Gulf of St. Lawrence, a distance of about 2,000 miles, their breadth on an average being about 120 miles. Their average altitude is about 2,500 feet; and the highest summits are rather more than 6,400 feet. The Ozark Mountains occupy a space about 300 miles long and 100 miles broad, and vary in height from 1,000 to 2,000 feet. The table-land in Labrador has an average height of 2,000 feet; but the Arctic highlands have a considerably less elevation. In the Mexican isthmus, the plateau of Chihuahua varies from 4,000 to 6,000 feet in height; and farther to the south the plateau of Anahuac varies from 6,000 to 9,000 feet in elevation. In this table-land there are several mountains, chiefly volcanic, which rise to an enormous height above the level of the sea, such as Jorullo, Popocatepetl, and Orizaba. The altitude of Popocatepetl is 17,720 feet above the sea-level; it is reckoned the highest peak in North America. The plateau of Central America extends from the Isthmus of Tehuantepec to that of Panama, diminishing in height from about 5,500 feet to about 200 or 300 feet at its extremity. Between the mouth of the river Chagres on the Atlantic side, and the city of Panama on the Pacific side, the distance is about 42 miles; and the highest ground on the proposed line of railway between these points is less than 300 feet.

SUMMARY OF BOUNDARIES.

NORTH.—Arctic Ocean.
WEST.—Pacific Ocean.
SOUTH.—Pacific Ocean.
EAST.—Isthmus of Panama, Atlantic Ocean.

SUMMARY OF SEAS, GULFS, ETC.

Baffin Bay, between Greenland and Prince William Land.
Gulf of Boothia, E. of Boothia Felix.
Hudson Bay, between East Main and Rupert's Land.
James Bay, S. of Hudson Bay.
Gulf of St. Lawrence, between New Brunswick and Labrador.
Bay of Fundy, between Nova Scotia and New Brunswick.
Delaware Bay, U.S. east coast.
Chesapeake Bay, U.S. east coast.
Gulf of Mexico, between United States and Mexico.
Caribbean Sea, between Mexico and West India Islands.
Bay of Honduras, W. of Caribbean Sea.
Bay of Guatemala, S.W. of Caribbean Sea.
Bay of Campeche, S. of Gulf of Mexico.
Bay of Panama, S. of Isthmus of Panama.
Gulf of Tehuantepec, S. of Mexico.
Gulf of California, between Peninsula of California and the mainland.
Queen Charlotte Sound, E. coast of British America.

SUMMARY OF STRAITS.

Davis Strait, S. of Baffin Bay.
Hudson Strait, between Atlantic and Hudson Bay.
Belleisle Strait, between Labrador and Newfoundland.
Frobisher Strait, N. of Hudson Strait.
Cumberland Strait, N. of Frobisher Strait.
Fox Channel, Arctic Regions.
Yucatan Channel, between Yucatan and Cuba.
Juan de Fuca Strait, between United States and Vancouver Island.
Behring Strait, between N. America and Asia.
Gut of Canso, between Cape Breton Island and Nova Scotia.

SUMMARY OF PENINSULAS.

Melville Peninsula, Arctic Regions.
Boothia Felix, Arctic Regions.
East Main and Labrador.
Nova Scotia, Dominion of Canada.
Florida, United States.
Yucatan, Central America.
Lower California.
Alaska.

SUMMARY OF CAPES.

Icy Cape, N. of Alaska.
Point Barrow, N. of Alaska.
Cape Bathurst, N. of British North America.
Murchison Promontory, N. of British North America.
Cape Farewell, S. of Greenland.
Cape Chudleigh, N.E. Labrador.
Cape Charles, S.E. Labrador.
Cape Race, S.E. Newfoundland.
Cape Sable, S.W. Nova Scotia.
Cape Cod } E. of United
Cape Hatteras } States.
Cape Sable, S. of Florida.
Catoche Point, N.E. Yucatan.
Cape Gracios à Dios, E. of Honduras.
Cape Corrientes, W. of Mexico.
Cape St. Lucas, S. of Lower California.
Cape Mendocino } W. of United
Cape Blanco } States.
Cape Romanzoff, W. of Alaska.
Cape Prince of Wales, W. of Alaska.
Cape Lisburn, W. of Alaska.

SUMMARY OF ISTHMUSES.

Chignecto, Nova Scotia.
Tehuantepec, Mexico.
Panama, Central America.

SUMMARY OF MOUNTAINS.

Rocky Mountains, comprising—Western Ranges, from North Coast to Central America. The principal peaks are—
Mount St. Elias, Alaska.
Mount St. Helens, W. United States.
Mount Hood, W. United States.
Mount Brown, British Columbia.
Mount Hooker, British Columbia.
Fremont's Peak, W. United States.
Orizaba, Mexico.
Popocatepetl, Mexico.
Alleghanies or Appalachian Mountains, comprising the Eastern Ranges.

LESSONS IN ITALIAN.—XII.

THE PREPOSITION DI—ITS USE, ETC.

THE proper use of the words *di*, *a*, *da*, *in*, *con*, *per*, *su*, *só-pra*, *fra*, and *tra*, is of such primary importance in Italian, that I shall devote this lesson to an elementary explanation of some of their peculiarities.

Di.

The use of this word very frequently coincides with the use of the case-sign, or preposition *of*, in English grammar :—

1. When the questions *of whom? of which? of what? whose? what kind or sort of?* require the genitive also in English: for example, *L' a-mó-re del pá-dre*, the love of the father; *i paé-si del prín-ci-pe*, the countries of the prince; *la cle-mên-za di Dí-o*, the clemency of God; *la gran-déz-za dél-la cit-tà*, the greatness of the town; *il lí-bro di Giá-co-mo*, the book of James.

2. When geographical or other proper names indicating possession, domain, authorship, etc., or merely for the purpose of defining them, are joined to other nouns: for example, *la cit-tà di Ve-né-zia*, the city of Venice; *il ré-gno di Spá-gna*, the kingdom of Spain; *il mé-se di Lú-glio*, the month of July; *il nó-me di Fran-cé-sco*, the name of Francis; *l' í-so-la di Cor-fù*, the island of Corfu; *la re-gí-na d' In-ghil-têr-ra*, the Queen of England; *il Ré di Prús-sia*, the king of Prussia; *l' im-pe-ra-tó-re d' Aú-stria*, the emperor of Austria; *l' as-sê-dio di Mán-to-va*, the siege of Mantua; *lo strét-to di Gi-bil-têr-ra*, the straits of Gibraltar; *l' im-pê-ro di Rús-sia*, the empire of Russia; *le tra-gê-die di Al-fiê-ri*, the tragedies of Alfieri; *le com-mê-die di Gol-dó-ni*, the comedies of Goldoni.

3. When words expressing quantity, weight, or any kind of measure, are joined to other nouns: for example, *ú-na quan-ti-tà di pé-co-re*, a quantity of sheep; *ú-na líb-bra di cár-ne*, a pound of meat; *un cen-ti-ná-jo di fiê-no*, a hundredweight of hay; *ú-na doz-zí-na di cuc-chiá-ji, di guán-ti, d' uô-va*, a dozen of spoons, gloves, eggs; *un brác-cio di pán-no*, a yard of cloth; *ú-na bot-tí-glia di ví-no*, a bottle of wine; *ú-na ca-ráf-fa d' á-cqua*, a decanter of water; *un' ón-cia di caf-fè* (kahf-fê), an ounce of coffee; *ví-no di diê-ci án-ni*, wine of ten years.

For the sake of elegance, the preposition *di* is, however, sometimes omitted after the words *cá-sa*, house; *pa-láz-zo*, palace; *piáz-zi*, place, square; *víl-la*, villa; *gal-le-rí-a*, gallery; *fa-mí-glia*, family; *pôr-ta*, gate, entry, and some others, when they are followed by the name of the owner or of the person after whom they are called: for example, *in cá-sa Al-tiê-ri*, at the Altieri-house; *vi-cí-no al pa-láz-zo Bor-ghé-se*, near the Borghese-palace; *súl-la piáz-za Bar-be-rí-ni*, on the Barberini-square; *per la víl-la Pan-fí-li*, for the villa Panfili; *nél-la gal-le-rí-a Dô-ria*, in the Doria-gallery; *dél-la fa-mí-glia Co-lôn-na*, of the Colonna family; *la pôr-ta San Gio-ván-ni*, St. John's-gate or entry; *a cá-sa 'l zí-o* (instead of *a cá-sa del zí-o*), at the house of the uncle; *ó-ra a cá-sa qué-sto, ó-ra a cá-sa quell' ál-tro* (instead of *di qué-sto, di quell' ál-tro*), now at the house of this one, then at the house of the other.

English compound nouns, or combinations of nouns, for the greatest part must be decomposed by the genitive case with the case-sign *di*, especially when one of the nouns merely defines and qualifies the other, which is the principal word conveying the principal idea: for example, garden door, *pôr-ta di giar-dí-no* (door of the garden); stone-quarry, *cá-va di piê-tra* (quarry of stone); autumn fruits, *frút-ti d' au-tún-no* (fruits of autumn); a music amateur, *un di-let-tán-te di mú-si-ca* (an amateur of music); Leipzig fair, *fiê-ra di Lí-psia* (fair of Leipzig); ox-tongue, *lín-gua di bôve* (tongue of an ox); horse's head, *tê-sta di ca-vál-lo* (head of a horse); felt-hat, *câp-pel-lo di fél-tro* (hat of felt); sugar-box, *cás-sa di zúc-che-ro* (box of sugar).

Whenever it is necessary with greater precision to define the noun in the genitive case so as to distinguish it from other objects of the same class, the article, according to its peculiar function of particularising that which is general, must be joined to the case-sign *di*.

The disregard of this rule will not unfrequently cause ambiguity: for example, *il pa-dró-ne dél-la cá-sa dó-ve a-bi-tiá-mo*, the master of the house where we live (*il pa-dró-ne di cá-sa*, is the master of the house in general); *un boc-cá-le del ví-no che bév-vi l' ál-tra sé-ra*, a measure (= about two pints) of the wine which I drank the other evening (*un boc-cá-le di ví-no*, is a measure of wine in general); *il mer-cá-to dei ca-vál-li*, the horse-market (*il mer-cá-to di ca-vál-li*, is merely a place where horses are sold); *il mer-cá-to dél-la sel-vag-gí-na*, the game-market; *il ma-gaz-zí-no, dél-la pá-glia*, the straw-magazine (*ma-gaz-zí-no di pá-glia*, is merely a magazine full of straw); *il ma-gaz-zí-no dél-le lé-gna*, the wood-magazine.

English adjectives, indicating the material or stuff from which anything is manufactured, or denoting qualities attributed or derived from proper names of countries, nations, or towns, for the greatest part will be translated into Italian by means of nouns in the genitive case: for example, a gold watch, *un o-ro-lô-gio d' ô-ro* (a watch of gold); a marble statue, *ú-na stá-tua di már-mo* (a statue of marble); a wooden table, *ún-a tá-vo-la di lé-gno* (a table of wood); an iron gate, *ú-na pôr-ta di fêr-ro* (a gate of iron); a silver spoon, *un cuc-chiá-jo d' ar-gên-to* (a spoon of silver); a meritorious soldier, *un sol-dá-to di mê-ri-to* (a soldier of merit); a spirited or talented youth, *un gió-va-ne di spí-rito, di ta-lên-to* (a youth of spirit, of talent); Italian silk, *sé-ta d' I-tá-lia* (silk of Italy); Viennese citizens, *cit-ta-dí-ni di Viên-na* (citizens of Vienna). It is, however, quite allowable to say: *stá-tua mar-mô-rea, sol-dá-to me-ri-té-vo-le, gió-va-ne spi-ri-tó-so, cit-ta-dí-ni Vien-né-si.*

Adverbs of place or time before nouns, or even adjectives, of this class, frequently, also, are translated by the genitive case: for example, the back door or room, *la pôr-ta la stán-za di diê-tro* (the door or room of behind); the hind-feet, *i piê-di di diê-tro* (the feet of behind); the following day, *il giór-no di do-má-ni* (the day of to-morrow); the present age, *il món-do d' og-gi-dì* (the world of now-a-days); after the present fashion or style, *al mô-do d' og-gi-dì* (after the fashion of now-a-days); the whole last night, *la not-tá-ta di jê-ri* (the whole night of yesterday); yesterday, *il giór-no di jê-ri* (the day of yesterday).

Whenever the infinitive mood of any verb explains and defines another word, the preposition *di* must be placed before it (just as the preposition *of* with the present participle of English grammar in such cases): for example, *Ha ú-na gran vô-glia di viag-giá-re,* he has a great desire to travel or of travelling; *è têm-po di an-dá-re,* it is time to go or of going; *ra-gió-ne di la-men-tár-si,* right to complain or of complaining; *l' o-nó-re di ve-dér-vi,* the honour to see you or of seeing you; *li-cên-za di par-tír-si,* permission to go away or of going away.*

Di is also placed after the words *quán-to,* how much, or great, or long; as, *al-quán-to,* something, a little, some; *tán-to,* so much, or great, or long; *al-tret-tán-to,* just as much, equal; *pô-co,* little, few; *mól-to,* much, a great deal; *niên-te,* nothing; *più,* more; *mé-no,* less; *trôp-po,* too much, etc.: for example, *quán-to di nô-ja sa-rêb-be per me,* how great a nuisance would it be for me; *dó-po al-quán-to di têm-po,* after some time; *tán-to di ví-no ed al-tret-tán-to d' á-cqua,* so much wine and just as much water; *pô-co di ú-ti-le ne ri-ca-ve-ré-te,* you will derive from this little advantage; *mól-to di má-le ne po-trêb-be se-guí-re,* a great deal of evil might be the consequence of it.

In these two phrases, *la Dí-o mer-cè!* thank God! and *la Dí-o grá-zia,* the grace of God, the word *di* is understood, and in full they run thus: *la di Dí-o mer-cè,* and *la di Dí-o grá-zia.* When, however, *Dí-o* is placed after the words *mer-cé* and *grá-zia,* the case-sign *di* cannot be omitted: for example, *la mer-cè di Dí-o,* and *la grá-zia di Dí-o.*†

The word *di* is sometimes a mere expletive: for example, *é-gli dí-ce di sì, ed í-o dí-co di nô,* he says yes, and I say no; *qué-sto diá-vo-lo di qué-sta fém-mi-na,* that devil of a woman; *quel po-ve-rí-no di mí-o fra-têl-lo,* that poor brother of mine.

As a last remark on the use of the case-sign *di* for the present, I shall state that this word, among all the prepositions of the Italian language, is of by far the most extensive use. The reason of this is that *di,* properly and philosophically speaking, merely expresses the mental separation of *ideas* or notions, while *da* indicates a real separation of objects, which distinction constitutes the principal and fundamental difference between these two important words *di* and *da.* The mere mental separation of ideas or notions may, however, serve any connection and relation between words, ever so loose and general, and no reader, bearing this truth in mind, henceforth need be surprised at meeting, in Italian books and conversations, with frequent substitutions of the case-sign *di* for many other prepositions: for example, for *a*: *I'-schia è ú-na í-so-la as-sá-i vi-cí-na di Ná-po-li,* Ischia is an island very near to Naples; for *da,* as, *u-scí-re del-la pri-gió-ne,* to go out of or from prison; *é-gli di pri-gió-ne il trás-se,* he took him from prison; for *con,* as, *di gran-dís-si-ma fôr-za si com-bat-té-a da cia-scú-na pár-te,* they fought with the greatest energy on each side; for *in,* as, *í-o l' uc-cí-si di leá-le bat-tá-glia,* I killed him in fair fight; for *per,* as, *é-gli pia-gné-a e di gran pie-tà non po-té-a môt-to fá-re,* he wept, and on account of his great emotion he could not utter a word.

It is evident that the variable nature of *di* will admit of many translations into English: for example, by *with,* as, *só-no con-tên-to di te,* I am satisfied with thee; by *at,* as, *mi rí-do di lui,* I laugh at him; by *of,* as, *mo-rír di fá-me,* to die of hunger; by *as,* as, *ser-vír di rê-go-la,* to serve as a rule; by *for,* as, *pre-gá-re ú-no di ú-na cô-sa,* to request one for something; by *than,* as, *più di du-e mí-la scudi,* more than two thousand crowns.

In some instances the peculiarity in the use of *di* may, without difficulty or twisting, be explained by ellipsis, particularly when it denotes descent or children: for example, *Gian-nuôl di Se-ve-rí-no, Cêc-co di Mes-sé-re An-giu-liê-ri,* in Boccaccio, where *fi-gliuô-lo,* child or son, is understood.

In the following and other exercises the pupil himself must examine whether he is to use before any noun or adjective the article or not, the prepositions *di, a,* and *da* only being occasionally employed to denote the genitive, dative, and ablative. It is, moreover, to be noted, that the words are placed in the order in which they are to be translated into Italian. I have thought it useful, in some cases, to denote the pronunciation of the *z* or *zz.* I have done so by placing after such words in parenthesis *ts,* thus (*ts*), when the pronunciation of the *z* or *zz* is to be the sharp, hissing one; and *ds,* thus (*ds*), when the pronunciation of the *z* or *zz* is to be the soft one.

Vocabulary.

Abyss, *a-bís-so,* m.
Action, *a-zió-ne,* f.
Air, *á-ria,* f.
And, *e.*
And not, *e non.*
Are, *só-no.*
Aunt, *zí-a* (*ts*), f.
Beauty, *bel-léz-za* (*ts*), f.
Behaviour, *con-dót-ta,* f.
Belong, *ap-par-tên-go-no.*
Belongs, *ap-par-tiê-ne.*
Body, *côr-po,* m.
Brother, *fra-têl-lo,* m.
Child, *fan-ciúl-lo,* m.
Colour, *co-ló-re,* m.
Commerce, *commêr-cio,* m.
Countenance, *fi-so-no-mí-a,* f.
Courage, *co-rág-gio,* m.
Cousin, *cu-gí-na,* f.
Darkness, *o-scu-ri-tà,* f.
Dawn, *spun-tár,* m.
Day, *giór-no,* m.
Disorder, *dis-ór-di-ne,* m.
Dress, *á-bi-to,* m.
Error, *er-ró-re,* m.
Exercise, *mó-to,* m.
Father, *pá-dre,* m.
Fault, *er-ró-re,* m.
Fertility, *fer-ti-li-tà,* f.
Field, *cám-po,* m.
Garden, *giar-dí-no,* m.
Glory, *gló-ria,* f.
Happiness, *fe-li-ci-tà,* f.
Here are, *éc-co.*
Highest degree, *cól-mo,* m.
Interest, *in-ter-és-se,* m.
Is, *è.*
Is not here, *non è qui.*
Is useful, *gió-va.*
Language, *lín-gua,* f.
Leads, *con-dú-ce.*
Legislator, *le-gi-sla-tó-re,* m.
Life, *ví-ta,* f.
Man, *uó-mo,* m.; pl. *gli uó-mi-ni.*
Master, *pa-dró-ne,* m.
Mind, *á-ni-ma,* f.; *spí-ri-to,* m.
Mirror, *spéc-chio,* m.
Money, *da-ná-ro,* m.
Must always obey, *dé-vo-no sém-pre ob-be-dí-re.*
Night, *nót-te,* f.
Ornament, *or-na-mén-to,* m.
Palace, *pa-láz-zo* (*ts*), m.
Parents, *ge-ni-tó-ri,* pl.
Perfection, *per-fe-zió-ne,* f.
Physician, *mé-di-co,* m.
Pleasure, *pia-cé-re,* m.
Practice, *es-er-cí-zio,* m.
Prince, *prín-ci-pe,* m.
Rainbow, *ar-co-ba-lé-no,* m.
Return, *ri-tór-no,* m.
Rising, *le-var,* m.
Room, *cá-me-ra,* f.
Says, *di-ce.*
Sense, *sén-so,* m.
Shortens, *ac-cór-cia.*
Sister, *so-rêl-la,* f.
Soldier, *sol-dá-to,* m.
Soul, *á-ni-ma,* f.
Spring, *pri-ma-vé-ra,* f.
Sun, *só-le,* m.
Tells, *dí-ce.*
Temperance, *tem-pe-rán-za,* f.
Three motives, *tre mo-tí-vi,* pl.
Tranquillity, *quié-te,* f.
Treasure, *te-só-ro,* m.
True, *vé-ro.*
Uncle, *zí-o* (*ts*), m.
Usage, *ú-so,* m.
Warmth, *ca-ló-re,* m.
Will, *vo-lon-tà,* f.
Wise man, *sá-vio,* m.
Young man, *gió-va-ne,* [m.

Exercise 3.

1. The rising of the sun. 2. The dawn of the day. 3. The return of spring. 4. The warmth of the air. 5. The beauty of the flower. 6. The darkness of the night. 7. The abyss of error. 8. The fertility of the fields. 9. The colours of the rainbow. 10. The senses of man. 11. The faults of young men. 12. Money is the soul of commerce. 13. Usage is the legislator of languages. 14. The master of the garden is not here. 15. The palace belongs to the prince. 16. Here are the rooms of the uncle. 17. The dresses belong to the cousin, and not to the aunt. 18. The brother tells the sister the will of the father. 19. The children must always obey the parents. 20. The physicians say, the disorder shortens life. 21. Exercise is useful to the body and to the mind. 22. The countenance is the mirror of the soul. 23. Tranquillity of mind is the highest degree of happiness. 24. Temperance is the treasure of the wise man. 25. The true ornament of the soldier is courage. 26. Practice leads to perfection. 27. Interest, pleasure, and glory are the three motives of the actions and of the behaviour of men.

KEY TO EXERCISES IN LESSONS IN ITALIAN.—XI.

Exercise 1.

1. The cloth. 2. Of the knife. 3. To the plate. 4. From the salt. 5. The aliments. 6. From the courtyards. 7. To the cooks. 8. From the dreams. 9. In theatre. 10. In the brook. 11. In the lungs. 12. With money. 13. With the pocket-handkerchief. 14. With the hats. 15. For pleasure. 16. For the cloak. 17. For the

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* Which special class of verbs, nouns, and adjectives requires the preposition *di* before the infinitive mood governed by them, will be explained hereafter. For the present, the above-stated merely general rule will be, I think, sufficient.

† Some other important omissions of the case-sign *di* will be explained hereafter.

young men. 18. On the bridge. 19. On the pictures. 20. Upon this earth. 21. The footman. 22. Of the Bridegroom. 23. To the stranger. 24. From the mattress. 25. The spits. 26. Of the emeralds. 27. To the writers. 28. From the printers. 29. In state. 30. In the mirror. 31. In the boots. 32. With study. 33. With the spirit. 34. With the sculptors. 35. By tools. 36. For the wood-cleaver. 37. For the sword-cutler. 38. Upon the rock. 39. On the benches. 40. The eye. 41. Of the bird. 42. To the friend. 43. From the bone. 44. The errors. 45. Of the engravers. 46. To the ungrateful. 47. From the trees. 48. In honour. 49. In the year. 50. In the ears. 51. With love. 52. With the dress. 53. With the wicked. 54. By deceit. 55. For the workman. 56. For the flatterers. 57. On the building. 58. Upon the unhappy.

RECREATIVE NATURAL HISTORY.

THE APE FAMILY:—ORANG-OUTANG—CHIMPANZEE—GORILLA.

NATURALISTS place man at the head of vertebrated animals, but immediately after come the apes, taking rank as the highest of all brute creatures. Uneducated men do not, however, regard these singular "four-handed" beings with much liking or respect. Curiosity is, indeed, always excited when an ape is seen, and the surest way to draw London to the Zoological Gardens would be an advertisement that an orang, a chimpanzee, or still better, a gorilla, had come into the possession of the society. But the curiosity of most spectators would be modified by a feeling of shrinking, or even of disgust. Scientific anatomists might examine with unmixed delight these men-like animals, but the greater number would feel as if a hideous caricature of the "human form divine" were set before them. As the Roman poet Ennius felt, 2,000 years ago, so do men regard an ape now, as "*turpissima bestia*" most hideous creature).* The same sentiment is shown in many old writers, who represent the demons in the forms of apes. What will ladies, who protest "they will never be married," say to the old notion, that all such dames would be attended by troops of apes in purgatory.†

But, notwithstanding this wide-spread feeling of dislike, man is irresistibly drawn to study creatures so strangely resembling himself in form, and so able to imitate many of his actions. The marvellous stories of travellers, and the fancies of certain theorists, have further stimulated this curiosity. We have been told of apes walking erect like men, and playing on flute-like instruments; that some were regarded as degenerated human tribes, and possessed the gift of language. William Bosman, the Dutch traveller in Africa, sagely conjectured that apes refrained from speaking, when near men, lest they should be caught and set to work! Some of our readers are probably familiar with the question, "Are not men simply improved and educated apes?" There must be something worthy of consideration in an order of animals respecting which such an inquiry could be put.

We may here ask, what is an ape? Were we to reply, "It is a four-handed, vertebrated mammal," the answer would be correct, but not sufficiently full, as the same definition would apply to most of the monkeys. We must therefore add that the true apes are without tails, and have no *cheek pouches*, in which to stow away food as it is gathered. The absence of tails and of cheek pouches distinguishes the apes from the monkeys and baboons. These cheek pouches, are, it is true, generally absent in the slow monkeys (*Semno pithecus*); but the long tails of the various species in this family must always clearly separate them from the orang or the chimpanzee.

We must now give a short description of each of the apes named at the head of this paper, and conclude with some special notes on the whole family.

THE ORANG-OUTANG.—The orang-outang, or red ape of Asia, was named *Simia satyrus* by Linnæus, but is now usually known as *Pithecus satyrus*. *Orang* appears to be a Malay word, meaning "men," or "people," and *utan* signifies "a forest;" so that *orang-utan* (or *outang*) denotes "the people of the woods." *Simia*, a word derived from the Greek, and signifying flat-nosed, is appropriate to the whole order. The epithet *satyrus* would naturally be selected by these whose minds were filled with the fabulous stories of the satyrs, beings intermediate between man and brutes. The name *pithecus* (πίθηκος), being the Greek word for ape, seemed, when added to the term *satyrus*, a fit descriptive epithet for the orang-outang.

The orang was, probably, the only ape known to such ancient naturalists as Aristotle, Pliny, and Galen. The latter is thought to have dissected some of these animals as the best available means of gaining a knowledge of the human skeleton.

The regions inhabited by these apes are Borneo, Java, Sumatra, and the islands of the Malay Archipelago, the latter being called, by a living writer, the home of "the orang-utan and of the bird of paradise." Solomon may have procured his apes from India (1 Kings x. 2), and the common English name of the animals is derived, by some, from a Sanscrit word.

In the gloomy depths of tropical forests the orangs find a home exactly suited to their organisation and wants. Being strict vegetarians, they obtain abundance of food at all seasons from the luxuriant fruits nourished by the fertilising warmth of an endless summer. Their four hands, long arms, and agile forms adapt them for living and travelling among the dense foliage, so that they are as truly formed for the forests as birds for the air.

Opportunities for observing these creatures are rare, and it is seldom that orang, chimpanzee, and gorilla are to be seen in this country. The stuffed skins, well set up, and the skeletons may, indeed, be studied at South Kensington: but something more than dried bones and preserved integuments are necessary to give a vivid idea of the activities and energies of life. Whether the orang is the most clever of the apes, or the most capable of education, cannot be ascertained with our present limited knowledge. We will shortly present in one view the various points of resemblance or difference between the several species, only remarking at present that the capacity for imitating human actions seems to be rather stronger in the chimpanzee than in the orang. Some of these apes are said to exceed man in height. One killed in Sumatra was found to measure seven feet, and possessed strength in proportion. Let the reader picture to himself an ape seven feet high, covered with long and light-brownish hair, broad-chested, long-armed, but short-legged, running along the ground with a waddling gait, but climbing trees like a cat, and springing from branch to branch with the activity of a squirrel and a speed truly marvellous. This orang was discovered by a body of armed sailors, and instinctively showed his dread of man by attempting to hide himself amidst the foliage of the highest tree. The strength of this ape may be estimated from the fact, that after receiving five musket-balls in his body, he sprang so vigorously from tree to tree, that the men were forced to fell every tree in the clump before they could bring their victim to the ground. Even then the dying ape taxed to the utmost the strength of his assailants, and snapped a stout spear in two as if it had been a lath. His peculiar expression when dying, and the mode in which he placed his hands on the wounds, as if to stop the flow of blood, made some of the sailors feel as if they were killing a being of their own race.

THE CHIMPANZEE (*Simia troglodytes*) has been described under various names, among which are Black Orang, Pygmy, Smitten, Pongo, and Troglodytes, the last being the most absurd. The reader will admit this, when he bears in mind that troglodytes* is a Greek word, signifying *a dweller in caves.* As the chimpanzees live in trees, the application of such a term to them may seem like a freak of fancy. These apes have been honoured by receiving a name which anciently designated a supposed nation living along the shores of the Red Sea, and of whom the old writers tell many a wondrous tale. They were small people, rode on small horses, fed on great serpents, had not the gift of speech, but were able to laugh, and were possessed of the fountain of the sun, which gave them an abundant supply of hot water every evening!

The chimpanzee is thought by some to stand nearer to man than the other apes, and even Linnæus was for a time at a loss whether to rank the creature as the lowest among men or the highest among the quadrumana. Some eminent men now deny the first place even among the apes to the chimpanzee, urging the claims of the gorilla, or those of the kooloo-kamba. Such "doubts" may well make men hesitate before they give the last correction to their zoological creeds. The chimpanzee appears to have the power of walking more upright than the orangs; the

* "Simia quam similis, turpissima bestia, nobis."

† For allusions to this idea, see Shakespeare's "Much Ado About Nothing," act ii., scene i., and the "Taming of the Shrew," act ii. scene i.

* Τρωγλοδύτης, from τρώγλη, *a cave*, and δύω, *I hide or live in.*

arms are shorter, more approaching the proportions of the human; the thumb is more developed, and the throat is not so much disfigured by the singular sac, which swells when the orang utters its loud and fierce cry.

The chimpanzee is a native of Western Africa, and was long supposed to be the only ape of this continent, the *magot* or Barbary ape (*Simia Innuus*), as it is often called, being more allied to the baboons. Two other species, at least—the gorilla and kooloo-kamba—have, however, recently been discovered in Equatorial Africa, which seems likely to gain the honour of being deemed the special land of the apes. Some years ago, three chimpanzees might have been seen at the same time in the Regent's Park Gardens, and their antics were invariably watched by a large number of spectators.

HEAD OF YOUNG CHIMPANZEE.

THE GORILLA. — This remarkable ape of Equatorial Africa has not long been made known to Europeans. It is true that the Carthaginian navigator, Hanno, was supposed to have taken the skins of three to Carthage; but these animals are now thought to have been chimpanzees, though called gorillas by the Greeks, who translated the account of Hanno's wonderful voyage. To M. Paul du Chaillu belongs the honour of describing the gorilla in its forest home, and the "Memoir" of Professor Owen gives a full account of the animal's structure. Many vain attempts have been made to keep living specimens of these apes in England; however, a good notion of their forms and enormous strength may be gained from the admirably set-up individual killed at the Gaboon river, and now at South Kensington.

HAND OF CHIMPANZEE.

FOOT OF CHIMPANZEE.

The first opportunity for examining any part of a gorilla was given in the year 1847, when a cranium was brought to England, and shortly afterwards two other skulls were added. But in 1858 the body of a gorilla, preserved in a cask of spirits, arrived at the British Museum, and was treated with all the anatomical honours due to such a visitor. The skin, bones, brain, nerves, and muscles were carefully examined by Professor Owen, and photographs of the animal, in various positions, were taken. All these representations may be studied in the "Memoir on the Gorilla." This ape bears a bad name abroad, and is thoroughly dreaded by the negroes, and especially by the women, who firmly believe that these animals delight to carry them off to their forest haunts. The hideous roar uttered by the gorilla when he advances to the attack, the ferocious courage of the creature, and the death-stroke which tears open the body of the assailant, have made this quadruman the terror of the forests. Superstition aids this feeling, as the natives think the spirits of certain deceased men enter into some gorillas, and endow them with human cunning and energies.

We will now conclude this paper with a few remarks applicable to the apes in general. All the species of this family have *opposable thumbs* on the four hands, and can therefore use both thumbs and fingers in grasping. Man has this structure in the hands only, the great toe being wholly useless for such a purpose. The case is reversed in many of the American monkeys, which have the opposable thumb on the hind-limbs only, and are therefore sometimes called *pedimana* (hand-like feet). A glance at the hand of the chimpanzee or the gorilla will show the vast superiority of the human thumb and hand over that possessed by any ape.

While the feet or hinder limbs of these quadrumana are fitted for grasping, their structure renders it impossible to plant the sole of the foot firmly on the ground. The outer edge only rests on the earth, and hence the rolling motion of these animals when moving on the ground. The mode in which the foot is joined to the ankle inevitably forces the sole to take an oblique and inward direction, admirably qualifying the ape to climb, but not to walk.

The comparative length of the arms in man and the various species of apes deserves attention. The human hand reaches to the middle of the thigh; that of the gorilla to the knee. The chimpanzee's fingers extend a little lower; those of the orang touch the ankle, and in some of the gibbons extend to the ground. The following comparison between the capacity of the human and ape skulls yields some instructive results. The average capacity of an English skull is 96 cubic inches; of a Hottentot's, 75; the gorilla's, $34\frac{1}{2}$; the chimpanzee's, $27\frac{1}{2}$; and that of the orang, 26 inches.

How many changes does the reader suppose would be necessary to make the body of a gorilla like that of a man? Twenty-four alterations of structure at least would be required to effect this transmutation in the physical organisation only. Thus it will be seen that numerous differences separate even the bodies of the apes from those of men. We shall not here attempt to explore the width and depth of the gulf which separates the intelligence of these creatures from ours. Some have ventured to inquire why those animals do not speak, as their organs of speech resemble man's? These inquirers forget that organs of speech must act according to the power of the mind which employs them; hence while man uses a glottis and vocal chords to form a language, the apes can but employ the same organs to produce a bark or a yell.

Many other topics are suggested respecting a family of animals so mysteriously resembling, and yet so widely differing from man; but we must refrain from entering upon these questions. The preceding observations may incite some readers to search more minutely into the numerous and important differences between the lowest man and the highest quadrumana.

MECHANICS.—XX.

PRIME MOVERS: WIND AND STEAM—DYNAMICS.

The next of the prime movers is the force of the wind. Heat expands all substances; hence, when any place is greatly heated by the sun's rays, the air over it expands and rises, and cold air from around rushes in to fill its place. This air in motion is called wind, and produces the effects with which all are familiar. It acquires momentum as it travels, and when any object obstructs it, presses against the obstacle with a force proportional to its speed. This pressure produces the greatest effect when it acts in the direction in which motion is required, as, for instance, when a ship is propelled by a stern wind. The sails are spread as nearly as possible across the ship, and the full force of the wind drives it onward.

If the vanes of a windmill are arranged like the float of a paddle-wheel, so that the wind acts sideways on the wheel, no effect will be produced unless one-half of it is protected from the wind; for its action on those floats which are uppermost tends to turn the wheel one way with exactly the same force that its action on the lower ones does the other way. Even if the lower half be thus shielded the wind acts on those at the side very obliquely, and these keep it off from the vertical ones. Hence little effect can be gained in this way, and the vanes are always arranged so as to make a small angle with the plane in which they revolve, and it is found that most effect is produced when different parts of the vane have a different inclination, those nearest the centre being inclined at a greater angle than those more remote.

The fourth, and in some respects the most important of the prime movers, is the expansive force of gases and vapours. The great advantage of this class is, that an almost unlimited amount of power may always be obtained, and that the cost is much less. Wind and water power often fail, but a steam-engine, which is the most common example of this class of prime movers, can work as well at one time as another.

We cannot stop now to explain the details of the construction of an engine, but the principle on which it acts is simply this:—When water is heated to 212°, a portion of it is converted into an invisible vapour called steam; this occupies a space nearly 1,800 times as large as the water, and we have thus an expansive force which is utilised and converted into any kind of motion we may require. The usual plan of employing it is to procure a large cylinder, with a piston capable of moving up and down in it; the pressure of the steam is first caused to act below this piston, which it drives to the top of the cylinder; by an arrangement of the valves the steam is then caused to act above instead of below, and thus an alternating motion is produced from the pressure, and this is, by means of a crank, changed into one of rotation.

If we have a piston with a surface of one square inch, the evaporation of a cubic inch of water will raise it 1,800 inches, or 150 feet. Now the pressure of the air on the piston is 15 pounds, and as this is overcome, the work done is 15 pounds raised 150 feet. This is 2,250 foot-pounds; or, to put it in a way more easy to remember, the evaporation of a cubic inch of water will produce force enough to raise a ton to a height of 1 foot.

Now this force is not created; something must be consumed in order to produce it, and this something is the fuel employed. A very important question, therefore, is to ascertain how much work ought to be accomplished by a given quantity of fuel. Of course this varies much with the construction of the furnace and boiler, but it is reckoned that a pound of good coal will, when employed in the best way, evaporate about 240 cubic inches of water, and therefore produce a force of about 540,000 foot-pounds.

The explosive force of gunpowder and similar explosive compounds come under this class of prime movers, though they are sometimes set down to chemical agency. When they are ignited they set free a large amount of different gases, which occupy a space many hundred times greater than that of the substances themselves, and this sudden liberation gives rise to the violent effects we are accustomed to see produced by their employment.

EXAMPLES.

1. How many units of work are required to raise 60 gallons of water to a height of 70 feet?
2. What power must an engine have to raise 20 tons of coal per hour from a mine 400 feet deep?
3. From what depth will an engine of 6 horse-power raise 8 tons per hour?

4. How much coal will be consumed in raising 5,000 cubic feet of water from a depth of 90 feet, a cubic foot of water weighing 62½ pounds?
5. How long will it take a man to raise 50 tons of material to a height of 60 feet by a windlass; and how long by ascending a ladder and letting his own weight raise it?

DYNAMICS—THE THREE LAWS OF MOTION.

We have now to pass on to the second and more difficult part of Mechanics. Hitherto we have had to deal with forces which acted on a body and produced equilibrium. If any of these forces be now altered or modified in any way, so that one or more remain unbalanced, some motion will take place, and the nature of this motion will, of course, depend upon the forces. It is the object of dynamics to inquire what these motions will be, and what are the laws that govern them; and though at first they may appear comparatively unimportant, we shall find as we advance that an acquaintance with them is of great practical use for many purposes.

The investigation of the action of the earth's attraction, of the motion of bodies projected with any given velocity, and of many other common things, depends on the principles of dynamics, and the laws we discover by examining these are found to apply on an infinitely more grand and glorious scale in nature, for by their action all the stars and planets are kept in their orbits and made to perform their varied revolutions. By these laws astronomers can not only explain and account for their varying distances and motions, but can foretell with the utmost accuracy eclipses and other phenomena of the heavenly bodies.

There is one important difference between statics and dynamics, and that is, that the latter is one of the *inductive* sciences, though perhaps the simplest of them. Some sciences, like arithmetic and geometry, are called deductive, their principles being deducible from abstract truths without reference to experiment, though that is sometimes resorted to as a corroborative evidence or a simpler mode of proving their truth. To this class statics belongs, for all its fundamental truths can be mathematically proved. Not so with dynamics, many of the truths of which can only be ascertained by experiment, and in order to ensure accuracy in these experiments they must be repeated again and again, for slight errors are likely to creep in, and it is only by taking the average of many different experiments that we can arrive at accurate results. Many, however, of its principles can be ascertained by deduction, and it thus approaches much more nearly to the deductive sciences than the other branches of natural philosophy,

As previously stated, we have in dynamics to introduce a fresh idea, that of *time.* In statics force was considered only as producing pressure, and therefore this element did not enter into our calculations; but it is clear that, in treating of motion, the time occupied is an important thing to consider.

It is needful at starting that we should have some mode of measuring the degree and intensity of motion, that is, the velocity of any body, and, as we saw, two quantities are needed to determine this—the space passed over, and the time occupied in passing over it. We may know that a force applied to a body causes it to move over a certain space, but to form a correct idea of the force, we must also know how long it takes to travel this distance. When we speak of a speed of 12 miles an hour, we mean that if the motion continued uniform through that space of time the body would have travelled 12 miles. It does not, however, imply that the body actually passes over 12 miles, but merely that it moves with that degree of speed. Great inconvenience often results from thus requiring two numbers to represent a velocity, and hence it is usual to express it by the number of feet passed over in one second. If a body moves a mile in 8 minutes, it passes over a furlong, or 660 feet, in one minute, and therefore over 11 feet in one second, and it is said to have a velocity of 11. When, therefore, we represent a velocity by a number, it is always to be understood as the number of feet passed over by the body in one second.

The motion of any body may be either uniform or variable. It is uniform when equal spaces are always passed over in equal times, and its velocity is then measured by the number of feet actually passed over in a second. When this number is not constant, the motion is variable, and the velocity at any point of time is measured by the space it would pass over in one second if it continued during the whole second to move at the same rate as at the given moment. A variable motion may be either accelerated or retarded, and if the gain or loss of velocity in equal times be equal, it is said to be a uniformly accelerated or retarded motion.

A railway train when first started affords an illustration of accelerated motion. The power of the engine is more than sufficient to overcome friction and the resistance of the air, and therefore the speed increases; but the resistance increases in a greater ratio, till, after a time, it exactly equals the power of the engine, and then equilibrium ensues, and the train continues in a state of uniform motion.

The actual measurement of the space passed over in a given time is often a difficult thing, especially as there are always counteracting forces which impede the motion in a greater or less degree. There are, however, various ways in which this may be accomplished, some of which we shall see as we proceed.

Now there are two modes in which we may regard force; one is, by considering merely the velocity imparted without any reference to the quantity of matter moved; force considered thus is called accelerating force. The other mode is by taking into account the quantity of matter moved as well as the velocity, and this is called moving force. These are not two different kinds of force, but merely two ways of regarding the same force. It is clear that a different amount of force is required to impart the same speed to two bodies of different weights. The impulse that would impart a very great velocity to a pistol-bullet may scarcely be able to move a large cannon-ball. The quantity of matter or mass of a body is thus an important element in measuring the force required to produce motion in it. Now we cannot determine exactly what the mass of a body is, as we do not know the ultimate particles of which it consists; but we can always measure it by the weight of the body, for gravity may be considered to act equally on all particles, and therefore two substances on which it acts equally—that is, which have the same weight—may be considered to contain the same quantity of matter. Hence, when we want to find the quantity of motion or *momentum* of any body—that is, the force which would be required to generate in it a motion equal to its own, or which it would exert against any obstacle which obstructed it—we have to multiply its velocity by its weight.

This is usually given as a definition: The momentum of any body is its mass multiplied by its velocity. If, for example, a body weighing 100 lbs. be moving with a velocity of 15 feet per second, its momentum is 1,500.

After thus much by way of definition, we pass on to the laws of motion; but we shall have to return to momentum. The most important principles of motion were drawn up by Newton in the shape of three general laws. These have since been altered in their form, but assert nearly the same facts. The first teaches that every body will continue in its state of rest or uniform motion in a straight line unless acted upon by some external force or forces. This law merely asserts the *inertia* of matter, that is, its inability of itself to alter or modify in any way any motion which has been imparted to it. We can easily understand that a body at rest will remain so unless some force be applied to it, as we see constant illustrations of the fact. It is, indeed, one of the earliest truths which we acquire from observation, but the other part of the law seems more at variance with experience. In fact, almost every motion we observe seems at first sight to point out the inaccuracy of the law; but it is only at first sight, and a little examination will show its truth. Let a stone be rolled along the ground with great speed, it comes to rest in a very short time; so, too, a boat when rapidly rowed along soon stops if the man ceases to ply the oars. The true reason, however, why in these and similar instances the motion ceases, is, that other forces neutralise that which has been acquired. In the first case, these forces are friction along the ground and the resistance of the air; in the second, the resistance of the water, for the boat as it advances must displace some of the water, and all the momentum it had acquired is thus soon dispelled. If all such counteracting causes could be removed, the body would move on for ever. This cannot, of course, be proved directly by experiment, but we can easily assure ourselves of its truth, for, in proportion as we remove these obstructions, the motion continues for a longer period. If, instead of rolling the stone along the ground, we send it on smooth pavement, the motion will continue to a much greater distance; and if we try the experiment on a good surface of ice, it will move farther still, the simple reason being that the force of friction which before overcame its motion has been greatly removed.

From experiments like these we can ascertain the truth of the law, and it is important to bear it in mind, since the neglect of it has often led to great mistakes.

Force, then, is not required to maintain motion, but only to produce or alter it, either by increasing or diminishing its speed, or by changing its direction.

We now turn to the second law of motion, which may be stated thus:—When any number of forces act on a particle, each produces its full effect in producing or altering motion, exactly as it would if it acted singly on the body when at rest.

Of this we have many simple proofs. Let a stone be dropped from the mast-head of a ship, it will fall exactly at the foot of the mast, just as if the vessel were perfectly at rest.

If gravity alone acted upon it, it would reach the deck some distance in the rear of the mast, for in the interval which it has occupied in falling, the vessel has been moving onwards, and the point from which the stone fell is, when the stone reaches the deck, vertically over a place some distance behind the mast; but another force was also acting on the stone, and that was the onward motion which, like the vessel, it had acquired. This motion was exactly equal to that of the vessel, as both were moving at the same rate; and each of these forces produces its full effect. The stone falls in exactly the same time as it would take if the vessel were at rest; it moves through the same horizontal space that it would if it were not falling; and at the end of the time occupied in falling is in the same place as if each force had acted singly during that length of time, the only difference being that then it would have passed over two sides of a parallelogram, whereas now it has travelled down the diagonal.

Another good illustration of this is afforded by a boat crossing a river when the stream is running down rapidly. Suppose the stream to be flowing in the direction of the arrow. A boatman at A wants to cross to a point B some distance lower down; he does not, however, steer directly for it, since, if he did, the force of the stream would carry him to some point much lower down, but he makes for a point almost opposite him. If the current be so rapid that it would carry him down from C to B in the time it takes him to row from A to C, he must steer directly across to C. There will be then two forces acting on the boat—his own force impelling it from A to C, and the force of the stream from C to B, and under the joint action of these two forces it will move from A to B in the same time that it would take him to row to C. If, now, he wants to cross again to D he must steer for some point higher up than A, for as B A is longer than A C, the tide will have more time to act upon the boat and carry it down. More commonly, however, he rows from B towards C along the shore, where the current has less force, and then crosses as at first. But it is clear that in either case each force produces its full effect.

Fig. 95.

In our lessons on statics we learnt the parallelogram of forces, and found that if two forces acting on a body be represented by two adjacent sides of a parallelogram, the resultant will be represented by the diagonal. We may now extend this principle to velocities, thus:—If any two velocities impressed on a particle be represented by two sides of a parallelogram, the diagonal will represent the resulting motion in direction and velocity.

We now pass on to the third law of motion, which was stated by Newton as follows:—Reaction is always equal and contrary to action, or the mutual actions of two bodies upon each other are always equal and in opposite directions. When a carriage is drawn by horses, they are pulled back with the same force as the carriage is drawn forward; so, if a boat in a stream be pushed off from another, the quantity of motion produced in each is the same. If both be of the same weight they will move with the same velocity; but if one be heavier, its motion will be so much less than that of the other. We see, thus, that motion is never lost, it always produces motion in other things; but as this is shared among all bodies in proportion to their mass, it soon becomes so small as to be unnoticed.

Now if we consider the pressure on a body to be the action, the quantity of motion produced is the reaction, and this law asserts that these are equal. But the quantity of motion is measured by the product of the mass and the velocity, that is, by the momentum generated.

The momentum produced is therefore proportional to the pressure. Hence the law is frequently stated thus:—When pressure produces motion in a body, the momentum generated is proportional to the pressure. Momentum, then, is the measure of moving force, as velocity is of accelerating force. From this we find a way of comparing these two. The latter is measured by the velocity, irrespective of the mass, and as the pressure, which is the moving force, imparts the velocity to the body, it is equal to the mass multiplied by this velocity. That is—moving force = mass × accelerating force. Hence the moving force divided by the mass gives the accelerating force.

From this we can calculate the dynamical unit of force, that is, the force required to cause the unit of mass to move one foot per second, which force we stated in our second lesson to be 7·85 grains.

The unit of mass is one cubic inch of distilled water, and this weighs nearly 253 grains. Now the accelerating force of gravity which produces this weight is 32·2, that being, as we shall shortly see, the velocity a falling body acquires in one second. But the velocity we want is only 1 or $\frac{1}{32 \cdot 2}$ of this. Hence the unit of moving force is 253 gr. × $\frac{1}{32 \cdot 2}$ or 7·85 gr.

The apparatus usually employed to prove the third law of motion consists of what is known, after its inventor, as Atwood's machine. It consists essentially of a fine cord, which passes over a wheel or pulley, and to each end of which equal weights are fastened.

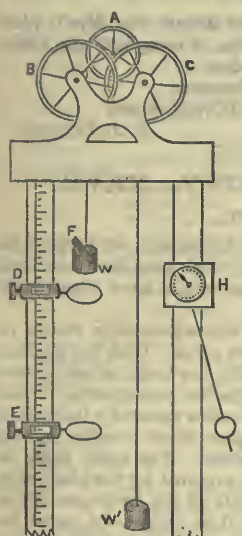

Fig. 96.

In Fig. 96, A represents the wheel over which the cord passes, a small groove being turned on the edge to receive it. In order to reduce friction, which would materially interfere with the accuracy of the results obtained, this wheel does not turn in bearings, but its axle rests upon the rims of four others called friction wheels. These turn with the axle, and so far diminish friction that its effect is scarcely noticed. One of the pillars which support these wheels is accurately graduated to inches and fractions of an inch.

A hollow ring, D, and a stage or table, E, are also fixed to clamps sliding on this pillar, so that by means of small thumb-screws they can be adjusted at any height and distance from each other that may be desired.

A pendulum of such a length as to tick seconds, with a small dial to register the number, is fixed on another support at H. A catch is also fixed above D, to hold W till it is allowed to fall. There are several minor details of construction which have to be attended to, but they need not be explained here.

Since W and W′ are equal they will balance each other, and no motion will ensue; but if we now take a small bar of metal, F, and lay it across the top of W, it will cause it to overbalance W′, and to descend with an accelerating velocity until it reaches the ring D, when, the bar being too long to pass through, will rest upon it, and W will continue to travel onwards with the momentum it has acquired. Now the weight moved is clearly the sum of the weights of W, W′, and F, and the moving force is the weight of F; and by a series of experiments it is found that the velocity with which W descends is always in the proportion of the weight of F, divided by the total weight moved. For instance, make W and W′ each to weigh $7\frac{7}{8}$ oz., and F a quarter of an ounce: the velocity will be represented by $\frac{1}{64}$, the mass moved being 16 oz., or 64 times the moving force. Now diminish each of the weights to $7\frac{3}{4}$ oz., and make F half an ounce. The mass moved will remain the same as before, but the moving force will be as large again as it was, and we shall find the velocity will be represented by $\frac{1}{32}$, that is, it will be twice as great as it was. In other words, if the mass remain the same, a double pressure is required to produce a double velocity, a triple pressure three times the velocity, and so on.

Now let the mass be doubled, the moving force remaining the same. Make W and W′ $15\frac{3}{4}$ oz. each, and F half an ounce, the velocity will now be $\frac{1}{64}$, or the same as it was at first. So that, if the mass be doubled, a double pressure is required to produce the same velocity. We see, then, that whether the mass or the velocity be increased, the pressure must be increased in the same proportion, and therefore that the pressure is proportional to the mass multiplied by the velocity, *i.e.*, to the momentum, and this is what the third law of motion asserts.

CORRESPONDENCE IN FRENCH.—II.

6.—Reply to Letter of Inquiry as to Solvency of a Firm.

Paris, August 19, 1882.

Messrs. Merivale Brothers, Havre.

Gentlemen,—We beg to acknowledge the receipt of your letters of the 26th of July and 19th inst.

Although we say that the firm H. Smith Bros. is sound, it is but fair to tell you, in confidence, that their reputation is not entirely above all suspicion; that this suspicion attaches itself chiefly to a want of delicacy and scruple in their business, of which a number of people have from time to time raised complaints, so as to diminish the credit which the firm used to enjoy.

We cannot, however, limit the extent of credit you may be disposed to give them, except in so far the foregoing may determine you.

Please to send us particulars as to what is being done in quinine in your city, and whether, as with us, it seems to go down. We are offered some of superior quality at 4 francs 50 cents. Be good enough to send us all the particulars you can obtain of this drug, partly as to the monopoly, as to the news from Peru, especially about the war, and as to the most favourable time for purchase.

We are, Gentlemen, your very obedient servants,

Henry Lafitte & Co.

Paris, le 19, *Août*, 1882.

Messieurs Merivale Frères, au Havre.

Messieurs,—Nous accusons réception de vos lettres du 26 Juillet et du 19 courant.

Tout en vous disant que la maison H. Smith frères est solide, nous devons aussi vous informer confidentiellement qu'elle ne jouit pas entièrement d'une réputation libre de toute censure; que cette censure porte sur un manque de délicatesse et de scrupule dans leurs affaires, dont bon nombre d'individus se plaignent, de manière à diminuer le crédit dont jouissait autrefois cette maison.

Nous ne pourrions donc vous fixer sur l'étendue du crédit à leur accorder sinon par ce que nous venons de dire.

Veuillez bien nous informer comment va le commerce de la quinine sur votre place et nous dire si, comme ici, cet article semble devoir fléchir. On nous en offre, de belle et bonne qualité, à 4fr. 50c. Ayez la bonté de recueillir sur cet article tous les renseignements que vous serez à même de vous procurer, tant sur le monopole, que sur les nouvelles qui arrivent du Pérou, au sujet de la guerre, et sur le moment le plus favorable pour faire des achats.

Agréez, Messieurs, l'assurance de notre parfaite considération,

Henri Lafitte & Cie.

7.—Letter of Inquiry as to State of Markets under Adverse Circumstances.

Amsterdam, May 2nd, 1882

Messrs. J. T. Van Praat & Co., London.

Gentlemen,—The latest news from America has overcast the commercial horizon and created a panic in our city. We tremble for the consequences which such a state of things may produce. The best houses are shaking, and we are momentarily expecting a general suspension. We do not know how your markets are, and in any case it would not become us to give you any advice; we merely throw out a hint, that the consequences of these untoward circumstances must be felt, with you, as in all the great industrial centres.

Be good enough to give us some information as to what you are doing, what you fear or hope, for we are somewhat uneasy

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as to the result we are likely to obtain from our stock, which is of considerable importance. In any case we shall not send more, but wait your orders.

In the hope of our hearing from you,

We remain, Gentlemen,

Your obedient servants,

TEN DOREN & J. HAAS.

Amsterdam, le 2 *Mai*, 1882.

Messieurs J. T. Van Praat & C^ie^, à Londres.

Les derniers courriers d'Amérique ont obscurci l'horizon commercial et jeté l'épouvante sur notre place. Nous tremblons pour les conséquences que peut amener une situation semblable. Les maisons les plus solides vacillent sur leur base, et l'on s'attend d'un moment à l'autre à une suspension générale. Nous ne savons dans quel état se trouve votre marché et dans tous les cas ce ne serait pas à nous à vous donner des conseils, mais nous pensons que le contre-coup de toutes ces mauvaises affaires doit s'y faire sentir comme dans tous les grands centres industriels.

Veuillez donc être assez bons pour nous donner quelques renseignements sur ce que vous faites, quelles sont vos craintes et vos espérances, car nous sommes peu tranquilles sur les résultats que nous devons retirer de nos marchandises, qui sont d'une certaine importance. En tout cas, nous suspendrons nos envois et attendrons vos commandes.

Dans l'attente de vous lire,

Nous vous présentons,

Messieurs,

Nos salutations cordiales.

TEN DOREN & J. HAAS.

8.—LETTER OF INQUIRY AS TO SOLVENCY OF A FIRM.

Lyons, August 21*st*, 1882.

Messrs. A. J. Peters, London.

Gentlemen,—Upon the recommendation of Messrs. Lambert Bros., of this city, we take the liberty to ask you to be good enough to inform us as to the respectability and solvency of Messrs. A. Wolff & Co., London, Commission Agents and Exporters, who have a house in Paris, Porte St. Martin.

As all their orders are to be sent to the London house, you would oblige us greatly by giving us some information as to the commercial position and repute of the said firm.

Thanking you beforehand for your trouble,

We are, Gentlemen,

Your very obedient servants,

FR. RICHON BROTHERS.

Lyon, le 21 *Août*, 1882.

Messieurs A. J. Peters, à Londres.

Sur la recommandation de Messieurs Lambert Frères, de notre ville, nous prenons la liberté de nous adresser à votre obligeance pour avoir des renseignements sur la maison A. Wolff & C^ie^, de Londres, faisant la Commission et l'Exportation, et ayant un comptoir à Paris, Porte Saint-Martin.

Comme tous leurs achats doivent être expédiés à leur maison de Londres, vous nous obligeriez, Messieurs, en nous adressant quelques renseignements sur leur position commerciale et leur solvabilité.

Nous vous remercions d'avance pour votre obligeance, et vous prions d'agréer,

Messieurs,

Nos salutations empressées,

FR. RICHON FRÈRES.

9.—REPLY TO LETTER OF INQUIRY AS TO SOLVENCY OF A FIRM.

London, August 28*th*, 1882.

Messrs. F. Richon Bros., Lyons.

Gentlemen,—In reply to your favour of the 21st, requesting some information, we confess that the wish to avoid injuring the credit of a countryman on the one hand, and to cause you loss by incomplete information on the other, greatly embarrasses us.

The facts are thus: Messrs. Wolff & Co. have, as silk importers, enjoyed a sound reputation, but their firm has in consequence of unforeseen circumstances (the sudden death of one of the partners, the prolonged struggle in America, and the failure of two or three houses at Leghorn and Amsterdam), not been able to compete with others more fortunate, and has engaged, it is said, in ruinous speculations. Still, the firm's credit is sufficiently good, and if the orders are not too large, their very magnitude causing them to be suspected, you may safely execute them.

We regret not to be able to give you a more circumstantial account of the firm in question, and relying upon your discretion as to the statement contained in this letter,

We have the honour to be, Gentlemen,

Your very obedient servants,

A. J. PETERS.

Londres, le 28 *Août*, 1882

Messieurs F. Richon Frères, à Lyon.

Messieurs,—En réponse à votre lettre du 21 courant, contenant une demande de renseignements, nous vous avouons que, ne désirant ni nuire au crédit d'un compatriote, ni vous occasionner de perte par des renseignements incomplets, nous nous trouvons dans un embarras extrême.

Voici les faits : Messieurs Wolff & C^ie^, faisant l'exportation de soieries, ont joui d'une bonne réputation, mais par suite de circonstances imprévues (la mort subite d'un des associés, la durée de la guerre en Amérique et la faillite de deux ou trois maisons à Livourne et à Amsterdam), la maison n'a pu soutenir la concurrence et s'est livrée, dit-on, à des spéculations ruineuses. Toutefois nous devons avouer qu'elle jouit encore d'un assez bon crédit, et si les achats ne sont pas d'une grande importance de manière à les rendre suspects, vous pouvez les exécuter en toute assurance.

Nous regrettons de ne pouvoir vous donner des détails plus circonstanciés sur la maison en question, et comptant sur votre discrétion sur ce que nous venons de dire,

Nous avons bien l'honneur

de vous saluer,

A. J. PETERS.

LESSONS IN CHEMISTRY.—XXVII.

TESTING, ETC.

IN this, the final lesson in Inorganic Chemistry, we propose to give, in an assembled form, those tests which have been described under the various bodies whose characteristics have been dwelt upon.

The Blowpipe.—The behaviour of various metallic oxides in the blowpipe flame has frequently been given. That the student may be enabled to prove experimentally the truth of our assertions, it is necessary briefly to describe the management of the blowpipe. It has been already stated, and a moment's inspection will decide the point, that the blowpipe flame consists of two distinct cones—the *inner* and *outer flames*. The inner flame is in great need of oxygen, since the air supplied by the blast only affords sufficient to satisfy the demands of the hydrogen in the gas, or hydrocarbon vapour; hence, if an oxide of a metal be placed in this cone, it becomes heated to a high temperature, and is induced to part with its oxygen to the needy carbon in the flame; thus the metal becomes *reduced.* This property of the inner flame has procured for it the name of the *reducing flame.*

In the outer flame the complete combustion of the carbon is determined, for much oxygen mingles with it from the surrounding air with which it is in contact. If a piece of metal be submitted to the action of this flame, it is heated to a high temperature, and is thus in a condition to be readily oxidised, which is always effected, save in the case, of course, of the noble metals. This flame is therefore called the *oxidising flame.*

To illustrate the peculiarity of these two flames, place a particle of lead on a piece of well-burnt charcoal; direct upon the metal the blowpipe flame, so that the point of the flame may play upon the metal. The lead will melt, then oxidise, and become a transparent liquid bead. Now move the charcoal further into the flame, so that the bead may be enclosed in the inner cone. Here it will soon be deprived of its oxygen, and return to the metallic state. This may be perhaps even more strikingly illustrated by submitting a piece of flint glass to the action of the whole flame; that part of the glass which is heated by the outer cone will remain clear, but that in the reducing flame will become opaque, being covered with a dark metallic lustre, the fact being that the lead oxide in the glass is reduced.

The means by which bodies are held in the blowpipe flame are generally these—(1) On a piece of charcoal, in which a little cup has been hollowed in order that the oxide may not be blown away; (2) in a small clay or platinum cup; (3) when the action with borax or microcosmic salt is required, a piece of platinum wire is thrust into a rod of glass, when its end is fused, the other end of the wire being hooked, as in Fig. 53. Platinum and glass have almost the same coefficient of expansion, so that the glass does not crack when it cools. The wire is heated, then placed in the borax, etc., which adheres to the hot wire; this is now introduced into the flame, and immediately swells up, but soon becomes a clear bead surrounding the hook of the wire. When in this state it is touched with the body which is to be tested, and again introduced into the flame. The following table, which is condensed from Conington's "Handbook of Chemical Analysis," gives concisely blowpipe tests. *h* signifies hot; *c*, cold; *supers.*, that the bead is supersaturated with oxide; *not sat.*, that it is not completely saturated with oxide.

Fig. 53.

WITH MICROCOSMIC SALT (Na,NH_4,H,PO_4).

Colour of Bead.	In Oxidising Flame.	In Reducing Flame.
Colourless.	*Silica* swims undissolved. *Alumina*, *Stannic* oxide, *Alkaline earths* and *earths* (supers. opaque). Zn, Cd, Pb, Bi, Sb oxides, not sat. (supers. yellowish).	*Silica* swims undissolved. *Alumina*, all *alkaline earths*, and *earths* (supers. opaque). *Stannic* oxides.
Yellow or Brownish	h. not sat. *Ferric* oxides. h. *Silver* oxide, c. *Nickel* oxide.	h. *Ferric* oxide (reddish).
Red.	h. *Nickel* oxide. h. supers. *Ferric* oxides.	h. *Ferric* oxide. c. *Cupric* oxide.
Violet or Amethyst.	*Manganic* oxides.	
Blue.	*Cobalt* oxide. c. *Cupric* oxide.	*Cobalt* oxide.
Green.	h. *Cupric* oxide. *Ferric* oxide containing cobalt or copper. c. *Chromic* oxides and *Uranic* oxides.	c. *Chromic* and *Uranic* oxides.
Grey and Opaque.		c. Oxides of Ag, Zn, Cd, Pb, Bi, Sb.

WITH BORAX (Na,H,BO_3).

Colour of Bead.	In Oxidising Flame.	In Reducing Flame.
Colourless.	*Silica*, *Alumina*.—Supers. opaque: *alkaline earths* and *earths*. *Silver* oxide.—Not sat.: Zn, Cd, Pb, Bi, and Sb oxides.	*Silica*, *Alumina*, *Stannic* oxide.—Supers., opaque: *Alkaline earths* and *earths*, *Manganic* oxides, h. *Cupric* oxide.
Yellow or Brownish.	h. not sat., *Ferric* and *Uranic* oxides, h. supers., Pb, Bi, and Sb oxides.	
Red.	h. *Ferric* oxides. c. *Nickel* oxide (red-brown). h. supers., *Chromic* oxide.	c. *Cupric* oxide.
Violet or Amethyst.	*Manganic* oxides. *Nickel*, containing *Cobalt*.	
Blue.	*Cobalt* oxide. c. *Cupric* oxide.	*Cobalt* oxide.
Green.	c. *Chromic* oxide, h. *Cupric* oxide, *Ferric* oxide, containing *Cobalt* or *Copper*.	*Ferric* and *Chromic* oxides.
Grey and Opaque.		As with Microcosmic Salt, and with *Nickel* oxide.

If the analysis of a compound substance be required, the works of Fresenius or Conington must be consulted; but if it be required to determine the quality of a single substance, such as the salt or oxide of a metal, the following tables will serve to direct the inquiry. In all cases, it must be remembered, the substance must be in a solution. All metallic bodies will be dissolved by concentrated or dilute hydrochloric or nitric acid, or aqua-regia. In most cases, water is a solvent of salts reduced to powder; some of the chief bodies which are insoluble are thus rendered soluble.

Silicates fuse with four parts of alkaline carbonate; the substance is now capable of solution in hydrochloric acid.

The *sulphates of barium* and *strontium* are similarly fused with alkaline carbonate. The result when digested in water gives its acid to the water with the alkali, and leaves the base, which is soluble in hydrochloric acid.

When *sulphate of lead* is thus treated, a metallic globule is found, thus indicating the nature of the body without further search.

Fluorides, when treated with concentrated sulphuric acid, evolve hydrofluoric acid gas, which etches glass. They are rendered soluble as silicates, and when digested with hot water, the water takes up the *acids*, leaving behind the *bases*, which are now soluble in hydrochloric acid.

Aluminates are rendered fusible by the same treatment.

THE ALKALIES.

	Platinum Perchloride ($PtCl_4$) gives	Tartaric Acid gives	
	Precipitate.	*Precipitate.*	
Potash.	Yellow.	White.	Violet flame, with blowpipe.
Soda.	None.	None.	Yellow flame.
Ammonia.	Yellow.	White.	Volatile when heated—Nessler's test decisive.

THE ALKALINE EARTHS.

	Calcium Sulphate (Ca,SO_4).	
	Precipitate.	
Baryta.	White.	Hyposulphite of Sodium, white precipitate.
Strontia.	White.	Hyposulphite of Sodium, no precipitate.
Lime.	None.	Alcohol flame, crimson. Oxalate of Ammonium, white precipitate.
Magnesia.	None.	Oxalate of Ammonium, no precipitate.

The preceding oxides give no precipitates with ammonia or ammonium sulphide, like the following group:—

Oxides of	Ammonia.	Ammonium Sulphide.	
	Precipitate.	*Precipitate.*	
Aluminum.	White.	White, insoluble in excess.	If both re-agents be added, a white *gelatinous* precipitate falls.
Chromium.	Blue-green.	Blue-green.	Potash gives a similar precipitate, which is *soluble* in excess.
Zinc.	White.	White, soluble in excess.	Potash gives a white precipitate, soluble in excess.
Manganese.	Flesh-coloured.	Flesh-coloured.	Potash, a similar precipitate, insoluble in excess.
Nickel.	Light green, soluble in excess.	Black, insoluble in dilute HCl.	Potash gives a light-green precipitate, insoluble in excess. Potassium cyanide gives a yellow-green precipitate.
Cobalt.	Blue, soluble in excess.	Black, insoluble in dilute HCl.	Potash gives a *blue* precipitate, insoluble in excess.
Iron (protoxide).	Green, insoluble in excess.	Black, soluble in dilute HCl.	Potash furnishes a *green* precipitate K_3FeCy_6 produces *dark Prussian blue.*
Iron (peroxide).	Red-brown.	Black, soluble in dilute HCl.	Potash yields a *red-brown* precipitate. K_3FeCy_6 gives a *brown.*

The following group is distinguished from the preceding by yielding precipitates with HCl and H_2S in an acid solution :—

SALTS OF	HYDROCHLORIC ACID (HCl).	AMMONIA.	
	Precipitate.		
Silver.	White, curdy.	Soluble.	With Potash, a brown precipitate, hydrated oxide.
Mercury.	White.	Blackened.	Silvers metallic copper.
Lead.	White.	Insoluble.	Potassium iodide gives a yellow precipitate.

SALTS OF	HYDROSULPHURIC ACID (H_2S).	AMMONIA.	
	Precipitate.		
Copper.	Black.	Green-blue in excess, the blue clear.	Deposits copper on iron.
Bismuth.	Black.	White, insoluble in excess.	Water produces a white precipitate.
Cadmium.	Yellow.	White, soluble in excess.	
Gold.	Black-brown.	Dark yellow, in strong solutions.	$FeSO_4$ precipitates metallic gold as a brown powder.
Platinum.	Black-brown.	Yellow, soluble in excess.	Potassium nitrate gives a yellow crystalline precipitate.
Antimony.	Orange.	White, insoluble in excess.	Potash gives a white precipitate, soluble in excess.
Tin (protoxide).	Brown, insoluble in dilute H,NO_3.	White, insoluble in excess.	$HgCl_2$ yields a grey precipitate.
Tin (peroxide).	Yellow, insoluble in NH_4O.	White, slightly soluble.	
Arsenic.	Yellow, soluble in NH_4O.	No precipitate.	Marsh's test.

Thus may be determined the *base* of a salt. By the following tables the acid, combined with the salt, may be detected :—

ACIDS.	BARIUM NITRATE ($Ba2NO_3$).	
	Precipitate.	
Chromic.	Yellow, soluble in HCl.	$AgNO_3$ gives a *purple-red* precipitate, soluble in HNO_3.
Sulphuric.	White, insoluble in HCl.	
Phosphoric.	White, soluble in HCl, without effervescence.	With $AgNO_3$ a yellow precipitate, soluble in HNO_3.
Boracic.	Ditto.	In a neutral solution, a yellowish precipitate, with Fe_2Cl_3; solution in HCl turns turmeric paper red-brown.
Carbonic.	White, soluble in HCl, *with* effervescence.	
Hydrofluoric.	White.	Heat with H_2SO_4, glass etched by fumes.

ACIDS.	SILVER NITRATE.	
	Precipitate.	
Hydrochloric.	White, insoluble in Ammonia.	
Hydriodic.	Yellow.	Pass Chlorine, add starch paste, a [deep blue.
Hydro-sulphuric.	Black.	
Hydrocyanic.	White.	Add HSO_4, and the odour of Prussic acid is evolved. The salts of Iron with HCl in excess give Prussian blue.
Nitric.		Add to solution equal quantity of H_2SO_4, then, with a solution of Green Vitriol, a black ring is formed where the liquids meet.

The student should work all these experiments, and when he is familiar with their results, he should have given to him various solutions, to determine their nature.

At the commencement of these lessons a few metals were arranged according to their atomicities. We now append the full list of the elements so arranged :—

Monatomic.

Bromine.	Fluorine.	Lithium.	Rubidium.
Cæsium.	Hydrogen.	Potassium.	Silver.
Chlorine.	Iodine.	Sodium.	Thallium.

Diatomic.

Barium.	Didymium.	Manganese.	Strontium.
Cadmium.	Glucinum.	Mercury.	Sulphur.
Calcium.	Iron.	Nickel.	Tellurium.
Cerium.	Lanthanum.	Oxygen.	Thorium.
Chromium.	Lead.	Palladium.	Uranium.
Cobalt.	Magnesium.	Selenium.	Zinc.
Copper.			

Triatomic.

Aluminum.*	Bismuth.	Gold.	Phosphorus.
Antimony.	Boron.	Nitrogen.	Rhodium.
Arsenic.			

Tetratomic.

Carbon.	Platinum.	Tantalum.	Titanium.
Niobium.	Silicon.	Tin.	Zirconium.

LESSONS IN GERMAN.—XLVII.

SECTION XCIX. (*continued*).—EXAMPLES ILLUSTRATING THE VARIOUS USES OF SOME CONJUNCTIONS AND ADVERBS.

Daher, damit, dann.

Die größte Wahr'scheinlichkeit der Erfül'lung läßt noch einen Zweifel zu; daher' ist das Gehoff'te, wenn es in der Wirk'lichkeit eintritt, je'derzeit überrasch'end. (Göthe.)	The greatest probability of (the) accomplishment (still) admits of (a) doubt; therefore it is that hope, when it becomes a reality, always surprises.
Heizen Sie schnell die Stube, damit' wir die nassen Kleider aus- und trock'ene an'ziehen können.	Warm the room immediately, that we may take off our (the) wet clothes, and put on dry (ones).
Erst bete, dann ar'beite.	First pray, then work.

Darum, deßwegen, deßhalb.

Nichts nennt er sein, als seinen Rit'termantel; darum sieht er jedes Bie'dermanns Glück mit scheelen Augen an. (Schiller.)	He calls nothing his, but a knight's cloak; he, therefore (*or*, on that account), looks upon every honest man's fortune with envy.
Das Wahre ist eine Fackel, aber eine ungeheu're; deß'wegen suchen wir Alle nur blinzend so daran' vorbei'zukommen. (Göthe.)	(The) truth is a torch, but an immense one; therefore we all attempt, only blinking at it, to pass by.
Der Haß ist ein acti'ves Miß'vergnügen, der Neid ein passi'ves; deßhalb darf man sich nicht wundern, wenn der Neid so schnell in Haß ü'bergeht. (Göthe.)	(The) hatred is an active displeasure, (the) envy a passive one; therefore one must not be surprised if (the) envy readily passes over into hatred.

Daß, demnach, denn.

Es ist kein Zweifel mehr, daß er uns betro'gen hat.	There is no longer any doubt that he has cheated us.
Wir sind schon fünf Stunden gegan'gen, und müssen demnach bald an der Stelle sein.	We have already walked five hours, and, accordingly, we must soon be at the place.
Ich kann Ihnen nichts sagen, denn ich weiß kein Wort davon'.	I cannot tell you anything, for I do not know a word about it.
Ich schätze ihn höher als Feldherrn, denn als Staatsmann.	I estimate him higher as a general than as a statesman.

Dennoch, dessenungeachtet, nichtsdestoweniger.

Philipp der Gü'tige war zu sehr Verschwen'der, um Schätze zu sammeln; dennoch fand Karl der Kühne in seiner Verlas'senschaft an Ta'felgeschirren, Juwe'len, Büchern, Tape'ten, und Leinwand einen grö'ßeren Vorrath auf'gehäuft, als drei reiche Für'stenthümer damals zusam'men besa'ßen. (Schiller.)	Philip the Kind was too great a prodigal to gather treasures; nevertheless Charles the Bold found in his inheritance a greater store of table-service, jewels, books, tapestry, and linen hoarded up, than three principalities together possessed at that time.

* Aluminum was erroneously classed as tetratomic in Lesson II.

Christ'ian der Vierte hatte sich in dem Vertra'ge von Kopenha'gen verbind'lich gemacht', ohne Zu'ziehung Schwedens keinen ein'seitigen Frieden mit dem Kaiser zu schließen, dessenun'geachtet wurde der Antrag, den Wal'lenstein ihm that, mit Bereit'willigkeit an'genommen. (Schiller.)	Christian IV. had bound himself, in the treaty of Copenhagen, not to conclude a partial peace with the emperor without the advice of Sweden; nevertheless, the offer which Wallenstein made him was accepted with the greatest readiness.
Doch versprach' er ihnen auf das Hei'ligste, daß diese Last sie nicht über vier Mo'nate mehr drücken solle; nichtsdestowe'niger blieben diese Truppen statt dieser vier Mo'nate, noch achtzehn im Lande. (Schiller.)	But he promised them, in the most sacred manner, that this burden should not oppress them more than four months; nevertheless, these troops remained in the land eighteen months instead of four.

Doch, ehe, endlich.

Er hat mich zwar oft belei'digt, doch kann ich ihm nicht böse sein.	It is true he has often offended me, yet I cannot be angry with him.
Ehe ich nach Hause gehe, werde ich zu Ihnen kommen.	I shall come to you before I go home.
Nachdem ich lange gewar'tet hatte, kam er endlich.	After I had waited for a long time, he came at last.

Entweder—oder.

Die Ue'brigen waren entwe'der bei dem geu'sischen Auf'stande mit den Waffen in der Hand gefan'gen, oder wegen ihres e'hemaligen Antheils an der Bittschrift des Adels, als Hoch'verräther ein'gezogen und verur'theilt worden. (Schiller.)	The remainder were either taken prisoners with their arms in their hands in the insurrection of the Gueux, or arrested and sentenced for high treason in consequence of their former participation in the petition of the nobility.

Falls.

Falls es regnen sollte, komme ich nicht.	In case it should rain, I shall not come.

Erst; dann, ferner; endlich, zuletzt.

Erst kamen drei Reiter, dann (ferner) folgte ein sin'gender Chor, und zuletzt' (endlich) auf vergol'detem Wagen die Braut und die Gäste.	First came three horsemen, then (farther) followed a singing choir, and at last (finally) the bride and the guests in (a) gilded carriage.

Folglich, gleichwohl.

Er ist mein Vater, folglich habe ich ein Recht auf seine Liebe und sein Vermö'gen.	He is my father, consequently I have a right to his love and his fortune.
Wir gingen vo'rige Nacht erst nach zwölf Uhr zu Bett; gleichwohl' waren wir morgens um sechs Uhr wieder auf.	We did not go to bed last night till after twelve o'clock; nevertheless we were up again at six o'clock in the morning.

Je—desto, jedoch.

Vergessen Sie nicht Ihr Versprech'en zu erfül'len; je eher, desto besser.	Do not forget to fulfil your promise; the sooner, the better.
Ich erwar'tete Ihren Sohn nicht, desto größer war aber mein Vergnü'gen, als er kam.	I did not expect your son, but my pleasure was so much the greater as he came.
Ich habe ihn gebe'ten, zu mir zu kommen, er hat es jedoch' nicht gethan'.	I requested him to come to me: he, however, has not done so.

Je nachdem, nämlich.

Sie werden belohnt' werden, je nachdem' Sie fleißig sind.	You shall be rewarded, according as you are industrious.
Alle seine Verwand'ten besuch'ten ihn, nämlich: sein Vater, zwei Schwestern, der Onkel und eine alte Tante.	All his relatives visited him; namely, his father, two sisters, his uncle, and an aged aunt.

Nicht nur—sondern auch.

Er hat ihm nicht nur sein Geld verspro'chen, sondern auch gege'ben.	He has not only promised him his money, but also given it.

Ob.

Ich habe ihm gera'then, es nicht zu thun; ob er aber meinen Rath befol'gen wird, ist zu bezwei'feln.	I have advised him not to do it; whether he will follow my advice, however, is doubtful (to be doubted).

So.

Wie der Vater, so der Sohn.	As the father, so the son.
Hätte mein Vater für mich gesorgt', so wie ich für dich sorge, so wäre ich was An'deres gewor'den, als ein Wirth.	Had my father assisted me as I do you, I should have become something better than an innkeeper.

Sonst.

Ein Wunder mußte gesche'hen, sonst fand sie nicht einmal' den Weg zu Euch. (Schiller.)	A miracle must have happened, else she had not so much as found the way to you.

Sowohl—als, or als auch.

Aber sowohl' die Lage, als die Befe'stigung der Stadt schienen jedem An'griffe Trotz zu bieten. (Schiller.)	But the situation, as well as the fortification of the town, seemed to bid defiance to every attack.

Um so.

Du hast es nicht gethan', und das ist mir um so lieber.	Thou hast not done it, and that is so much the more agreeable to me.

Ueberdies.

Er ließ in aller Eile die Fe'stungswerke seiner Residenz' aus'bessern, versah' sie mit Allem, was sie fähig machte, eine lange Bela'gerung aus'zuhalten, und nahm noch überdies' zwei tausend Spanier in seine Mauern auf. (Schiller.)	He caused the fortifications of his capital to be repaired in the greatest haste, furnished it with all that enabled it to stand a long siege, and besides took two thousand Spaniards within its walls.

Vielmehr.

Man mag nicht mit Jedem' leben, und so kann man auch nicht für Jeden leben; wer das recht ein'sieht, wird seine Freunde höchlich zu schätzen wissen, und seine Feinde nicht hassen, noch verfol'gen; vielmehr' erlangt' der Mensch leicht einen grö'ßeren Vortheil, wenn er die Vor'züge seiner Wi'dersacher gewahr' werden kann.	One cannot live with every one, neither can one live for every one; he who rightly perceives this will highly appreciate his friends, and neither hate nor persecute his enemies: much rather do men obtain with facility a greater advantage, when aware of the superior qualities of their adversaries.

Weder—noch.

Weder verlei'ten will ich Euch zu einem falschen Schritte, noch von einem falschen zurück'halten. (Göthe.)	Neither will I persuade you to a false step, nor keep back from a false one.

Weil.

Ich will nichts mit diesem Menschen zu thun haben, weil er ein Bö'sewicht ist.	I will have nothing to do with this man, because he is a villain.

Wenn, wenn nicht.

Ich würde mit Vergnü'gen zu Dir kommen, wenn ich hoffen könnte, Dich zu Hause an'zutreffen.	I would come to you with pleasure, if I could hope to find you at home.
Ich kann es nicht thun, wenn Sie mir nicht helfen.	I cannot do it, if you do not help me.

Wie.

Wie die Arbeit, so der Lohn.	As the work, so the reward.
Was hast du wie meine Sonne, wie meinen Himmel, wie meine Fluren, wie mein geschäf'tiges, rast'loses Leben? (Herder.)	What hast thou like my sun, like my sky, like my meadows, like my busy, restless life?

COMPARATIVE ANATOMY.—XVIII.

VERTEBRATA.

The previous lessons have prepared the student for the consideration of the Vertebrata, the last and greatest division of the animal kingdom.

In this division, as in others, the Divine Architect has followed out, in all the beauty which his every work evinces, that successive gradation from a comparatively simple to a more complex organisation. The Vertebrata are an extensive series of animals, which, though occupying earth, air, and water, and possessing wide differences in their general form, habits, and degree of intelligence, have yet certain characters in common by which the naturalist is enabled to classify them. The step between this and the previous division is not so sudden and complete as to create a distinct line of demarcation. It is by a gradual transition. On the very boundary line of the two divisions there is a little being which forms the connecting link between them, by partaking of the characters of both: this is the lancelet (*Amphioxus lanceolatus*), so named from its lanceolate form. It is found in the European seas, especially the Mediterranean. Its respiratory or breathing apparatus is that of an ascidian mollusc; but it has a rudimentary spine and a spinal marrow, which are decidedly vertebrate. It is this spine or backbone which constitutes the principal feature in the bases of classification. Every animal in possession of a spine, howsoever rudimentary or imperfect, must belong to this great division of Vertebrata. In proportion as the spine is found developed, so will be the other bones which complete the skeleton. Independently of these two characters, the Vertebrata are distinguished by a more highly organised breathing and circulatory apparatus. They possess a heart, and have red blood; they have a brain and spinal marrow; and a corresponding increase in the development of the emanating nerves. They are provided with sensory organs, such as those of hearing, sight, smell, taste, and touch. The anatomy of these several structures will be briefly reviewed under the respective sub-divisions of the Vertebrata.

This grand division is subdivided into five great classes:—Fishes, Amphibia, Reptiles, Birds, and Mammals.

FISHES.

In accordance with the plan previously followed, we must begin our description with that class which presents the lowest organisation—namely, fishes. They are the most extensively distributed throughout the globe, and the most numerous and prolific of the whole division. Wherever water abounds, in the familiar pond, or in the rippling stream of a narrow brook, in lake or river, sea or ocean, there are floating tenants possessing an almost infinite variety of shape and size, from the little minnow to the huge shark. Man, the other extreme of the vertebrate kingdom, unable to explore the waters at will, as he beholds the pond or lake whose gentle surface is scarcely ruffled, or the rugged waves of the mighty deep tossed to and fro in mountain masses, can form no conception of the vast numbers of living beings situated beneath, listlessly enduring the one, or revelling delighted in the other. The great Pacific, with the lesser ocean the Atlantic, had been traversed by a living chain ages before adventurous and enterprising man first thought of connecting shore to shore by means of a submarine electric cable; and the very power which a series of successive discoveries made him acquainted with lay buried in some of its depths.

The student may form a bare idea of their numbers, when informed that in the herring fishery off Lowestoft, in 1854, nineteen millions were caught in that single season.

It will naturally be surmised that the circumstance of fishes being destined to live in so dense a medium as water, their structure will indicate an especial adaptation to this kind of life. Their bodies present the shape which offers the least resistance to the opposing fluid, being smooth, more or less flattened, or rounded and tapering from the middle towards either extremity. They have no neck, the head joining the trunk immediately.

The body, by means of an air-sac contained in the interior, is rendered nearly of the same specific weight as the fluid in which it is immersed. Forming an ornamental protective covering to the surface of the body are numerous scales attached to folds of the skin, and overlapping each other by their free margins, like tiles on the roof of a house. These scales present a variety of shapes in different fishes; and also of consistence, from a mere membrane to a strong bony plate. Some fishes have no scales.

Fishes move themselves by means of fins, which serve the place of limbs in higher animals. The two anterior and posterior correspond respectively to the fore and hind legs. The anterior pair are called the pectoral fins. They are invariably situated on the breast, immediately behind the gills. Those situated on the belly are called ventral fins. The single fins are the dorsal (Fig. III., 1, 2), the anal (4), and the tail or caudal fins (7). These fins are supported by filaments of more or less power and flexibility. The fins differ in their number and size, and also in the nature of the rays or filaments which support them. The pectoral or ventral, or both, may be absent; or there may be no fins at all.

We must now briefly review the principal internal structures in the anatomy of the fish.

All fishes possess a more or less perfect skeleton, the chief element of which is the spine, or vertebral column. This occupies the axis of the body, and extends its whole length. It is composed, not of one single piece, but of a number of segments, connected together by means of a fibrous material. Each segment is made up of a number of parts.

The central piece (Fig. V., 1) is named the body. It is shaped like an hour-glass, with the two extremities hollowed out into conical cavities, which sometimes communicate. Several processes project from the body. Above and below there are two small processes (5, 6), which soon unite together, enclosing arch-shaped spaces; afterwards continuing onwards as single processes. These are named respectively the upper and lower spinous processes. The upper arch lodges a portion of the spinal marrow; the lower, the large artery of the trunk. Besides these there are two other processes (4, 4), the lateral or transverse, which project from each side of the body. The use of these spines is to give attachment to muscles, and afford them leverage in producing the requisite movements in locomotion. In the lowest fishes the vertebral column is represented merely by a continuous mass of a soft consistence, made up of the simplest form of cartilage, running through the whole length of the animal, and known as the dorsal cord. In the lancelet, previously mentioned, the spine consists of a series, from sixty to seventy in number, of very rudimentary segments. The spinal marrow extends the whole length of the column, but there is no trace of a skull or brain. Connected either with these spine segments, or their lateral processes, are a number of smaller processes called ribs. These, when complete, surround the body, enclosing and protecting the soft parts. They unite in front with a chain of bones resembling the breast-bone of higher animals. Sometimes the ribs are wanting.

There are other little bones which spring from the ribs and vertebræ—often very numerous, as in the herring.

The limits of this paper will not allow a description of the bones of the skull. They are numerous, and present a complex arrangement.

Teeth.—True osseous teeth are found in all the classes of the Vertebrata except birds. The teeth of fishes are generally osseous and plentiful. They present in different fishes a variety of interesting forms. In the perch, they are so slender and minute as to resemble the pile of velvet. In the Chætodontidæ,* a family of bony fishes, the teeth resemble bristles, from whence they derive their name. These fishes are numerous on the rocky shores of warm climates, and are often beautifully and variously coloured. One species of this family, the *Chelmon rostratus*, an inhabitant of the shores of Asia, possesses the faculty of shooting insects with drops of water projected from the mouth, and seizing them as they fall.† The well-known pike (*Esox*) has its mouth crowded with innumerable teeth, both sharp and formidable.

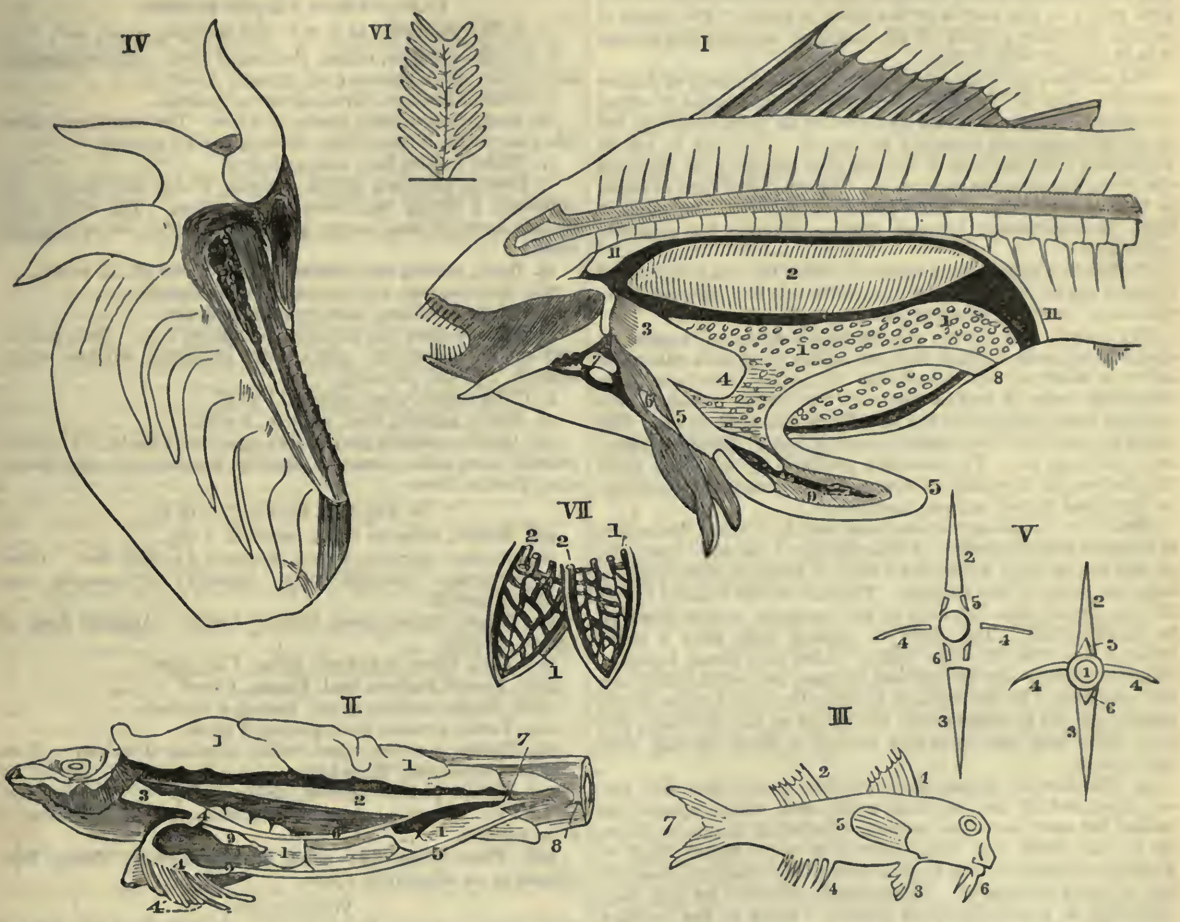
The teeth are attached to the bones surrounding the mouth by means of ligamentous tissue, but not in sockets, like those of the higher Vertebrata. They are frequently movable. There are two rows, generally, in the upper jaw, arranged in a parallel manner. The teeth of the shark are arranged in several rows, the anterior only being perpendicular; the remainder are recumbent. (Fig. V.)

* Χαιτη, a mane; οδους, a tooth. † Dr. Baird.

When Steno first examined the teeth of the shark, he was surprised to find a great number of teeth placed on the inside of each jaw, lying close to the bone. From their position and arrangement he thought they were useless. Herissant afterwards showed their use by proving that as the anterior teeth of each row are broken off, drop out, or wear away, the posterior ones come forward to supply their place. This act of renewal seems to be persistent during life. In most fishes the teeth are constantly changing, the older ones being succeeded by others developed in the neighbourhood. Some fishes—for example, the sturgeon—are entirely toothless.

kept apart by means of an intervening elastic substance; liver, large; spleen, invariably present; and kidneys likewise.

The *breathing apparatus* consists of a number of loose fringes or gills suspended in cavities, and attached to bony or cartilaginous arches; three or four, or more, being fixed on each side of the neck. Matteucci estimated the surface of the gills of the common ray to measure 2,250 square inches. The cavity in which the gills are suspended communicates both with the mouth and the outer surface of the body. The water is taken into the mouth, forced through the inner aperture of the gill cavity, where it comes into contact with the gill fringes, bathing them



I. Diagram of the general arrangement of the Viscera of a Fish. II. Diagram of arrangement of the Viscera of a Herring. III. Diagram showing the Fins of a Fish (after Knox). IV. Diagram showing the perpendicular position of the Upper Teeth, and the recumbent position of the Lower Teeth in the Jaws of the Shark. V. Vertebræ of a Fish (after Rymer Jones). VI. Diagram showing divided Gill of a Fish. VII. Capillary net-work of a pair of Leaflets of the Gills of an Eel (after Carpenter).

Ref. to Nos. in Figs. I., II.—1, ovary; 2, air-bladder; 3, œsophagus or gullet; 4, stomach; 4′, pyloric cæca; 5, 5, intestine; 6, liver; 7, oviducts; 8, anus; 9, spleen; 10, heart; 11, kidney and urinary passage. III. 1, 2, the first and second dorsal fins; 3, ventral fin; 4, anal fin; 5, pectoral fin; 6, feelers; 7, caudal fin. V. 1, body or central piece; 2, spinous process; 3, inferior spinous process; 4, lateral or transverse processes; 5, nerve-processes and arch; 6, hæmal processes and arch. VII. 1, 1, branches of the branchial artery conveying venous blood; 2, 2, branches of the branchial vein returning aërated blood.

The *alimentary canal* consists of a simple tube, which passes nearly straight through the body. The gullet is short and muscular, and the stomach large, separated from the intestine by a small valve or curtain. Sometimes the stomach, as in the herring (Fig. II., 4′), presents a series of tubular prolongations, which terminate in blind extremities.

The inner membrane of the shark's intestine is arranged in deep spiral folds, which wind from end to end. The compartments between the spiral layers communicate through a small aperture in the centre of each valvular projection. The object of this spiral arrangement is to increase the surface over which the nutrient material of the food has to pass. The valves are

freely, thus aërating the blood which circulates through the minute blood-vessels of the leaflets (Figs. VI., VII.). The water is then expelled through the outer aperture, which is guarded by a valvular curtain.

Most fishes possess an air-bladder, which frequently communicates with the gullet or stomach. It is furnished with a muscular apparatus to regulate its capacity, so as to increase or diminish the specific gravity of the animal. Some anatomists consider it to be homologous to the lungs. Its principal use, however, is, as Willoughby long ago (1686) pointed out, to bring their bodies to an equilibrium with the element in which they swim, to enable them to impel or move themselves in any direction. Fishes occupying the deep stratum of water have no air-bladder—such as the well-known fishes the skate, sole, turbot, and eel.

The circulatory apparatus consists of a heart with a double cavity and blood-vessels. The upper cavity, the auricle, is thin-walled, and receives the blood from the veins. The lower cavity, the ventricle, is thick and fleshy. By contracting upon the blood it drives it to the gills to be aërated, and thence into the large vessel and system.

Nervous System.—The brain of fishes is small, and made up of a single and three pairs of little masses of nervous matter. The single one is named the cerebellum. The anterior masses give origin to the nerves of the sense of smell. The organ of smell is the same as that of air-breathing animals, except that it is in contact with water.

The middle pair of masses represents the cerebrum of higher animals. The posterior afford origin to the nerves of sight. The shape of the eye varies considerably in different fishes, but in all the transverse diameter is largest. The size is not in proportion with the body of the fish—for example, the salmon's eye is smaller than the haddock's. The eye is flattened in front, so that in some fishes it is almost half a sphere. The pupil is large, so as to take in as much light as possible, but generally motionless.*

The hearing apparatus is enclosed within the head, having no external ear or auditory canal, for collecting and conveying the vibrations by which sound is produced and transmitted.

The torpedo and electric eel (*Gymnotus electricus*) possess an electrical apparatus, which they can discharge at will, communicating a shock to any animal with which they come in contact. Humboldt tells us that he has seen two horses killed in five minutes when exposed to the attacks of the electric eel. The latter is a native of the warmer parts of South America, Demerara, Surinam, etc. The sensation produced by the shock from the electric fish is exactly that caused by accumulated electricity as developed by the ordinary machine.

The *roe* or *ovary* may be single or double. When distended, it occupies a large portion of the abdominal cavity. The milt, or soft roe of male fishes, has a similar position, and equals in bulk the ovary of the females. They are to the unaided eye so like the female, that it is only in the spawning season they can be distinguished. The ovary is nothing more than a membranous bag, with its inner lining folded into broad festoons, wherein the eggs are formed and retained until sufficiently ripe for expulsion. In the eel and lamprey the eggs escape by the rupture of the membrane into the cavity of the abdomen, and from which they pass outwards through a small opening close to the anus.

In the osseous fishes, the eggs first escape into the sac, and pass out by means of a small duct which opens just behind the anus, as in the herring. In the cartilaginous fishes, as in the shark and ray, there is a much higher type of generative function. The eggs are extremely numerous, amounting to many thousands. Leuwenhoeck counted no less than 9,384,000 in a middling-sized codfish. Even in the common herring 60,000 eggs have been found in a single female. The parent fish usually selects shallow water for the deposition of her eggs; this done, her maternal duties and anxieties for her offspring terminate.

CLASSIFICATION.—The best classification of fishes is that adopted by Professor Huxley, viz., into six orders:—

1. *Dipnoi.*—An order of fishes which breathe both by lungs and gills. This order contains only the "mudfish," Lepidosiren and Rhinocryptis.
2. *Elasmobranchii.*—Sharks, rays, and Chimæræ belong to this order.
3. *Ganoidei.*—An order of fishes mostly extinct. It includes the sturgeons and bony pikes.
4. *Teleostei.*—Fishes with completely ossified skeletons.
5. *Marsipobranchii*, which includes the lampreys and hags.
6. *Pharyngobranchii.*—The order of fishes represented by the amphioxus, in which the perforated pharynx performs the function of gills.

Before closing the paper, it is well to remark that though fishes may be the lowest type of the vertebrate series of animals, yet they have the ascendancy over their superior kindred in point of antiquity. Geologists tell us that they were the first of the vertebrals that appeared on the earth, and at an epoch long antecedent to the deposits in which the remains of the higher animals are found; and that they possessed equally as high an organisation as the highest fishes of the present day.

* The eel has a transparent horny convex covering at some distance before the eye, to defend it from external accident.

LESSONS IN LATIN.—XXXVIII.

DEVIATIONS IN THE THIRD CONJUGATION.

1. *Perfect in* -SI; *Supine in* -SUM.

a. The stem ends in *d* or *t*: for example, *claud*, *mit*.

i. Claudo, claudere, clausi, clausum, *I shut*. The compounds have clūdo, clūsi, clūsum; as, includo, *I shut up*.

ii. Divīdo, dividere, divisi, divisum, *I divide*.

iii. Læde, lædere, læsi, læsum, *I injure*. The compounds have lido; as, illido, illidere, illisi, illisum, *I strike against*.

iv. Lūdo, ludere, lusi, lusum, *I play*.

v. Plaudo, plaudere, plausi, plausum, *I clap my hands*. So applaudo, *I signify approbation by clapping*. The other compounds have -ōdi, -osi, -osum; as, explōdo, *I drive out by clapping hands*.

vi. Rado, radere, rasi, rasum, *I graze, shave* (E. R. *razor*).

vii. Rodo, rodere, rosi, rosum, *I gnaw, slander*.

viii. Trūdo, trudere, trusi, trusum, *I thrust*.

ix. Vādo, vadere (no perfect, no supine), *I go*. Both perfect and supine are in the compounds; as, evādo, evadere, evasi, evasum, *I go out, get away*.

x. Cedo, cedere, cessi, cessum, *I yield*.

xi. Mitto, mittere, misi, missum, *I send*.

xii. Quatio, quatere (no perfect), quassum, *I shake*. The compounds have cutio, cussi; as, decŭtio, decutere, decussi, decussum, *I shake down*.

b. The stem ends in *g*, *c*, or *ct*.

xiii. Mergo, mergere, mersi, mersum, *I dip*.

xiv. Spargo, spargere, sparsi, sparsum, *I scatter, sow*. Compounds, spergo, spergere, spersi, spersum: for example, conspergo, *I sprinkle*.

xv. Tergo, tergĕre, tersi, tersum, *I wipe*. Another form of tergeo, tergēre.

xvi. Figo, figere, fixi (figsi), fixum, *I fix, fasten*.

xvii. Flecto, flectere, flexi, flexum, *I bend*.

xviii. Necto, nectere, nexui, nexum, *I tie, knit*.

xix. Pecto, pectere, pexi, pexum, *I comb*.

xx. Plecto, plectere, plexi (rare), plexum, *I weave*. Here may be placed, also, these two:—

xxi. Premo, premere, pressi, pressum, *I press*. Compounds, prĭmo; as, comprĭmo, comprimere, compressi, compressum, *I press together*.

xxii. Fluo (stem, flu; noun, fluvius, *a river*), fluere, fluxi (fluxus as an adjective), *I flow*.

VOCABULARY.

Cachinnatio, -onis, f., *a loud laugh*.
Committĕre, *to commit, do*.
Concedĕre, *to concede, grant*.
Connectĕre, *to connect, put together*.
Copulare, *to bind in couples, to bind together*.
Corradĕre, *to scrape together*.
Deludere, *to delude, deceive*.
Discludere, *to shut apart, separate*.
Elidĕre, *to dash against*.
Eludere, *to insult, scoff at*.
Histrio, -ōnis, m., *a player*.
Imprimĕre, *to print, impress*.
Janus, -i, m., *Janus (Dianus), a Roman divinity*.
Libra, -æ, f., *a pound*.
Locare (in and abl.), *to place*.
Modius, -i, m., *a bushel*.
Numa, -æ, m., *Numa, the Roman king of that name*.
Perpetuitas, -ātis, f., *perpetuity, duration, durability*.
Præcordia, -orum, n., *the diaphragm*.
Regnum, -i, n., *a reign*.
Viritim, *man for man, among the men*.

EXERCISE 141.—LATIN-ENGLISH.

1. Templum Jani bis post Numæ regnum clausum est. 2. Si ridēre concessum sit, vituperatur tamen cachinnatio. 3. Si concessĕris esse Deum, confitendum tibi est, ejus consilio mundum administrari. 4. In omnium animis Dei notionem impressit Deus ipse. 5. Magna vis est conscientiæ, ut qui peccārint, pœnam semper ante oculos versari putent. 6. Virtutes ita copulatæ, connexæque sunt, ut omnes omnium partic̆ipes sint. 7. Cæsar populo præter frumenti denos modios ac totidem olei libras, trecenos quoque nummos viritim divisit. 8. Qui diffĭdit perpetuitati bonorum suorum, ei timendum est, ne aliquando, amissis illis, sit miser.

Exercise 142.—English-Latin.

1. My house was shut yesterday. 2. I will shut thy house. 3. The temple is being shut. 4. The temple will have been shut. 5. The boy has been shut out of the school. 6. They concede that there is a God. 7. They must confess that there is a God. 8. God has impressed an idea of himself on all minds. 9. I will divide a hundred bushels of wheat (*among them*), man for man (100 *bushels to each man*). 10. Are not the virtues united together? 11. He who distrusts in God must fear that he may some time be miserable.

Vocabulary.

Apud Mantineam, *at the battle of Mantinea.*	Diffluĕre, *to flow abroad.*	Exanimare, *to kill, pass., to lose one's life, die.*
Calīgo, -ĭnis, f., *darkness.*	Discutĕre, *to scatter, frustrate.*	Exsibilare, *to hiss off.*
Clypeus, -i, m., *a shield.*	Dispergere, *to scatter abroad.*	Extrudere, *to push out.*
Concludĕre, *to enclose.*	Dispicio, -spexi, -spectum, *to open the eyes.*	Fugare, *to put to flight.*
Confluĕre, *to flow together.*	Dissipo, 1, *I spread abroad.*	Hasta, -æ, f., *a spear.*
Defigĕre, *to fasten* (in aliquâ re).	Emergĕre, *to come up (out of the water), emerge.*	Mobĭlis, -e, *movable.*
Deflectere, *to bend down, turn on one side.*	Exagitare, *to torture.*	Nebula, -æ, f., *a cloud.*
Demergĕre, *to sink, to let down.*		Quondam, *formerly.*
Detrudĕre, *to push* [*down.*		Salvus, *safe, saved.*
		Stimulus, -i, m., *a goad.*
		Transfigere, *to pierce, stab.*
		Ut primum, *as soon as.*

Exercise 143.—Latin-English.

1. Te in tantum luctum et laborem detrusum esse graviter doleo. 2. Cur ædibus istum extrusisti? 3. Spero amicum ægrotum e morbo evasurum esse. 4. Si animus e corpŏre evasĕrit, tum demum vivet et vigebit. 5. Sole orto, caligo discussa est. 6. Omnia pericula, quæ urbi impendebant, ducis fortitudo et consilium discussit. 7. Marius senile corpus paludibus demersum occultavit. 8. Animus cœlestis ex altissimo domicilio depressus, et in terram quasi demersus est. 9. Leges perlongum tempus hostium vi dimersæ, tandem emerserunt. 10. Deus immortalis sparsit animos in corpora humana. 11. Omnia quæ nunc artibus conclusa sunt, quondam dispersa et dissipata fuerunt. 12. Epaminondas apud Mantineam gravi vulnere cecidit. 13. Epaminondas quum superasset Lacedæmonios apud Mantineam, atque ipse gravi vulnĕre exanimari videret, ut primum dispexit, interrogavit salvus ne esset clypeus.

Exercise 144.—English-Latin.

1. Where will Marius hide himself? 2. Marius has hidden himself in the marsh. 3. Will the soldiers hide their bodies in the marsh? 4. The minds of men have been let down from heaven to the earth. 5. The men who were sunk have come up. 6. The soldier loses his life by that heavy wound. 7. I saw two men die in battle, being pierced with spears. 8. The dying soldier opened his eyes, and asked if the enemy were scattered. 9. All other things but God are perishing; God remains, and ever will remain, fixed in the deep (*altus*) roots of his own life. 10. The young man has turned aside from the way of virtue. 11. The clouds are scattered, the sun has shone forth. 12. God has scattered the seeds of virtue in all minds.

Fabula.—Pavo.

Pavo[1] graviter[3] conquerebatur[2] apud[4] Junonem,[5] dominam[7] suam,[6] quod[8] vocis[10] suavitas[9] sibi[12] negata esset;[11] dum[1] luscinia,[2] avis[3] tam[4] parum[5] decōra,[6] cantu[8] excellat.[7] Cui[1] Juno,[2] "et[4] merito,"[5] inquit;[3] "non[7] enim[6] omnia[9] bona[10] in[12] unum[13] conferri[11] oportuit."[8]

Vocabulary.

Apud, *before.*	Juno, -ōnis, *Juno, a Roman female divinity, the queen of heaven.*	Nego, 1, *I deny.*
Confero, 3, *I bestow.*	Luscinia, -æ, f., *a nightingale.*	Oportet (perfect, oportuit), *it is right, becoming.*
Conquĕror, 3, *I complain.*		Pavo, -ōnis, m., *a peacock.*
Et merito, *and deservedly, properly so too.*		

Fabula.—Anseres et Grues.

In eodem quondam prato pascebantur anseres et grues. Advenienti domino prati, grues facile avolabant; sed anseres, impedīti corpŏris gravitate, deprehensi et mactati sunt.—Sic paupĕres cum potentioribus in eodem crimine deprehensi, soli dant pœnam, dum illi salvi evādunt.

Vocabulary.

Crimen, criminis, n., *an accusation, crime.*	Impedio (pes, *a foot*), 4, *I hinder.*	Potentior (comparative of potens), *more powerful.*
Dare pœnam, literally, *to give punishment;* that is, *to suffer punishment.*	Macto, 1, *I slaughter.*	Pratum, -i, n., *a meadow.*
Deprehendo, 3, *I catch.*	Pascor, pasci, pastus sum, *I feed.*	Quondam, *formerly.*
	Pauper, -ĕris, *a poor man.*	

Construction of "Dare Pœnam," etc.

Pœna, from the Greek ποινη (*poi'-ne*), originally denotes the sum of money by which impunity was purchased, or satisfaction was given to the injured. Hence it meant, in general, redemption-money, or the means of escape; a penalty, or the suffering undergone in consequence of a crime. But as the root-idea is that of a fine or mulct, so the guilty were said to give the payment or punishment (dare pœnam), and the injured to take payment or punishment (sumere pœnam). The plural of the nouns is also used. Accordingly, we have two classes of expression, the instances of which come under :—

To give punishment, i.e., *to be punished.*	To take punishment, i.e., *to punish.*
dare pœnam, or pœnas, *to give the penalty.*	sumere pœnam, or pœnas, *to take the penalty.*
solvere pœnas, *to pay the penalties.*	suscipere pœnas, *to take the penalties.*
pendere pœnas, *to pay the penalties.*	petere pœnas, *seek, or require the penalties.*

One or two other forms which appear in the following exercise will now be readily understood.

Vocabulary.

Calidus, -a, -um, *hot.*	Repeto, 3, *I seek, require.*	Scelerātus, -a, -um, *wicked.*
Maledictum, -i, *a curse.*	Reus, -i, m., *an accused person.*	Temeritas, -ātis, f., *rashness.*
Pœni, -orum, m., *the Carthaginians.*		

Exercise 145.—Latin-English.

1. Repetit pœnas filio pater justus. 2. Reum mulctavit mulctâ maximâ civem judex. 3. Avum annis debilem affecit consul gravi pœnâ. 4. Pœnam dignam ejus scelere capere non potuit Cicero. 5. Vobis victi Pœni pœnas sufferant. 6. Maximas pœnas pendo temeritatis meæ. 7. Pro vestris maledictis pœnæ pendentur mihi hodie. 8. Calido dabis sanguine pœnas. 9. Pœnas gravissimas ex sceleratis hominibus sumseruut judices.

Exercise 146.—English-Latin.

1. I will inflict punishment on bad boys. 2. Bad boys will be punished. 3. Bad boys will have to suffer punishment suitable to their evil deeds. 4. The judge punished the criminals very severely. 5. Being conquered, you will suffer punishment from (Lat. *to*) the conquerors. 6. I have been punished. 7. I will punish them.

KEY TO EXERCISES IN LESSONS IN LATIN.—XXXVII.

Exercise 137.—Latin-English.

1. After I have dined, I shall take a walk. 2. We will dine to-morrow in the garden. 3. Did you not hear that we shall dine in the garden to-morrow? 4. As long as any hope remained in my mind, I fought for my country's liberty. 5. Now during three months have the enemies besieged our city. 6. I am not so iron-hearted as not to be moved (*I am not that iron-hearted one who is not moved*) by the tears of all these with whom you see me surrounded. 7. Many think that they will appear kind to their friends, if they enrich them in any way whatever. 8. Take care lest you decide concerning any matter before you have carefully investigated it. 9. Your letters grieved me greatly. 10. If any one has been bitten by a mad dog, madness seizes him. 11. As long as you were speaking, the boy listened most attentively (*hung upon your lips*). 12. Have you become liable for a friend? 13. I have become liable. 14. Many things, both in the senate and in the forum, were either prudently foreseen or actually replied to by Lælius. 15. Cicero relates that Dionysius, in order that he might not entrust his neck to a barber, taught his daughters to shave him; and so (he narrated) that in this filthy and menial office the royal virgins, as barber-girls, clipped the beard and hair of their father.

Exercise 138.—English-Latin.

1. Prandi. 2. Amici mei pranderunt. 3. Postquam amici mei pranderint, ambulabunt. 4. Audistine me in horto pransurum esse? 5. Audivi te a tonstricula tonsum esse. 6. Non est verum, tonsor me totondit. 7. Da mihi illam sicam. 8. Extorque sicarii sicam de manibus. 9. Mater paterque adolescentis interitum lugebunt. 10. Extorsi sicam servo de manibus. 11. Quid vides? 12. Video urbem circumsessam. 13. Patria nostra sapientia industriaque valde aucta est. 14. Bello industria sapientiaque potiores sunt.

Exercise 139.—Latin-English.

1. The leader soothed the excited minds of the soldiers with gentle words. 2. My mind was wonderfully delighted and soothed by reading the poems of Virgil. 3. So agreeable to me was the making of this book, that it removed all the irksomeness of old age. 4. I will not come to you before I have wiped away all my grief. 5. Has the table been wiped yet? 6. They burned 40,000 books at Alexandria. 7. I do not doubt that, in a short time, the whole of Germany will burn with war. 8. Who is there on whom fortune has always smiled?

9. I know not why I have been laughed at by you. 10. Thus have I persuaded myself, thus do I feel that our minds are not mortal. 11. Who believes that the citizens will object to peace? 12. Who is always confident that that which is frail and perishing will remain steadfast and firm? 13. The glory of the Romans has remained till our time. 14. Lycurgus commanded that all citizens should eat in common.

EXERCISE 140.—ENGLISH-LATIN.

1. Soleo de amicorum meorum fortuna gaudere. 2. Gavisi sunt. 3. Gaudebunt. 4. Sorores meæ gavisæ sunt. 5. Fortuna fortibus hominibus arridet. 6. Putasne fortunam fortibus arrisuram esse? 7. Nego fortunam fortibus semper arridere. 8. Deridet philosophum. 9. Cur philosophus a puero deridetur? 10. Non est dubium quin philosophi a stultissimis derisi sint. 11. Oratores student excitos civium animos permulcere. 12. Persuasum est mihi oratores excitos hominum animos permulcere debent. 13. Napoleone regnante, tota Europa bello arsit.

Fable.—The Kid and the Wolf.

A kid, standing on the roof of a house, abused a wolf who was passing by. To whom the wolf said, "Not you, but the roof has abused me." Place and opportunity often render timid men bold.

Fable.—The Crane and the Peacock.

A peacock, spreading out his feathers in the presence of a crane, said, "How great is my beauty and your ugliuess!" But the crane, flying forth, said, "And how great is my swiftness and your slowness!" This fable warns us not, on account of any good which Nature has allotted to us, to despise others, on whom Nature has bestowed other advantages, and perhaps greater ones.

THE UNIVERSITIES.—VI.

DUBLIN UNIVERSITY.—I.

THE University of Dublin differs in two important respects from the sister universities of Oxford and Cambridge. 1st. It consists of but one college, "The College of the Holy and Undivided Trinity." 2ndly. Residence is not necessary in order to obtain a degree.

The one college, however, in Dublin University is much larger and wealthier in endowments than any college in the other universities, having generally about 1,300 students on its books; and the non-requirement of residence enables persons of limited means, and who may be engaged in some occupation, to obtain a degree, who might not be able to do so at all if residence were a *sine quâ non.* In our remarks on this university, we propose first to explain, as simply as possible, the ordinary course required to obtain the B.A. and higher degrees, and then to enumerate the various rewards that can be obtained in Trinity College, and the encouragements in the way of prizes which are peculiarly acceptable to students of moderate means, as either affording them an opportunity to pass through college at a reduced rate, or giving them the means to meet the requisite expenses.

The first thing which one seeking for a degree wants to know is, how he is to become a member of the college, and therefore we commence with an explanation of the mode of "entrance," or "matriculation," as it is technically called. Every candidate for entrance into Trinity College, Dublin, must pass the "Entrance Examination," which is usually held in the months of January, April, June, October, and November. The precise dates are given each year in the University Calendar, or can be obtained by application to "The Senior Lecturer, Trinity College, Dublin." Before "entering," each candidate has to select some one of the college tutors (who are always fellows) to be his tutor; not that he is in any ordinary sense to receive tuition from him, but the college tutor is the medium of communication between the student and the board during his college course, and is ready at all times to obtain information for and advise his pupils. There is no payment to the tutor further than what is included in the ordinary college fees, to which we shall presently refer.

Having resolved to enter, and selected and been accepted by a particular tutor, the candidate presents himself for entrance, and is examined in the following course:—Latin and English Composition, Arithmetic, English History, Modern Geography, Algebra (the first four rules and fractions), Euclid (Books i., ii., and iii.), and any two Greek or Latin authors from the following list:—

Greek.

1. Homer, "Iliad." Books i., ii., vi.
2. New Testament, Gospels of St. Luke and St. John, and the Acts.
3. Euripides, "Hecuba," or "Troades."
4. Sophocles, "Antigone."
5. Plato, "Apologia Socratis."
6. Lucian, Walker's "Selections."
7. Xenophon, "Anabasis." Books i., ii., iii.

Latin.

1. Virgil, "Æneid." Books i., ii., vi., vii.
2. Horace, "Odes."
3. Horace, "Satires" and "Epistles."
4. Sallust.
5. Livy. Books i., ii., iii., xxii. (any two of these).
6. Cæsar, "De Bello Gallico." Books i., ii. iii.
7. Cicero, "De Amicitia" and "De Senectute."

Having "passed" the entrance examination, the student becomes a Junior Freshman; and before we proceed to explain the rest of his course, we will mention the fees which have to be paid at entrance by ordinary students.

Each successful candidate must pay £15 within twelve days after his examination; and his half-year's fees, due on the 22nd of March and 22nd of September in each year, until he obtains his B.A. degree, are £8 8s. These charges include all payments of every kind for non-resident students. Those who reside in college have to pay additional fees for rooms, commons (*i.e.*, their dining in the "Common" Hall), and their personal expenses.

During his first year in college, a man is designated a Junior Freshman; during the Second, a Senior Freshman; during the third, a Junior Sophister; during the Fourth, a Senior Sophister; at the end of which he may pass his degree examination and become a B.A.

A "year" in university language does not mean a calendar year, but the period from October 10th to the following 30th of June; the remaining portion of the year being the long vacation. The college year consists of three "Terms." Michaelmas Term begins on the 10th of October and ends on the 20th of December; Hilary Term begins on the 10th of January and ends on the Feast of the Annunciation of the Virgin Mary; Trinity Term begins on the 15th of April and ends on the 7th of July.

Each of these terms can be "kept" by those who reside in or near college attending the Term Lectures, or by those who cannot attend lectures passing the Term Examination, which is held in the Examination Hall, and generally lasts two or three days. Having entered and been enrolled as a Junior Freshman, a student, to rise to the class of Senior Freshman, must keep one term at least *by examination.*

JUNIOR FRESHMAN CLASS.

The subjects for the ordinary examinations for the several terms in the Junior Freshman year are as follow:—

Hilary Term.

Mathematics.—Euclid, Books i., ii., iii., vi., and Definitions of Book v.; Arithmetic; Algebra, Elementary Rules.

Classics.—Olynthiac Orations of Demosthenes, Books i., ii.; Cicero, "Pro Milone."

*English Composition.**—Macaulay's Biographies of Goldsmith, Johnson, and Pitt.

Trinity Term.

Mathematics.—Euclid, as before; Arithmetic, as before; Algebra, to the end of Quadratic Equations; Trigonometry, to the end of solution of Plane Triangles.

Classics.—The "Medea" of Euripides; Books iii. and iv. of the "Odes" of Horace.

English Composition.—Clarendon Press Selections from Addison's "The Spectator Club."

Michaelmas Term.

Mathematics.—Euclid, Arithmetic, Algebra, and Trigonometry, as before.

Classics.—Book viii. of Herodotus to chap. 99, and Book xxi. of Livy.

English Composition.—Goldsmith's "Vicar of Wakefield."

Having kept one of the above terms by passing the examination, the student will become a Senior Freshman. The student can always ascertain from the calendar, or from his tutor, the dates fixed for the Term Examination.

To rise to the class of Junior Sophister, the student must pass the "General Examination of Senior Freshmen," held at

* The books named under this head at all the examinations are intended to supply subjects for English composition.

*

the commencement of Michaelmas Term. Before, however, he will be allowed to go up for this examination, he must have kept three terms as a Freshman: one of these (as already pointed out) must be by passing a Term *Examination* in his Junior Freshman year; one must be in the Senior Freshman year, either by passing the Term Examination or attending the Term Lectures; and the third may be in either year, kept either by lectures or examination. The lectures delivered during one term are on the subjects which form the examination of the following term. We subjoin here a list of the subjects of examination for each term in the Senior Freshman year, including the Michaelmas Examination, which must be passed by all students to rise from the Senior Freshman to the Sophister Class:—

SENIOR FRESHMAN CLASS.

Hilary Term.

Mathematics.—Same as in the Junior Freshman year.
Logic.—Abbott's "Elements of Logic."
Classics.—Plato's "Apologia Socratis," and "The Orations of Cicero against Catiline."
English Composition.—Johnson's "Lives of Dryden and Pope."

Trinity Term.

Mathematics.—Same as before.
Logic.—Same as before.
Mathematical Physics.—Galbraith and Haughton's "Statics."
Classics.—Sophocles, "Œdipus Tyrannus;" Terence, "Adelphi."
English Composition.—Scott's "Ivanhoe."

Michaelmas Examination.

Mathematics.—Same as before.
Logic.—Same as before.
Mathematical Physics.—Statics, as before; Galbraith and Haughton's "Dynamics."
Classics.—Homer, "Iliad," Books xxii., xxiv.; Virgil, "Æneid," Books iv., vi.
English Composition.—J. S. Mill's Inaugural Address at St. Andrew's University.

In addition to the examinations already explained, all students (except Roman Catholics and Dissenters) must pass four Catechetical Examinations, one of which must be in the Junior Freshman year, and two in the Senior Freshman year. The Catechetical Examinations are held each term immediately after the Ordinary Term Examinations, in the following subjects:—

JUNIOR FRESHMEN.

Hilary Term.—The Gospel according to St. Luke.
Trinity Term.—The Acts of the Apostles.
Michaelmas Term.—Secker's "Lectures on the Creed."

SENIOR FRESHMEN.

Hilary Term.—Genesis, and the first twelve chapters of Exodus.
Trinity Term.—The two Books of Samuel; 1 Kings, ch. i.—xii.
Michaelmas Term.—Paley's Evidences, part i., proposition i.

Before being allowed to present himself for his B.A. examination, which is held in the Michaelmas Term of the Senior Sophister year, the student must have kept one term *by examination* in his Junior Sophister year, and one term (either by examination or lectures) in his Senior Sophister year, and one in either Senior or Junior Sophister year (either by examination or lectures).

The subjects for examination during the Junior Sophister year are:—

Michaelmas Lectures and Hilary Examination.

Classics.—Thucydides, Book ii.; Tacitus, "Annals," Book xi.
Mathematical Physics and Astronomy.—Mechanics as in Senior Freshman year; Galbraith's "Hydrostatics and Optics."
Logic.—Abbott's "Elements of Logic."
French.—Molière's "Misanthrope."
German.—Goethe's "Hermann."
English Composition.—Macaulay's Essays on Addison and Clive.

N.B.—At the examinations in the Junior and Senior Sophister years, two languages only out of the four need be taken.

Hilary Lectures and Trinity Examination.

Classics.—Homer, "Odyssey," Books vi. and xi.; Juvenal, "Satires," iii., viii., x., xiii.
Mathematical Physics and Astronomy.—Mechanics, Hydrostatics, and Optics, as before; Brinkley's Astronomy (New Edition), chaps. i. to xiii., both included.
Logic.—Abbott's "Elements of Logic."
French.—Racine's "Britannicus."
German.—Lessing's "Minna."
English Composition.—Shakespeare's "Macbeth" and "As You Like It."

Trinity Lectures and Michaelmas Examination.

Classics.—Æschylus, "Prometheus Vinctus;" Horace, "Satires."
Mathematical Physics and Astronomy.—As before.
Logic.—Locke's "Essay," Introduction; Book ii. to chapter xxvi. inclusive (omitting sections 10—20 of chapter i., sections 10 to end of chapter xiii., chapter xv., and sections 11—71 of chapter xxi.); Book iii. (omitting chapters vi. to ix.).
French.—Guizot's "Civilisation en Europe."
German.—Goethe's "Gedichte." (Ed. Selss.)
English Composition.—Mill "On Liberty."

Those Junior Sophisters who desire to do so may present themselves for examination in a course of Experimental Science, or in a course of Natural Science, *instead of* in the classical course given above:—

EXPERIMENTAL SCIENCE.

Hilary Examination.

Heat.—1. Dilatation of Solids, Liquids, and Gases. 2. Specific and Latent Heat. 3. Radiation and Conduction of Heat.

Trinity Examination.

Electricity.—Fractional and Voltaic Electricity. *Heat.*—As before.

Michaelmas Examination.

Heat.—As before. *Electricity.*—As before. *Magnetism.*

Atkinson's Translation of Ganot's Treatise on Physics is recommended to the student.

NATURAL SCIENCE.

Hilary Examination.

Zoology.—Macalister, Invertebrates, London Science Class Book Series: Protozoans and Polyps.
Botany.—Prantl, Elementary Text Book of Botany (2nd Edition, by S. H. Vines), Parts I. and II.

Trinity Examination.

Zoology.—Macalister, Invertebrates, London Science Class Book Series: Worms and Molluscs.
Botany.—Prantl, Elementary Text Book of Botany (2nd Edition, by S. H. Vines), Parts I., II., III.

Michaelmas Examination.

Zoology.—Macalister. Invertebrates, London Science Class Book Series: Articulates; with the Demonstrations of the Professor.
Botany.—Prantl, Elementary Text Book of Botany (2nd Edition, by S. H. Vines), Parts I., II., III., IV.; with the Demonstrations of the Professor.

In the Senior Sophister year there are seven distinct courses, headed—Astronomy, Ethics and Logics, Mathematical Physics, Experimental Science, Natural Science, Classics, or Languages, and English Composition, as given below.

Students in general must answer in the course headed Astronomy, Ethics and Logics, and English Composition, and in *any two* of the four remaining courses which they may prefer.

Students, however, who have credit for full attendance on the Professional Lectures in the Schools of Divinity, Law, Physics, or Engineering, in any term, will, at the subsequent examination, be required to answer in *one* only of the four remaining courses, in addition to Astronomy, Ethics and Logics, and English Composition.

At the Degree Examination, no student can claim this privilege unless he has credit for full professional attendance for the actual year in which he presents himself for his Degree.

Students taking up Languages may select *any two* of the four Languages, Greek, Latin, French, and German. A student selecting French or German will be required to write a translation from English into French or German.

Michaelmas Lectures and Hilary Examination.

1. *Astronomy.*—As in Junior Sophister year.
2. *Ethics and Logics.*—Stewart's Outlines of Moral Philosophy, Part ii.; Locke, as in Junior Sophister year, with Book iv., chapters i. to xi., both included (omitting chapter vii.).

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3. *Mathematical Physics.*—Mechanics, Hydrostatics, and Optics, as in Junior Sophister year.
4. *Experimental Science.*—The Experimental Physics of the Junior Sophister year; Reynolds' Experimental Chemistry, Parts i. and ii.
5. *Natural Science.*—Geology—Huxley, Physiography. Zoology—Macalister, Vertebrates, London Science Class Book Series: Fishes. Botany—Thomé, Text Book of Botany: Algæ and Fungi.
6. *Classics or Languages.*—*Greek*—Aristotle, Nicomachean Ethics, Book ii. *Latin*—Cicero de Officiis, Book i. *French*—V. Hugo, Les Crépuscules. *German*—Schiller, W. Tell.
7. *English Composition.*—Milton, Comus, and Paradise Lost, Books i. and ii.

Hilary Lectures and Trinity Examination.

1. *Astronomy.*—As before.
2. *Ethics and Logics.*—Stewart, as before; Locke, as before; Butler's Analogy, Introduction, and Part i. (omitting chap. i.); Butler's Dissertation on Virtue.
3. *Mathematical Physics.*—As before.
4. *Experimental Science.*—The Experimental Physics of the Junior Sophister year, as before; Reynolds' Experimental Chemistry, Parts i., ii., and iii.
5. *Natural Science.*—Geology—Haughton's Manual of Geology: the chapters relating to Fossils. Zoology—Macalister, Vertebrates, London Science Class Book Series: Reptiles and Birds. Botany—Thomé, Text Book of Botany: Mosses and Ferns.
6. *Classics or Languages.*—*Greek*—Plato, de Republicâ, Book i. *Latin*—Virgil, Georgics, i., iv. *French*—Montaigne, Essais, ii., chap. xii. *German*—Heine, Buch der Lieder.
7. *English Composition.*—Carlyle's Essays on Johnson, Burns, and Scott.

Trinity Lectures and Michaelmas (Degree) Examination.

1. *Astronomy.*—As before.
2. *Ethics.*—Stewart and Butler, as before; Butler's Sermons, Preface and Sermons, i., ii., iii., viii., ix.
3. *Mathematical Physics.*—As before.
4. *Experimental Science.*—As before.
5. *Natural Science.*—Geology—Huxley and Haughton, as before. Zoology—Macalister, Vertebrates, London Science Class Book Series: Mammals. Botany—Thomé, Text Book of Botany: Flowering Plants.
6. *Classics or Languages.*—*Greek*—Demosthenes, de Coronâ (omitting Documents cited). *Latin*—Tacitus, Annals, Book xiv. *French*—Boileau, Satires. *German*—Schiller, Abfall der Niederlande.
7. *English Composition.* — Shakespeare, Julius Cæsar and The Tempest.

The students in the different classes will be examined in the above course both by papers and *vivâ voce*; and, in the translation of selected passages from the classical authors, separate weight will be allowed for the style of the English Composition.

CIVIL SERVICE PAPERS.—II.

GROUP I. (*continued*).

4.—FOREIGN OFFICE, ST. JAMES'S PARK. (*Nomination.*)

THIS office carries on all the administrative business of the state in its relations with foreign countries; pursues the policy of the Foreign Secretary for the time being to its practical end—as the oversight of ambassadors, consuls, and all diplomatic agents of Great Britain. Age of admission for clerks, 18 to 24 (as regards those who have not a home in London or in the immediate vicinity, they must not be less than 20 years of age); for *attachés*, 20 to 26; consuls, 25 to 50; foreign service messengers, 25 to 35. Establishment as follows:—

Chief Clerk, £1,000 to £1,250; 5 Senior Clerks, £900 to £1,000; 7 Assistant Clerks, £700 to £800; 20 First Class Junior Clerks, £200 to £600; 4 Second Class ditto, £100 to £200; Librarian and Keeper of the Papers, £700 to £1,000; Sub-Librarian, £550 to £650; 2 First Class Clerks in Librarian's Department, £400 to £500; 2 Second Class ditto, £250 to £360; 4 Third Class ditto, £100 to £240; Superintendent of the Treaty Department, £700 to £1,000; Assistant in the Treaty Department, £550 to £650; Clerk in ditto, £250 to £360; 5 Clerks in Chief Clerk's department: 2 at £400 to £600; 1 at £400 to £500; 2 at £250 to £360; Translator, £250; Oriental Interpreter, £400; 10 Clerks, Lower Division, £80 to £200; Clerk in the Passport Office, £250; Private Secretary to the Secretary of State, £300; Précis Writer, £300; Printer, £150; Reader in the Printing Establishment, 40s. per week; Office-keeper (Resident), £250; ditto, £150; 6 ditto, £100 and £125.

Patronage in the Secretary of State for Foreign Affairs.

I. CLERKS.

Obligatory Subjects.

1. Orthography and Handwriting.
2. Arithmetic (including Vulgar and Decimal Fractions).
3. English Composition.
4. Précis Writing.
5. French.
6. Latin.
7. General Intelligence.
8. German.
9. Geography.

*Optional Subjects.**

10. History of Europe [Text-books, Michelet's "Précis de l'Histoire Moderne," and Dyer's "Modern Europe," last edit. 1789 to 1871.]
11. Constitutional History of England—Hallam (chap. xiii. to end); May.
12. Ancient Greek.
13. Spanish.
14. Italian.

II. CLERKS IN CHIEF CLERK'S DEPARTMENT.

1. Exercises designed to test Handwriting, Accuracy of Punctuation, and Orthography.
2. Arithmetic (including Vulgar and Decimal Fractions and the principles of Exchange).
3. Geography (a general knowledge).
4. Book-keeping by Double Entry (Elementary).
5. French (Translation).

III. ATTACHÉS.

1. Orthography.
2. Handwriting.
3. Précis Writing.
4. Latin (Grammar and Translation into English).
5. Arithmetic (the first four rules, and Decimals—Colenso).
6. Euclid (Book I.).
7. Geography.
8. French (Grammar, Translation, Conversation, and Dictation).
9. German (Grammar, Translation, Conversation, and Dictation).
10. Constitutional History of England [Text-books, Blackstone's "Commentaries" (Kerr's Edition of 1862), and Hallam's "Constitutional History of England"].
11. A general knowledge of the Political History of Europe and of the United States of North America, from the Treaty of Paris, in 1815, to the Treaty of Villafranca, in 1860, comprising an acquaintance with the most important international transactions during that period.
12. Political Economy [Text-books, Adam Smith's "Wealth of Nations," and Mill.]
13. General Intelligence, as evinced by the manner in which they acquit themselves under examination, and specifically by the quickness they may show in seizing the points in papers read by them or read over to them once or twice.

IV. THIRD SECRETARY.

Third secretaries who desire a certificate of having satisfactorily passed an examination in public law will be required to show a competent general knowledge of the ordinary rights and obligations of sovereign states in time of peace, and of belligerents and neutrals in war.

They will also be expected to be able to give an account of—(1) The nature and authority of international law; (2) The sources from which it is derived, the leading authorities (British and Foreign) on the subject, and the manner of referring to and applying those authorities; (3) The political constitution of the several States, and Unions of States, in Europe and America, so far as the constitution of each may affect its international relations; (4) The status, duties, and privileges of public ministers, and diplomatic agents; (5) The general principles of the law of nationality and of domicil.†

* *Only two Optional Subjects may be taken up—a Language and a History.*

† *The books recommended are Wheaton's "Elements of International Law;" Heffter, "Das Europäische Völkerrecht der Gegenwart," either in the Original German or in the French translation of Jules Bergson, and for* (5) *Westlake's "Treatise on Private International Law," Chapters I., II., III., with the Naturalisation Acts,* 33 *Vict. c.* 14, *and* 35 *and* 36 *Vict. c.* 39.

V. Translators to Missions.

Exercises in Translations from and into that language or those languages upon which the candidate is destined to be employed.

VI. Vice-Consul.

1. Arithmetic (including Vulgar and Decimal Fractions).
2. English Composition and Dictation.
3. French (written and spoken).
4. The language of the port at which the candidate may be appointed to reside.
5. British Mercantile and Commercial Law. [Text-book, Smith's "Compendium of Mercantile Law," Book II., chaps. i. to iv., Book III., chaps. i. to iv., and vii.]

GROUP II.

We now proceed to give the particulars of offices occupying a second, but still a high rank in the service. These are the Admiralty, Audit Office, India Office, Duchy of Lancaster Office, Local Government Board, Privy Council Office, Board of Trade, War Office, Woods and Forests, and Office of Works.

1.—The Admiralty, Whitehall and Somerset House.

(*Open Competition.*)

This department is charged with the preparation and maintenance in an efficient state of the navy of the kingdom. Head-quarters at Whitehall, branches at Somerset House. The dockyards and other naval establishments, at home and abroad, are under its management.

Establishment as follows:—

Secretary's Department.—On the Higher Division of the Establishment: Principal Clerk, £900 to £1,000 per annum (with allowance of £200 as Assistant Secretary); 3 Principal Clerks, £900 to £1,000; 6 Assistant Principal Clerks, £700 to £800; 10 Clerks, £200 to £600; 5 Clerks, £150 to £400. Lower Division: 26 Clerks, £95 to £250 (with duty pay to some).

Department of the Controller of the Navy.—Controller of the Navy, £1,700 (and allowance for house rent, £200); Director of Naval Ordnance, £1,000; Assistant to ditto, £600. *Constructive and Engineering Staff.*—Director of Naval Construction, £1,500 to £1,800 per annnm; Director of Dockyards, £1,500; 2 Chief Constructors, £600 to £850; 3 Constructors, £400 to £550; 7 Assistant Constructors, First Class, £300 to £450; 6 Second Class ditto, £160 to £240; 2 Third Class ditto, £100 to £150; Curator of Drawings, £150 to £200; 8 Draughtsmen, 6s. per diem; Engineer-in-Chief, £1,000 to £1,200; Engineer Assistant to Director of Dockyards, £500 to £650; Chief Inspector of Machinery, £500 to £650; 2 Engineer Inspectors, £400 to £500; Chief Engineer, £300 to £400; Engineer, £268; 2 Assistant Engineers, First Class, £300 to £450; 2 Second Class ditto, £160 to £240; 5 Draughtsmen, 6s. per diem. *Gun Mounting Staff.*—Engineer Inspector, £400 to £500; Assistant Engineer, Second Class, £160 to £240; 2 Examiners of Dockyard Work, £350 to £450; 2 Modellers, £3 6s. per week; Director of Stores, £800 to £1,000; 2 Examiners of Store Acconnts, £250 to £350. *Clerical Staff.*—On the Higher Division of the Establishment: 2 Principal Clerks, from £700 to £900 per annum; 7 Senior Clerks, from £400 to £650; 7 Clerks, from £100 to £500; 6 Clerks, £150 to £400; allowances to 2 Senior Clerks for acting as Principal Clerks in their absence, £50 each, and to one as Head of Gunnery Branch, £50; to a Clerk acting as Private Secretary to the Controller, £50. Lower Division: 26 Clerks, from £95 to £250 per annum (and duty pay); 5 Dockyard Writers, at 4s. to 8s. per diem and Subsistence Allowance.

Victualling Department.—Director of Victualling, £800 to £1,000 per annum. *Clerical Staff.*—On the Higher Division of the Establishment: 3 Senior Clerks, £400 to £650 per annum; 4 Clerks, £100 to £500. Lower Division: 13 Clerks, £95 to £250 (and duty pay).

Purchase and Contract Department.—Director of Navy Contracts, £1,200 per annum; Assistant Director of Navy Contracts, £700 to £900. *Clerical Staff.*—On the Higher Division of the Establishment: 3 Senior Clerks, £400 to £650 per annum; 1 Clerk, £100 to £500; 4 Clerks, £150 to £400. Lower Division: 11 Clerks, £95 to £250 per annum; Viewer of Coals in South Wales, £450 to £550; Custodian of Store Patterns, £260.

Medical Department.—Director-General of the Medical Department of the Navy, £1,300; Deputy Inspector-General of Hospitals, £766 (and allowances); Fleet Surgeon, £548 (and allowances). *Clerical Staff.*—On the Higher Division of the Establishment: 3 Senior Clerks, from £400 to £650 per annum; 1 Clerk from £100 to £500; 2 Clerks from £100 to £400 (and allowances). Lower Division: 9 Clerks, from £95 to £250 per annum.

Department of the Accountant General.—Accountant General of the Navy, £1,500 per annum; Deputy Accountant General, £1,200; Assistant Accountant General, £1,000. *Clerical Staff.*—On the Higher Division of the Establishment: 6 Superintendent Clerks, from £700 to £900 per annum; 16 Clerks, from £400 to £600 and £650; 10 Clerks, from £100 to £500; 4 Clerks, £150 to £400. Lower Division: 117 Clerks, from £95 to £250 per annum (duty pay to some of the above); 11 Boy Clerks, from 14s. to 19s. per week; 11 Writers from £80 to £170 per annum. Inspector of Yard Accounts, £700 to £800; Assistant ditto, £400 to £650; Professional ditto, £350 to £450; District Audit Staff, under reorganisation; Principal Dockyard Writers, £200 to £250; Dockyard Writers, from 4s. to 8s. per diem, and Subsistence Allowance.

Department of the Director of Transports.—Director of Transports, £1,000 per annum; Assistant Director of Transports, £700 to £900; Naval Assistant to Director of Transports, £700 to £800. *Clerical Staff.*—On the Higher Division of the Establishment: 3 Senior Clerks, from £400 to £650 per annum; 5 Clerks from £100 to £500. On the Lower Division of the Establishment: 9 Clerks from £95 to £250 per annum.

Department of the Director of Works.—Director of Engineering and Architectural Works, £1,300 per annum; Assistant Director of Works, £800; Surveyor, £700 to £800; Snrveyor of Coast Guard Buildings, £500 to £600; Inspector of Coast Guard Buildings, £300 to £400; 3 Accountant Clerks, £125 to £400; 3 Lower Division ditto, £95 to £250; 3 Draughtsmen, £150 to £400; 2 Lower Division ditto, £95 to £250; Modeller, 6s. 8d. per diem. *Clerical Staff.*—On the Higher Division of the Establishment: 1 Senior Clerk, from £400 to £600 per annum; 2 Clerks from £150 to £400; 3 Clerks from £95 to £250 per annum.

2.—Exchequer and Audit Office, Old Palace Yard.

(*Open Competition.*)

This is under the direct control of the Treasnry, and its business is to discharge the function of auditor to the public accounts. It is governed by a Comptroller and Anditor-General, an assistant, and a chief clerk.

The establishment is as follows:—

Directing Branch.—8 Inspectors, or Principal Clerks, including the Chief Clerk, £775 to £900; 7 First Class Clerks, £620 to £750; 19 Second Class Clerks, 1st section, £420 to £600; 28 ditto, ditto, 2nd section, £200 to £400. *Examining Branch.*—28 Examiners, 1st section, £215 to £400; 27 ditto, 2nd section, £100 to £200; 67 Lower Division Clerks, £80 to £200; Private Secretary, £150.

3.—India Office, St. James's Park. (*Open Competition.*)

Discharges all the administrative detail of the government of India in England. Presided over by a Secretary of State for India, who has the patronage of the department. Governed by two under-secretaries of State, an assistant under-secretary, and a council of fifteen members. There are also subordinate heads of departments, controlling branches charged with special duties. Clerks are divided into senior and junior sections, and there are also temporary clerks and copying-clerks. Book-keepers must pass the Lower Division examination, and have a satisfactory knowledge of book-keeping.

Secretary's Office.—1 Chief Clerk, £800; 1 Clerk, Fixed Station, £700; 1 ditto, £600; 1 Despatch Clerk, £400; Clerks, £100, rising £16 to £450; 1 Private Secretary to Secretary of State, £300; 2 ditto Under ditto, £150.

Indian Correspondence Department.—1 Secretary for the

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Financial Department; 1 ditto Revenue ditto; 1 ditto Judicial ditto; 1 ditto Public, Educational, and Ecclesiastical Department; 1 ditto Political and Secret ditto; 1 ditto Railway and Electric Telegraph Department; 1 ditto Public Works ditto;—all at £1,200; 7 Assistants to the above, £700; 1 Précis Writer (if also Private Secretary), £700; 1 Chief Clerk, £800; 1 Clerk, Fixed Station, £700; 1 ditto, £650; 1 ditto, £600; 1 ditto, £550; Clerks, £100, rising £16 to £450.

Military Department.—1 Secretary, £1,200; 1 Assistant ditto, £1,000; 1 Clerk, Fixed Station, £800; 1 ditto, £700; 1 ditto, £600; 1 ditto, £500; 1 ditto, £450; 1 ditto, £500; Clerks, £100, rising £16 to £450.

Marine and Transport Department.—1 Secretary, £1,200; 1 Chief Clerk, £800; 1 Clerk, Fixed Station, £600; Clerks, £100, rising £16 to £450.

Inspector-General of Stores Department.—1 Inspector-General, £1,200; 1 Deputy ditto, £650; 1 Assistant ditto, £500; 1 Accountant, £800; 1 Snb-Inspector, £350; 1 ditto, £350; Clerks, £100, rising £16 to £400; Examiners, £150 to £300; Assistant ditto, £120 to £150.

Accountant-General's Department.—1 Accountant-General, £1,200; 1 Clerk, Fixed Station, £900; 1 ditto, £750; 1 ditto, £700; 1 ditto, £650; 1 ditto, £600; 1 ditto, £500; 1 ditto, £450; Clerks, £100, rising £16 to £450.

Cashier's Department.—1 Cashier, £1,000; 1 Clerk, Fixed Station, £800; 1 ditto, £700; 1 ditto, £600; Clerks, £100, rising £16 to £450; 1 Anditor, £1,200; 1 Official Agent, £1,000; 1 Reporter of the Records, £1,000. (Clerks to the above receive the same salaries as those in the other departments.) 1 Librarian, £500; 1 Keeper of the Musenm, £500; 1 Under ditto, £300; 1 Reporter of Indian products, £500; 1 Examining Physician, £ 500; 1 Standing Conncil, £500; 1 Clerk of the Works, £400; 1 Geographer, £200; 1 Chaplain, £100.

Writers' Department.—1 Superintendent, £500; 61 Writers, for the first five years, £80; from 5 to 10, £90; from 10 to 15, £100; from 15 to 20, £120; from 20 to 25, £150; from 25, £200. (Allowance of 1s. a sheet of 480 words for extra work.)

4.—DUCHY OF LANCASTER OFFICE, LANCASTER PLACE, WATERLOO BRIDGE. (*Nomination.*)

Discharges the few official duties of the Duchy Court of Lancaster, Her Majesty being Duchess of Lancaster. The Chancellor of the Duchy is a Cabinet Minister. There are several professional and special appointments in connection with the office, bnt the clerical staff is qnite small, and the clerks on it are not promoted to the higher posts. They are appointed by the Chancellor of the Dnchy; must be between 18 and 25 years of age at time of appointment.

OBLIGATORY SUBJECTS.

1. Handwriting and Orthography.
2. Arithmetic, including Vulgar and Decimal Fractions.
3. English Composition.
4. Précis Writing.
5. Geography of the British Isles.

OPTIONAL SUBJECTS.

6. Law of Real Property, especially the Law of Landlord and Tenant (an elementary knowledge).
7. Latin.
8. English History.
9. French.
10. Mathematics (Euclid, Books I.—IV. and VI.; Algebra, including the Binomial Theorem; Plane Trigonometry, including the Solution of Triangles.

5.—LOCAL GOVERNMENT BOARD, WHITEHALL. (*Open Competition.*)

Formerly the Poor Law Commission. Discharges all duties connected with the administration of the poor law in this country, to which is now added the management of local government business generally. Presided over by a Cabinet Minister, who is called the President. Governed by secretaries and assistant secretaries, and a chief clerk. Establishment as follows:—One Chief Clerk, £750 to £850; 7 Principal Clerks, £650 to £800; 12 First Class, £400 to £600; 30 Second Class, £200 to £350; 1 Clerk, £200 to £350; 3 ditto, £90 to £200; 61 Clerks (Lower Division), £95 to £250; 7 Inspectors' Clerks, £80 to £120; Clerks, various salaries, ranging from £100 to £400.

6.—BOARD OF TRADE, WHITEHALL. (*Open Competition.*)

Consists of a President and a Committee, with parliamentary and permanent secretaries, assistant secretaries, and also certain professional officers. The Civil Service element in the office is represented by first, second, and third class, and snpplementary clerks. Establishment as follows:—6 Principals, £650 to £800; 17 Upper Division Clerks, £200 to £400; 2 Snpernumerary Clerks, £600; 6 Assistant Clerks, First Class, £300 to £400; 21 ditto, Second Class, £160 to £280; 59 Lower Division Clerks, £95 to £250.

7.—WOODS AND FORESTS, WHITEHALL PLACE. (*Open Competition.*)

Office consists of two commissioners, two principal clerks, two senior clerks, and assistant and junior clerks. A considerable staff of professional persons is also attached to the department; bnt these are not strictly to be included in the Civil Service. Establishment as follows:—2 Principal Clerks, £600 to £900; 2 Senior Clerks, £500 to £600. Clerks to Snrveyors of Forests—3 Supplementary, £200 to £250; 4 ditto, £100 to £200; 2 ditto (Lower Division), £80 to £200.

8.—OFFICE OF WORKS, WHITEHALL PLACE. (*Open Competition.*)

Consists of a First Commissioner (who is the real governing element), Her Majesty's principal Secretaries of State, and the President and Vice-President of the Board of Trade. There are a secretary, and a nnmber of professional officers connected with the royal parks and gardens, and with the maintenance of pnblic buildings. The office staff comprises principal clerks, first class, second class, and third class clerks. Dnty, to carry out all administrative detail in connection with the parks, gardens, and bnildings belonging to the pnblic. 3 Principal Clerks, £600 to £800; 8 First Class Clerks, £315 to £400; Clerk in Charge of Acconnts, £400 to £600; 10 Second Class Clerks, £100 to £300; 32 Clerks of the Lower Division, £80 to £200; 4 Assistant Examiners, £150 to £400; 7 Junior Examiners, £150 to £300.

9.—WAR OFFICE, PALL MALL. (*Open Competition.*)

Formerly there were two distinct establishments—that of the Secretary of State for War, and that of the Commander-in-Chief of the Army. The former was of minor importance, the military department transacting all the chief business connected with the administration of military affairs. Recently the entire civil business has been placed nnder the control of the Secretary of State, and the establishment is now at the office in Pall Mall.

Civil Clerks.—21 Principals, £700 to £900; 45 Seniors, £450 to £650; 48 Clerks, £150 to £400 and £500; 17 Clerks (Upper Division), £150 to £400; 56 Supplementary Clerks, £180 to £300; 209 Clerks (Lower Division), £95 to £250.

Surveyors, Draughtsmen, Clerks, &c.—Chief Surveyor, £800 to £1,000; Chief Draughtsman, £400 to £650; 2 Assistant ditto, £250 to £400; 2 Snrveyors, First Class, £400 to £500; Assistant Snrveyor, £180 to £280; 6 Clerks (Upper Division), £100 to £400; 5 Clerks (Lower Division), £1,800 together; 9 Lower Division Clerks in Works Division, £95 to £250; 10 Civil Assistants and Draughtsmen, Intelligence Department, £1,725 together; Draughtsman, £200.

10.—PRIVY COUNCIL OFFICE, DOWNING STREET. (*Open Competition.*)

Discharges office duties connected with the several functions of the Privy Conncil, whether as a conrt of justice or a governing council. Is controlled by the Lord President, assisted by coadjntors in the ministry, and by snbordinate heads of departments. Chief Clerk, £1,000 to £1,200; 2 Senior Clerks, £500 to £800; 2 Junior ditto, £100 to £300; 3 Clerks (Lower Division), £80 to £200; 1 Supplementary Clerk, £300 to £400.

LESSONS IN GEOLOGY.—XI.

THE VEGETABLE KINGDOM—CLASSIFICATION OF ROCKS.

Fossil botany is in a very unsatisfactory state, therefore we shall not describe the vegetable kingdom so fully as we have that of the animals.

Examining the structure of all vegetable organisms, we shall at once divide them into Cellular and Vascular—that is to say, in one class we shall not be able to discern any regular formation; but the substance of the plant appears to be made up of fibres interlaced, without any definite order. This peculiar growth may be seen in *Fungi* (mushrooms, etc.) or in *Algæ* (sea-weeds), and is considered the lowest development of vegetable life.

The *Vascular* plants exhibit a more complex structure. They contain vessels, through which sap—the blood of the vegetable world—circulates, by means of which the plant grows, flowers, and fructifies.

IDEAL FOREST OF THE CARBONIFEROUS PERIOD, SHOWING GIGANTIC TREE FERNS, ETC.

The manner in which plants are propagated affords another means of classification.

Many of the cellular plants have no seed-organs, but they seem to be produced from sprouts, which shoot off from the mother plant; from this peculiarity they are called *Thalogens*.

The vascular plants bear a division both as to their seeds and the manner of their growth.

1. The *Cryptogams* do not show any seed-organs, nor yet perfect flowers. Ferns belong to this family; the spore or seed of which appears attached to the under-surface of the fronds. Mosses, equisetums, mare's-tails, etc., are all cryptogams; and many fossil plants, we shall find, belong to this group.

2. *Phanerogamic monocotyledons*, or "flowering plants with one seed-lobe" — grasses, lilies, palms, canes—are of this family.

3. *Phanerogamic gymnosperms.*—Flowering plants, but having naked seeds. The very widely-distributed tribe of the *Coniferæ*, or firs, belongs to this family.

4. *Phanerogamic dicotyledons.*—Flowering plants having two seed-lobes. This is by far the largest class, and comprehends all true forest trees and shrubs.

The *division as to their manner of growth* is interesting. The cryptogams increase at the point only, which is pushed further and further, elongating the leaf. This is readily observed in the mosses and the ferns, which latter unroll the leaf or frond already formed from the root. From this "point-growth" they are termed *Acrogens*.

The next class, the Phanerogamic monocotyledons, grow in a very peculiar way, which is well illustrated in the cane and bamboo. They shoot out from the knots or joints; not a thin twig, which gradually increases in size, but a thick, succulent piece, which hardens, but does not increase. Thus they are said to "*grow from within*," and are termed *Endogens*. The structure exhibited by a section of sugar-cane illustrates the appearance of the "wood;" it is full of minute holes, with no marks of grain.

The *Phanerogamic gymnosperms* are a connecting link between the endogens and the exogens. The wood of the pine or fir-tree, if examined under the microscope, is readily distinguished from the true wood of the exogens by the presence of minute dotted vessels.

The *Phanerogamic dicotyledons* are *exogens*—that is, the sap rises up the interior of the tree, and, reaching the extremity of the branches, it descends by the bark, and puts on every year another layer of wood. The tree thus "grows from the outside," so that, when a section of a tree is made, the number of rings counted from the outside to the centre indicates the age of the tree.

The above classes are subdivided into orders, which contain about 300 genera and 100,000 species.

Remembering that the fossiliferous rocks are of aqueous origin, it will readily be expected that the great majority of fossil remains must be of aquatic animals and plants, chiefly, however, marine.

Any land animal or plant which is found in a fossil state must have been embedded by accident. For instance, a flooded river carries down to the sea the bodies of animals surprised by the rising waters, and also plants, which are torn up by the impetuosity of the swollen current; but, in comparison to the number of aquatic animals and plants which exist in the water, and when they die become embedded in the sediment, the number of land organisms must be very small. Still fewer remains of birds may we expect to find; and those which would be most likely to be preserved in the accumulating strata would be birds which inhabited the sea-shores, or the banks of rivers or marshes.

When we bear in mind the almost insignificant scratchings of geologists in the rocky surface of the earth—what a very small portion of the crust has been examined—we cannot but wonder at the very numerous list of fossils which have been collected, and be led to think what vast records of animal and vegetable life the rocks could unfold had we power to examine the strata fully. To give the reader some idea of the number of fossils, and the relation the past bears to the present orders of life, we transcribe a list of British fossils, compiled by Professor Jukes. Since the table was constructed, some of the numbers have altered; but it is sufficiently accurate for our purpose.

LIVING AND FOSSIL SPECIES IN THE BRITISH ISLANDS.

	Number of Living Species.	Number of Fossil Species.	Proportion of Living to Fossil.
Plants	4400	655	6·7 : 1
Zoophytes	70	435	1 : 6·2
Polyzoa	70	258	1 : 3·7
*Testacea	513	4590	1 : 8·9
Echinodermata	70	492	1 : 7·0
Crustacea	300	298	1 : 1·3
Fishes	162	741	1 : 4·6
Reptiles	18	190	1 : 10·0
Birds	332	11	30 : 1
Mammals	70	110	1 : 1·5

* "Testacea" is a word usually applied to all molluscs which are "shielded" by shells.

We are more likely to have registered all the species of existing molluscs which inhabit our seas, than to have discovered individuals of every species which lie entombed in the rocks of our island; and yet, as far as our research has gone, the living species are not a tithe of the number of fossil Testacea already known by us.

This means to say that our rocks chronicle the history of the rise and fall of ten complete populations of the seas which girt our island. We have no reason to think that the land animals change less slowly than the species which inhabit the sea, and yet we only discover that fossil species of Mammalia are more numerous by *one-half* than those which now exist; because, as we have said, when we do discover such a fossil, we have happened to hit upon the place where a land animal was accidentally deposited amid the accumulating sediment.

The Distribution of Fossils.—From the foregoing remarks the reader will readily perceive that the distribution of fossils is not indiscriminate, but is regulated by certain considerations. The fossils contained in one stratum of rock represent that order of life which was existing at the time the rock was being deposited; and if, at some distant place, the same kind of rock was discovered in which we found one fossil similar to any of those which the former rock contained, we should continue our search, confidently expecting to find other members of the same group.

For instance, the Mediterranean Sea may be looked upon as one area of life. Occasionally we find a species peculiar to one locality, but the great majority of shells is common to all the coasts. The rivers which discharge themselves into that sea are depositing strata. Suppose that the bed were elevated, and the rocks found by the Rhone, the Po, and the Nile were examined, the mineral matter of the rocks would vary, but the fossils would be well nigh all the same.

From this instance, which is in progress under our observation, we deduce another fact, that although the mineral matter which composes rocks may be essentially different, yet, provided that the deposition of those rocks be during the same period and within the same area of life, their fossil contents will bear a close resemblance; and it is possible that every species in the one will be found in the other.

Yet it must not be concluded that rocks deposited at the same time of necessity contain the same fossils. A deposition of strata may be going on off the shores of Siberia, and another in the Bay of Bengal; but no one will expect that these two areas of deposition are included in the same area of life. In the one an Arctic fauna, or a generation of Arctic life, is being enfossilled, and in the other the fauna is truly tropical; and yet, for all that, the conditions of climate are so widely different, that certain cosmopolite species will be detected in each, and, to use Von Buch's phrase, a peculiar "facies," or general resemblance—a family likeness—will pervade the character of the two groups; so that, although two classes of rocks may have been deposited at very distant places and under very different conditions, but at the same period, the geologist is seldom at fault to show that such is the case from common characteristics possessed by their fossils, although the majority of those fossils belong to different species.

The distribution of life, and the laws which regulate it, is a most interesting subject; but, from our imperfect knowledge of Palæontology, it can only be studied with regard to living species. From such study, however, we have learned sufficient to teach us that it is very dangerous to assert what may have been the climate and the nature of the country when a certain species, now in a fossil condition, were in existence. Experience, however, seems to point out that all changes in species which occupied a certain area were very gradual; and if the fossil contents of two adjacent strata are widely different from each other, it argues that long ages interposed between their respective deposition, and that a series of intermediate deposits are wanting, which, had they been present, would have established a gradation in the forms of life.

CLASSIFICATION OF ROCKS.

Three prominent characteristics aid us in classifying rocks according to their chronological order:—(1) *Their order of superposition;* (2) *their mineral characters;* and (3) *their fossil contents.* If two strata are discovered, one lying on the other, we may at once infer that the one which is beneath was deposited before the other. Cases, however, are known where, by a tremendous upheaval of the surface, a series of strata has been actually turned over; but this is very local, and not at all difficult to discover. Yet the order of superposition is not always satisfactory, for it very frequently happens that between the deposition of the two strata vast periods of time intervened; and, to complete the series, it would be necessary to insert perhaps several strata between the two adjacent rocks—strata which are found to have been deposited in this very period in other areas. For instance, suppose England were submerged, and a layer of rock deposited over the whole surface of our island, in Wales this newly-deposited rock would rest on the old Silurians—rocks hoary with the vastness of their age—while this same rock is found on the opposite coast to be resting on the tertiary formations—that is, those last upheaved from the ocean bed. Obviously it would be a great error to conclude that, because this new rock was found superimposed upon the Silurian, therefore it was deposited immediately after that foundation.

Hence, although the order of superposition may and does determine the relative times of deposition of the whole series of rocks, yet we cannot infer that any one rock was immediately deposited after another because it happens to lie upon it.

The *mineral character* of a rock, although it may be put in as evidence as to its age, yet is by no means conclusive. For we find the same kind of rock appearing again and again in the different formations. This a glance at the following tabulations will at once decide; and, moreover, it is not unusual to find a limestone growing gradually more arenaceous until it became a sandstone, which merely means to say that the area of the deposition of the limestone was on the same level and contiguous to the area of the deposition of the sandstone; but we cannot assert that the two rocks could not be deposited at the same time because of their different mineral characters.

The *organic remains* in a rock are the surest of all tests of age. The same fossils may be found in several succeeding strata, but every strata has some fossils peculiar to itself by which it is at once known, and referred to its proper position. A knowledge of Palæontology is therefore absolutely necessary to the miner. Many a coal shaft has been sunk in a class of rocks which never yield coal, and that, too, when every bucket brought up silent witnesses, which, had they found an interpreter, would have prevented much useless expenditure.

As we describe the various formations, we shall note and delineate those fossils which are characteristic of them.

The earliest classification seems to have been made by Steno in 1669, who divided all rocks into *primary* and *secondary*. Some ten years later, Leibnitz improved upon this nomenclature by substituting the words *stratified* and *unstratified*.

Then came Werner and Hutton. The former conceived that the deposition of all existing rocks was due to the action of water; whereas the Vulcanists, the followers of Hutton, differed from the Neptunists in ascribing the production of the Primary and Transition rocks to igneous action. Each of these leaders classified the rocks according to their theories.

At the beginning of this century, William Smith, "the father of English geology," commenced his labours, and from him a race of investigating geologists has sprung, by whom the rocks have been classified in the following order. The formations are in a descending order:—

1. Post-Tertiary. The latest accumulations.	6. Permian, or New Red Sandstone.
2. Tertiary.	7. Carboniferous or Coal System.
3. Cretaceous or Chalk.	8. Devonian, or Old Red Sandstone.
4. Oolitic.	9. Silurian.
5. Triassic.	10. Metamorphic.

Below these lie the Primary Rocks, but it must not be supposed that the rocks of igneous origin are not found in the stratified rocks, for it will be shown that granite was in a state of fluidity when the Oolite was being deposited; but we shall explain this in our next lesson.

A division of the rocks has been made according to their fossils, or the types of life they exhibit, as compared with our present orders of life:—

Period	Formations
1. Cainozoic period (*Recent life*)	Post-tertiary. Tertiary.
2. Mesozoic period (*Middle life*)	Cretaceous. Oolitic. Triassic.
3. Palæozoic period (*Ancient life*)	Permian. Carboniferous. Devonian. Silurian.
4. Azoic period (*No life*)	Metamorphic.

This classification was objected to on the ground that we had no right to say that there were no fossils in the Metamorphic rocks because as yet we had found none; and, therefore, for Azoic the term *Hypozoic* (below life) was substituted: and, seeing it was impossible to draw the line of demarcation between the Mesozoic period and the Palæozoic on the one hand, or the Cainozoic on the other, the Mesozoic and the Cainozoic were included in the term *Neozoic*, or new life. Hence the division now stands—

Neozoic period (*New life*) . .	Post-tertiary. Tertiary. Cretaceous. Oolitic. Triassic.	Palæozoic (*Ancient life*) . .	Permian. Carboniferous. Devonian. Silurian.
		Hypozoic (*Below life*)	Metamorphic.

Our illustration shows an ideal forest of the Carboniferous period, when the coal deposits were formed.

LESSONS IN FRENCH.—LV.

§ 27.—Rules on the Use of the Numeral Adjectives.

(1.) In speaking of the days of the month, the French use the cardinal, not the ordinal numbers, except, however, for the first, which is expressed by **premier** :—

le *premier* juin,	*the first of June.*
le *deux* mars,	*the second of March.*
le *dix-sept* avril,	*the seventeenth of April.*

L'ouverture des États-généraux eut lieu le *cinq* mai, 1789. Thiers.	*The opening of the States-general took place on the fifth of May, 1789.*

(2.) The cardinal numbers are also employed in speaking of sovereigns and princes, except the first, which is expressed by **premier** without article :—

Henri *premier*,	*Henry the First.*
Charles *dix*,	*Charles the Tenth.*
Louis *dix-huit*,	*Lewis the Eighteenth.*

Louis *onze* avait trente-huit ans, quand il monta sur le trône. Anquetil.	*Lewis the Eleventh was thirty-eight years old when he ascended the throne.*
La mort de Grégoire *sept* n'éteignit pas le feu qu'il avait allumé. Voltaire.	*The death of Gregory the Seventh did not extinguish the fire which he had kindled.*

(3.) In speaking of Charles the Fifth, Emperor of Germany and King of Spain, and of the Pope Sixtus the Fifth, the word **quint**, *fifth*, is used :—

Charles-*quint*,	*Charles the Fifth.*
Sixte-*quint*,	*Sixtus the Fifth.*

§ 28.—Numeral Nouns.

(1.) The numeral nouns in use in French are :—

unité,	*unit.*	trentaine,	*thirty.*
couple, paire,	*couple, pair.*	quarantaine,	*two score.*
trio,	*trio, three.*	cinquantaine,	*fifty.*
demi-douzaine,	*half-dozen.*	soixantaine,	*sixty.*
huitaine,	*eight days.*	une centaine,	*a hundred.*
neuvaine,	*nine (nine days of prayer).*	deux centaines, etc.	*two hundred.*
		un millier,	*one thousand.*
dizaine,	*ten, half a score.*	deux milliers,	*two thousand.*
douzaine,	*dozen.*	une myriade,	*a myriad.*
quinzaine,	*fifteen, fortnight.*	un million,	*a million.*
vingtaine,	*score, twenty.*		

(2.) The termination *aine*, when added to words of number, is equivalent to the English *some*, in cases like the following: I have *some* twenty books, i.e., about twenty books, *J'ai une* **vingtaine** *de livres.*

§ 29.—Fractional Numerals.

un quart,	*one quarter.*	deux cinquièmes,	*two fifths.*
trois quarts,	*three quarters.*	un sixième, etc.	*one sixth, etc.*
le tiers,	*the third.*	un dixième, etc.	*one tenth, etc.*
deux tiers,	*two thirds.*	un centième,	*one hundredth.*
la moitié,	*the half.*	un millième,	*one thousandth.*
un cinquième,	*one fifth.*		

(1.) It will be seen that, with the exception of **tiers, quart,** and **moitié**, these numbers are nothing but the ordinal adjectives. They may, therefore, take the mark of the plural when necessary.

(2.) The word **demi**, when used adjectively and preceding the noun, is invariable, and is joined to it by a hyphen :—

une *demi*-heure, f.	*half an hour.*
une *demi*-livre, f.	*half a pound.*

(3.) When coming after the noun to denote an *additional* half, it agrees in gender with the noun :—

une heure et *demie*,	*one hour and a half.*
une livre et *demie*,	*one pound and a half.*

(4.) When used substantively, **demi** may take the form of the plural :—

Cette horloge sonne les heures et les *demies*.	*This clock strikes the hours and the half-hours.*

§ 30.—Ordinal Adverbs.

(1.) Ordinal adverbs are formed from ordinal adjectives by adding **ment** to the latter: **premièrement** and **secondement** being formed from **première** and **seconde**, the feminine of **premier** and **second** :—

premièrement, unièmement,	*first; in the first place.*	neuvièmement,	*ninthly.*
		dix-septièmement,	*seventeenthly.*
deuxièmement, secondement,	*secondly.*	vingtièmement,	*twentieth.*
troisièmement,	*thirdly.*	vingt et unièmement,	*twenty-first.*
quatrièmement,	*fourthly.*	vingt deuxièmement,	*twenty-second,*
cinquièmement,	*fifthly.*		
sixièmement,	*sixthly.*		*etc., etc.*

(2.) **Premièrement** is only used by itself; **unièmement** is only employed in composition with **vingt, trente, quarante,** etc. **Secondement** is only used by itself; but **deuxièmement** is used both by itself and in composition with **vingt, trente,** etc.

(3.) Hyphens are employed with ordinal adverbs in the same cases as with numeral adjectives. [See § 25 (2), and § 26 (6).]

(4.) Instead of the adverbs mentioned above, a Latin form: **primo, secundo, tertio, quarto,** etc., etc., is also frequently used.

§ 31.—Indefinite Adjectives.

(1.) The indefinite adjectives are used when anything is to be represented or referred to in a general or indefinite manner. They are :—

aucun,	*not any, not one.*	plusieurs,	*several.*
autre,	*other.*	quantes,	*every.*
certain,	*certain.*	quel,	*what.*
chaque,	*every, each.*	quelconque,	*whatever.*
maint,	*many.*	quelque,	*some.*
même,	*same.*	tel,	*such.*
nul,	*no.*	tout,	*all.*
pareil,	*such.*		

(2.) **Aucun**, f. **aucune**, is generally followed by a noun, with which it must agree. It requires **ne** before the verb :—

aucun homme, *no man;*	*aucune* femme, *no woman.*

Aucun chemin de fleurs *ne* conduit à la gloire. La Fontaine.	*No flowery path leads to glory.*
On méprise tous ceux qui *n'ont aucune* vertu. La Rochefoucauld.	*All those who have no virtue are despised.*

(3.) **Aucun** is by some French authors sometimes used in the plural :—

Ils ne peuvent souffrir aucun empire légitime, ne mettent *aucunes* bornes à leurs attentats. Montesquieu.	*They can bear no legitimate dominion, set no bounds to their crimes.*

(4.) **Autre**, *other*, is common gender, and may take the mark of the plural. It is also used substantively with or without a reference to a noun :—

J'ai acheté un *autre* cheval.	*I have bought another horse.*
Voici le premier volume de votre histoire d'Angleterre, où sont les deux *autres?*	*Here is the first volume of your English history, where are the two others?*

(5.) **Certain**, f. **certaine**, is in this sense always placed before its noun :—

Certain renard . . . La Fontaine.	*Certain fox* . . .

(6.) **Chaque** is of both genders, and is used only in the singular. It always precedes the noun, and should never be used without one :—

Chaque âge a ses plaisirs, *chaque* état a ses charmes. DELILLE.	*Every age has its pleasures, every situation its charms.*

(7.) **Maint, f. mainte,** familiar expression; may be nsed in the singular or in the plural, and repeated before its noun:—

Je l'ai dit *mainte* fois.	*I said it many a time.*
Maints et *mainte* travaux.	*Very many works.*

(8.) **Même,** placed before the noun, has the sense of *same*, in English. Placed after the nonn it means, generally, *himself*, *herself*, *itself*, or *themselves*. It is sometimes used as an adverb, when it may be rendered by the word *even*. As an adjective, **même** is common gender, bnt may take the mark of the plural:—

c'est la *même* vertu } *it is the same virtue*	c'est la vertu *même*. } *it is virtue itself.*

Le peuple et les grands n'ont ni les *mêmes* vertus, ni les *mêmes* vices. VAUVENARGUES.	*The people and the great have neither the same virtues nor the same vices.*
Il lui donna *même* ses habits.	*He gave him even his clothes.*

(9.) **Nul** is a stronger negative than **aucun.** It agrees in gender and nnmber with the noun which it qualifies. Like **aucun,** it reqnires **ne** before the verb:—

Nul homme n'est heureux; *nulle* chose ne peut le rendre tel. BOISTE.	*No man is happy; nothing can render him so.*
Nulle paix pour l'impie; il la cherche, elle le fuit. RACINE.	*No peace for the impious; he seeks it, it avoids him.*

(10.) **Nul** is sometimes used absolutely in the sense of *no one*:—

Nul n'est content de sa fortune, ni mécontent de son esprit. MME. DESHOULIÈRES.	*No one is pleased with his fortune, nor displeased with his own wit.*

Note.—**Nul** modifies its meaning according as it precedes or follows its noun. See § 84 (14).

(11.) **Plusieurs** is common gender, and always in the plural:—

Il faut bien qu'il y ait *plusieurs* raisons d'ennui, quand tout le monde est d'accord pour bâiller. FLORIAN.	*There must necessarily be several reasons for ennui, when all agree in yawning.*

Plusieurs may be used as a pronoun with or without reference to a nonn:—

Il n'a qu'un frère, mais moi j'en ai *plusieurs.*	*He has but a brother, but I have several.*
Plusieurs l'ont cru.	*Many believed it.*

(12.) **Pareil, f. pareille,** is chiefly used in exclamatory sentences:—

Comment a-t-il pu commettre une faute *pareille?*	*How could he commit such a fault?*

(13.) **Quantes** is only used in the feminine plural with the word *fois*:—

Toutes et *quantes* fois, *or* toutes fois et *quantes.*	*Every time, whenever.*

(14.) **Quel, f. quelle,** takes the gender and number of the noun to which it relates. It is sometimes immediately followed by its noun, from which it may be separated by one or several words:—

Quel tableau ravissant présentent les campagnes! DELILLE.	*What a delightful picture the country offers!*
Quelle invisible force a soumis l'univers! L. RACINE.	*What invisible hand has conquered the universe!*
Quels sons harmonieux, *quels* efforts ravissants, De la reconnaissance égalent les accents!	*What harmonious sounds, what ravishing strains, equal the voice of gratitude!*

(15.) **Quelconque** is always placed after the noun, and varies only for the plural:—

Toutes les jouissances sont précédées d'un travail *quelconque.* MME. CAMPAN.	*All enjoyments are preceded by some sort of exertion.*
Deux points *quelconques* étant donnés . . . THE ACADEMY.	*Two points whatsoever being given . . .*

(16.) **Quelque** in the sense of *some* (*a certain number*), or *whatever*, agrees in nnmber with the noun:—

Il y a du mérite sans élévation, mais il n'y a point d'élévation sans *quelque* mérite. LA ROCHEFOUCAULD.	*There is merit without elevation, but there is no elevation without some merit.*
Quelques vains lauriers que promette la guerre, On peut être héros sans ravager la terre. BOILEAU.	*Whatever vain laurels war may promise, one may be a hero without ravaging the earth.*

But when *whatever* precedes a noun subject of the verb *to be*, it is expressed in French by two words, viz., **quel,** which agrees in gender and number with the noun, and the conjunction **que**; in this case the verb is used in the subjnnctive, and placed before its subject:—

Quels que soient ses projets.	*Whatever his projects may be.*
Quelle que soit votre intention.	*Whatever your intention may be.*

(17.) **Quelque** used adverbially, in the sense of *about* or *some* or *however*, is invariable:—

Quel âge avez-vous? Vous avez bon visage! Eh! *quelque* soixante ans. RACINE, *les Plaideurs.*	*How old are you? You look well. Oh! some sixty years.*
Alexandre perdit *quelque* trois cents hommes, quand il vainquit Porus. D'ABLANCOURT.	*Alexander lost some three hundred men when he vanquished Porus.*
Quelque méchants que soient les hommes, ils n'oseraient paraître ennemis de la vertu. LA ROCHEFOUCAULD.	*However wicked men may be, they do not dare to appear enemies of virtue.*

(18.) **Tel, f. telle,** agrees with the nonn which it qualifies:—

tel livre, *such book.*	*telle* lettre, *such letter.*
tels livres, *such books.*	*telles* lettres, *such letters.*

In reference to persons it is sometimes used as a pronoun:—

Tel qui rit aujourd'hui . . .	*He who laughs to-day . . .*

(19.) **Tout,** meaning *every*, is always in the singular, but varies for the feminine:—

Tout citoyen doit servir son pays; le soldat de son sang, le prêtre de son zèle. LA MOTTE.	*Every citizen should serve his country; the soldier with his blood, the priest with his zeal.*
En *toute* chose, il faut considérer la fin. LA FONTAINE.	*In everything we must consider the end.*

(20.) **Tout,** in the sense of *all*, agrees in gender and number with the noun to which it relates:—

tout l'argent, *all the money.*	*toute* la toile, *all the cloth.*
Il était au-dessus de *tous* ces vains objets qui forment *tous* les désirs et *toutes* les espérances des hommes. MASSILLON.	*He was above all those vain objects which form all the desires and all the hopes of men.*

See § 94 (5).

As an adjective, **tout** loses its final *t* in the mascnline plural, which is **tous**; but preserves it when it is used substantively:—

Plusieurs **touts** distincts.	*Several distinct wholes.*

§ 32.—THE PRONOUN.

(1.) The pronoun, in French, as in other langnages, is a word used to represent the nonn, in order to prevent its too freqnent repetition.

(2.) The pronoun serves also to designate the parts which each person or thing takes in speech. This part is called *person.*

(3.) There are three persons: the first, or that which speaks; the second, or that spoken to; the third, or that spoken of.

(4.) There are five sorts of pronouns:—

The personal;	The demonstrative;
The possessive;	The relative;
The indefinite.	

§ 33.—THE PERSONAL PRONOUN.

(1.) The personal pronouns are so called because they designate the three persons more especially than the other pronouns. These pronouns are:—

	Nominative Form.		*Relative Form.*	
	Singular.	*Plural.*	*Singular.*	*Plural.*
1.	je, *I;*	nous, *we;*	me, *myself;*	nous, *ourselves;*
2.	tu, *thou;*	vous, *you, ye;*	te, *thyself;*	vous, *yourselves;*
3.	il, *he, it, m.;* ils, m. *they;* elle, *she, it,* f.; elles, f. *they.*		se, soi, *himself; herself; itself;*	se, *themselves;*

(2.) *Direct Object, Accusative.*
When placed before the verb.

	Singular.	*Plural.*
1.	me, *me;*	nous, *us;*
2.	te, *thee;*	vous, *you;*
3.	le, *him, it,* m.; la, *her, it,* f.; se, *himself, herself, one's self, itself;*	les, *them;* se, *themselves, one another, each other.* m. f.

When placed after the verb.

Singular.	*Plural.*
moi, *me;*	nous, *us;*
toi, *thee;*	vous, *you;*
le, *him, it,* m.; la, *her, it,* f.;	les, *them,* m. f.

(3.) *Indirect Object, Dative.*
When placed before the verb.

	Singular.	*Plural.*
1. me,	*to me;*	nous, *to us;*
2. te,	*to thee;*	vous, *to you;*
3. lui,	*to him; to her; to it;*	leur, *to them* (both genders);
se,	*to himself; to herself; to one's self; to itself;*	se, *to themselves; to one another; to each other.*

When placed after the verb.

Singular.			*Plural.*		
moi,	à moi,	*to me;*	nous,	à nous,	*to us,*
toi,	à toi,	*to thee;*	vous,	à vous,	*to you;*
lui,	à lui, à elle,	*to him; to her;*			
soi,	à soi,	*to himself; to herself; to one's self; to itself;*	leur,	à eux, m. à elles, f.	*to them.*

(4.) *Indirect Object, Genitive and Ablative.*
Always placed after the verb.

Singular.		*Plural.*	
de moi,	*of* or *from me;*	de nous,	*of* or *from us;*
de toi,	,, *thee;*	de vous,	,, *you;*
de lui,	,, *him;*		
d'elle,	,, *her;*	d'eux,	,, *them,* m.;
de soi,	,, *himself; herself; one's self; itself;*	d'elles,	,, *them,* f.

EXERCISES IN EUCLID.—II.

PROPOSITION VI.—In the figure of Euc. I. 5, if GO (Fig. 6), drawn at right angles to AG, meet AH in O, H being the intersection of BG and CF, then OF shall be perpendicular to AF.

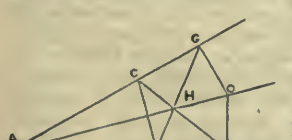


Fig. 6.

In Proposition IV. we proved that AH will bisect the vertical angle BAC; therefore the angle GAO is = to angle OAF. Hence in the two triangles GAO, OAF, because GA = AF and AO is common, also included angle GAO = included angle OAF, ∴ also base OG = base OF (Euc. I. 4). Again, in the same triangles, because AG = AF, and OG = OF, also base OA is common, ∴ included angle AGO = included angle AFO. But AGO is a right angle by construction; hence, AFO is a right angle, and OF is perpendicular to AF. Q. E. D.

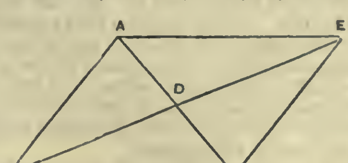


Fig. 7.

PROPOSITION VII.—If AC (Fig. 7), the side of a triangle ABC, be bisected in D, and BD joined and produced to E, so that DE may be equal to DB, then, if AE be joined, the angle AED shall be equal to the angle DBC.

Join CE. Then, since the straight lines AC, BE cut in D, therefore the angle ADB is equal to the vertical and opposite angle CDE (Euc. I. 15). Then in the two triangles ADB, CDE, because side AD = DC by construction, and side BD = DE also by construction, also included angle ADB = included angle CDE, therefore base AB = CE. Again, in the same triangles, because AB = CE, and BD = DE by construction, also base AD = DC by construction, ∴ included angle ABD = included angle DEC. By an exactly similar proof applied to the triangles ADE, BDC, we see that base AE = base BC, and angle AED = angle DBC. Q. E. D.

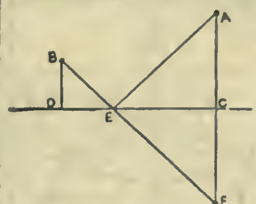


Fig. 8.

PROPOSITION VIII.—If A, B (Fig. 8) be two points on the same side of a given line CD, find in CD a point E, such that the angle AEC may be equal to the angle BED.

From A draw AC perpendicular to CD (Euc. I. 12), and produce AC to F, so that CF = AC (Post. 2, Euc. I. 3). Join BF (Post. 1), and let BF cut CD in E. Join AE (Post. 1), then shall the angle AEC be = to angle BED. For since AC is at right angles to EC, and by Euc. I. 15 the vertical or opposite angles between two straight lines are equal, therefore the angles ACE, ECF are equal, and AC = CF and CE is common, ∴ base AE = base EF (Euc. I. 4); and because AE = EF and EC is common, also base AC = base CF, ∴ angle AEC = angle CEF (Euc. I. 8). But by Euc. I. 15, angle CEF = angle BED; therefore, by Axiom 1, angle AEC = angle BED. Q. E. F.

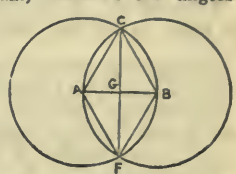


Fig. 9.

PROPOSITION IX.—In the figure of Euclid I. 1, if the circles cut again in F (Fig. 9), and AF, BF be joined, the figure AFBC is a rhombus.

For since AC, AB, AF are radii of the same circle, AC and AF are equal to AB (Def. 15), and since BC, BA, BF are radii of the same circle, BC and BF are equal to BA (Def. 15). But by Axiom 1, things which are equal to the same thing are equal to one another; therefore AC, AF, BC, BF are all equal. Hence, by Def. 32, the figure AFBC is a rhombus. Q. E. D.

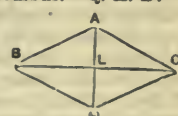


Fig. 10.

PROPOSITION X.—In an isosceles triangle ABC (Fig. 10), if AL be drawn from the vertex A perpendicular to the base BC, and if AL be produced to M, so that LM = LA, then shall BM be = to BA. Join BM and MC. Then, because AL = LM by construction, and BL is common, also right angle BLA = right angle BLM, therefore base BA = base BM (Euc. I. 4). Q. E. D.

PROPOSITION XI.—If in any triangle the sides AB, AC (Fig. 11) be bisected in L, M, and LO, MO be drawn at right angles to AB, AC, meeting in O: then ON drawn perpendicular to BC will bisect BC.

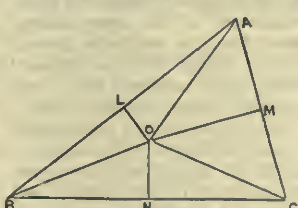


Fig. 11.

Join OA, OB, OC. Then, because BL = LA, and LO is common, also right angle BLO = right angle ALO, therefore base BO = base OA (Euc. I. 4). In a similar way base CO = base OA (Euc. I. 4); therefore, by Axiom 1, BO = OC. Therefore, BOC is an isosceles triangle, and ON is drawn perpendicular to the base. Therefore, by Proposition I., ON bisects the base—that is BN = NC. Q. E. D.

Corollary.—Hence, obviously O is the centre of a circle passing through A, B, C. This is called the circumscribed circle, or circle described about the triangle ABC.

PROPOSITION XII.—In the figure of Euclid I. 9, if with centre A (Fig. 12) and radius AF, a circle be described cutting AB, AC in L and M, then shall EL be equal to DM.

*

For since A L, A F, A M are radii of the same circle, they are all equal (Def. 15); therefore A L = A M. But by construction of Enc. I. 9, A D = A E; therefore, by Axiom 3, the remainders D L, E M are equal. Also, by Euc. I. 5, the angles on the other side the base of an isosceles triangle are equal; therefore the angle L D E = angle D E M. Therefore, since L D = E M, and D E is common to the two triangles L D E, D E M, therefore base L E = base D M. Q. E. D.

Corollary.—It is obvious by symmetry that L E, D M will intersect on A F, since A F bisects the angle B A C.

Our next article will extend as far as Euc. I. 24; and we shall deduce proofs of the following propositions :—

PROPOSITION XIII.—In a triangle A B C, if B O, C O bisecting the angles A B C, B C A, and meeting in O, be equal, then shall A B be equal to A C.

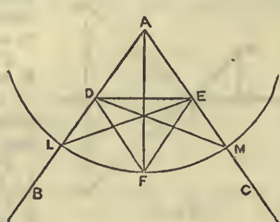


Fig. 12.

PROPOSITION XIV.—In a triangle A B C, if B O, C O bisecting the angles A B C, B C A, and meeting in O, be equal, then shall O A bisect the angle A B C.

PROPOSITION XV.—In the figure of Euc. I. 1, if the circles cut again in F, and C A produced meet the circle again in H, then C H is greater than C F.

PROPOSITION XVI.—In the figure of Euc. I. 5, prove that B G must be greater than B C.

PROPOSITION XVII.—In the figure of Euc. I. 16, if E C be equal to E F, the angle A B C will be equal to the angle B C F.

PROPOSITION XVIII.—In the figure of Euc. I. 22, if the circles cut again in L, then shall D K be equal to D L.

PROPOSITION XIX.—At a given point in a given straight line, to make an angle equal to a given rectilineal angle.

*** Another solution of Euc. I. 23.

PROPOSITION XX.—In the figure of Enc. I. 15, if E F, E G be drawn at right angles respectively to A B and C D, the angle F E G is equal to the angle B E D or A E C.

LESSONS IN ENGLISH LITERATURE.—II.

LITERATURE IN ENGLAND BEFORE THE AGE OF CHAUCER.

As we have chosen the age of Chaucer as that at which to commence the history of English Literature, it would be inappropriate to attempt any minute or elaborate account of those remains which have come down to us of earlier forms of literature. But in order that the student may understand how great the change was which took place in the latter part of the fourteenth centnry, and how mnch English literature owes to the great writers of that period, it is necessary that he should know something of those who preceded them.

THE PERIOD BEFORE THE NORMAN CONQUEST.

From our knowledge of the character, habits, and pursuits of the Saxon invaders of England, it would not be difficult to guess what would prove to be the character of the compositions brought by them from their German home, or prodnced among them during the earlier days of their contest with the Britons. These "hosts of heathen swarming over northern seas," and overrunning helpless Britain, were wild, fierce, and uncivilised; their life was wholly made up of war and adventure; their gods were gods of battles, and their national heroes were warriors; their conquest of Britain itself displayed energy and courage in abundance, and the most relentless cruelty in no less degree; and their literature (if we may be allowed to stretch a point, and apply the word to compositions which were not generally written, but handed down from mouth to mouth) consisted of songs of war and adventure, the achievements of heroes related in verse. By far the most important specimen of the poetry of this period is the "Lay of Beowulf." The date of the poem is doubtful. It may have been brought (as some think) by the Saxons from Germany to their new home in England; or it may have been composed in England. The scene of the poem, too, is doubtful, whether it be Sweden, or Denmark, or England, or mere dreamland. But it is clear that it was composed by and for Saxons dnring, if not before, the early years of their settlement in England; and it is therefore a good representative of the class of which we are speaking. It relates with much energy and freshness how Hrothgar, King of Heorut, and his thanes were persecuted by a monster, Grendel, who dwelt in the fens, and used to come by night and carry off the thanes as they slept in the hall after the feast; how Beowulf, a thane of Hygelac, King of the Goths, heard of their distress, and came by sea to their aid; how he slew the monster Grendel, and afterwards its mother, who sought to avenge her son; how he subsequently became a great king, bnt was ultimately killed in fight with a formidable dragon. The poem is long, and is full of pictures of the life and manners of the period. It is written in the alliterative metre characteristic of the older Saxon poetry—a metre in which the poetic form consists mainly in the recurrence at certain intervals of syllables beginning with the same letter; a metre of which we shall speak more fully and give some examples hereafter.

To what extent poetry of this character was cultivated among the earlier Saxon settlers it is impossible to tell, for the remains that have come down to us are extremely scanty. But from the importance attached at all times to the songs of the Gleemen, who were both poets and musicians, composing songs as well as singing them, we may well snppose that there mnst at one time have been very many of such poems in existence.

But the character of the Saxon people, and therefore of their literature, soon underwent a great change. From invaders they became rulers; from a series of armies obeying their military chiefs, a nation with political institutions. And, more important still, from heathen they became Christian. The consequence of these changes is at once seen in the literature of the people. It becomes essentially Christian and religious. The monasteries were the repositories of learning and the centres of intellectual life; the literature consisted of religious treatises, and of histories with a strong theological tinge. And the language of the church, Latin, became for a time the language used in the most important literary productions in England. For the same reason, too, it was but natural that the Celtic race, which had become Christian during the period of the Roman occupation, and among whom Christian learning had never wholly died out, should for a long period take the lead in literature, especially since the communication with Ireland, at that time holding a prominent place in the race of learning, exercised a strong influence over Great Britain. Gildas, the supposed author of a history of the Saxon conquest of Britain—which is probably not the work of Gildas, but is certainly of great antiquity—was a Briton of Strath Clyde—that is, of the British kingdom remaining in the valley of Clyde, of which Dumbarton was the capital. Nennius, the supposed author of the History of the Britons, was also of British race. In Ireland were born St. Columba, the apostle of Scotland; St. Columbanus, one of the greatest theologians of the age; and St. Gall, his pupil, who carried Christianity into Switzerland.

The first great name among the Christian Saxons is that of Bede, surnamed the Venerable. He was born about 672. In early childhood he entered the monastery of Wearmouth, afterwards removing to that of Jarrow, and in due time received the orders of deacon and priest. In the monastery his whole life was spent in a close devotion to science and literature in all their then known branches. His works, which are in Latin, are very numerous, including treatises on various branches of natural science, on grammar, Latin orthography and prosody, numerous theological treatises, and commentaries on various portions of the Holy Scriptures. Bnt to posterity his most valuable works are his histories, and among these by far the most important is his Ecclesiastical History of England. This is a work of great diligence and research, and remains to this day the most important authority upon Anglo-Saxon history. Bede died in the year 735, but his influence by no means died with him. Not only did his books remain behind as storehouses of knowledge, but his own example and personal influence had attracted around him a school of learned men who did much to extend the effect of his labours. At the end of the same century flourished Alcuin, also a native of the north of England, one of the most distinguished of that group of learned men who adorned the court of Charlemagne.

In the meantime, several prominent writers in the vernacnlar Saxon had appeared, their works being either intended to popularise the truths of Christianity for the benefit of the uninstructed, or else more translations of works previously existing in Latin. The first Saxon author of eminence during the Christian period was Cædmon, who lived in the seventh century. He is said to have been originally a herdsman in the employment of the abbey of Whitby. But having suddenly developed a gift of poetry, till then unsuspected by himself or others, and therefore attributed, after the manner of the times, to angelic inspiration, he adopted a monastic life, and passed the rest of his days in the monastery of Whitby. He was the author of a paraphrase of large portions of the Holy Scriptures, in the old Saxon alliterative metre. This work was evidently greatly valued, and of great influence for centuries after the author's death. Having been long lost, a manuscript copy of it was discovered by Archbishop Usher, and it was published abroad in 1655. Many scholars have thought that Milton derived some suggestions for his great epic, "Paradise Lost," from the ancient poet.

The most eminent of the Saxon writers before the Conquest, in genius as well as in station, was King Alfred. He reigned from 871 to 901; and among the many great services which he rendered to his country, few were more important than the encouragement which he gave to literature and education. By gathering learned men about him, and by appointing them to the abbeys and sees in which they were likely to exercise most influence over the people, as well as by his own example and persuasion, he sought to stimulate the pursuit of knowledge. But what more immediately concerns us here is his labours as an author. He published translations from the Latin into Saxon of several works of a religious character; but his most important translations were those of Bede's "Ecclesiastical History," the "Universal History" of Orosius—a work written by a Spanish scholar early in the fifth century, and which had long been a popular text-book among those who understood Latin—and the "Consolations of Philosophy" of Boethius, the work of a noble Roman, who, after long faithfully serving the Gothic King Theodoric, was at last disgraced, and, after a long imprisonment, unjustly put to death by his ungrateful master in 526. He wrote his famous work during his imprisonment.

Many smaller writers in the Anglo-Saxon tongue might be named; but those we have mentioned are sufficient to indicate the character of the vernacular literature. The only other work which it is necessary to refer to is one of a very different kind. The "Saxon Chronicle" is a work of more historical than literary interest. It is a mere record from year to year of the chief facts of English history, from the invasion of Julius Cæsar, B.C. 55, down to the death of Stephen, in A.D. 1154. The opinion of the best scholars is that so much as relates the history down to the time of Alfred was composed in the reign of that king, and that the chronicle was afterwards continued from time to time, until it finally came to a close at the period we have mentioned.

THE PERIOD AFTER THE NORMAN CONQUEST.

The Norman Conquest was the death-blow to all literature among the conquered people. Saxon bishops and abbots gave place to Norman. The richest lands passed to the Normans. Every great office of trust and profit was reserved for the Normans. The Saxons were crushed and ground beneath the unflinching tyranny of a people alien in language as in race. The "Saxon Chronicle," it is true, was still carried on in the abbey of Peterborough; but the people were far too completely prostrate to have heart or energy left for any higher literary effort.

Latin literature, however, received a great impulse from the Conquest, for by it England was brought into closer contact with the continent of Europe. In those days the common wealth of learning knew no distinction of race or country. In our days every nation has its own favourite course of study, in which students are taught by their own countrymen, and in their own tongue. But in the days of which we are speaking, there was one curriculum of learning, and one language for the learned. An English student would have been equally at home at Oxford, at Paris, or at Bologna. In each place he would find the same men teaching the same philosophy, and in the same tongue. Accordingly, long before the Conquest the Saxon Alcuin had taught at the court of Charlemagne; and Scotus Erigena, the Irish philosopher, in France. So now the archbishopric of Canterbury was occupied immediately after the Conquest by two Italians in succession, Lanfranc and Anselm, both of them great theologians and scholars. John Duns Scotus, of Celtic race, and a native either of Scotland or Ireland, taught the scholastic philosophy both at Oxford and in Paris; while the great English schoolmen Alexander Hales and William of Occam taught in France and Germany. Of the English philosophers who lived and taught in England, the most eminent was Friar Roger Bacon, known to fame as the reputed inventor of gunpowder, who pursued the study of natural science with unwearied diligence and remarkable success in the thirteenth century, and acquired thereby the questionable reputation of a great magician.

Poetry in Latin also was cultivated among the learned with considerable success; but most of the productions of this class are of comparatively little interest to us in the present day. There is one class of Latin poems, however, which deserves to be specially noted, not only because it is curious in itself, but still more because it reveals to us much of the thoughts of men at the period; and, moreover, it shows the beginning of a spirit which received its full development in the days of Wycliffe. Walter Map, or Mapes, was a churchman eminent for learning and ability in the reign of Henry II., and held the office of Archdeacon of Oxford. To him was popularly attributed a great mass of poetry written in rhymed Latin verse, the subject of which was generally the corruptions of the clergy, and which attained immense popularity. Map may very likely have written some of the poems attributed to him, but there is no doubt that most of them are of a later date, and are not the work of one writer, but of a series of writers. The central figure in most of these poems is a certain imaginary bishop "Golias," the representative of idleness, corruption, and sensuality among the clergy. There is the "Vision of Golias," the "Confession of Golias," and a vast number of other poems connected with his name. Most of these compositions are satires of the broadest kind, directed against the clergy, especially the monks, and, above all, the Cistercians; but among them are to be found a good many very serious exhortations and moral discourses as to the obligations of the clerical life, and upon kindred subjects. This Gobias literature, its remarkable extent, and great popularity, are instructive, as showing how closely the popular disgust at the growing corruptions of the clergy, and particularly of the monastic orders, was connected with the early development of our literature, a subject upon which we shall have more to say hereafter.

But the class of Latin writings most especially characteristic of this period are the innumerable chronicles which were produced during it. These chronicles were written by monks in the great monasteries scattered over the kingdom. They are the histories of different periods; some of them purporting to contain the history of the world from the creation, others only the history of England, or even a small portion of it. And they are of very various degrees of merit, some of them being the merest transcripts of earlier writers, while others give us very life-like pictures of contemporary events. Among the most famous of these chroniclers—famous, some for their truth and others for their falsehood—are William of Malmesbury, Geoffrey of Monmouth, Giraldus Cambrensis, Roger of Hoveden, Matthew Paris, William Rishanger, and Ralph Higdon.

But the Norman conquerers of England were, as a class, no more competent to understand a literature in Latin than the conquered Saxons. They had, therefore, as was natural, a literature of their own in French. In France two dialects, or rather two languages, prevailed. In the South was spoken the Provençal tongue, and in this tongue the *Troubadours* composed and sang their poems. In the North was spoken a different dialect, the ancestor of the modern French, and its poets were the *Trouveres.* Of the works of these latter, the Normans, no doubt, brought many with them from France, and many more came over later, or were composed in England. The poetry of the Trouveres is the poetry of chivalry, the poetry of the Crusaders. It consisted chiefly of romances in verse upon subjects of chivalry, the adventures of King Arthur and his Round Table, and those of Charlemagne and his peers, occupying by far the largest space. But the subjects of those romances were very various, though their character is very uniform. There was, besides, a class of stories in verse or prose, founded, not upon the adventures of heroes, but upon the simpler incidents of real life, which were known as *fabliaux.*

We have said that the Norman Conquest was for the time the destruction of the native literature. The "Saxon Chronicle," no doubt, was continued for nearly a century longer, down to the end of the reign of Stephen; and there are still extant songs in the native tongue dating from a very early period. But these exceptions are so slight, that it may safely be said that after the Conquest the Saxon tongue soon ceased to be used for literary purposes, its place being taken partly by Latin, and partly by Norman-French.

The period between the death of Stephen and the age of Chaucer, a period of about two hundred years, is commonly divided, as has been already pointed out, into two pretty equal periods, during which the names Semi-Saxon and Old English are applied to the language. But we must again remind the student that these divisions are adopted, not to mark any sudden breaks in the development of the language, but because chronological divisions are convenient as aids to the memory in retaining a large number of facts spread over a long time.

During the first of these two periods, the Semi-Saxon, we find a tendency to revival in the English language, though the remains that have come down to us are but small in extent. Layamon was a priest of Earnley, on the Severn, probably in the days of Henry II. He wrote a chronicle of Britain, under the title of "Brut." The name represented the general, though of course groundless, belief among our ancestors that this island was colonised by one Brutus, of Trojan descent, and after him was called Britain. This chronicle, as the author himself tells us, was founded upon several earlier books in Latin, including Bede's history, and upon the French narrative of Wace. The work of Layamon displays considerable poetical power and originality; and it curiously illustrates the character of the times in which it was written, and the transition that was commencing, by its form; for, alternating with the old Saxon system of alliterative verses, it shows us the rhyming versification borrowed from the Norman-French. In the main, however, its structure is Saxon.

To the same century, though probably a later portion of it, belongs the "Ormulum," so called by its author Orm, or Ormin, after his own name. Ormin was an Augustinian friar, and his book is a metrical version of the Gospel narrative, harmonised, as he explains himself, from the four Evangelists; and with homilies or discourses added upon the various passages, in the order in which they occur in the Church services. The "Ormulum" is very long, and has but little poetical merit; but the versification is smooth, and its form is worth noting. The metre is almost identical with the modern ballad metre, but without rhyme, and also without alliteration.

Other remains of Semi-Saxon literature have come down to us, but none of so great general interest as the two of which we have spoken. The largest and most important work of this period which has been published next to those mentioned is the "Ancrem Ricole," or "Rule for Anchoresses" (that is, nuns). This curious book is a treatise on the duties and dangers of nuns, with full instructions for their guidance upon all points, illustrated by warnings and examples from the Bible and other sources. It is addressed, apparently by a learned divine, to three ladies, "sisters, of one father and one mother, having in the bloom of youth forsaken all the pleasures of the world and become anchoresses."

The remaining period, falling between the middle of the thirteenth century and the age of Chaucer, is that during which the name of Old English is given to the language; and in it, as in the preceding period, the literature in the native tongue is but scanty.

The two most ambitious works in English belonging to this period are metrical chronicles, those of Robert of Gloucester, and Robert Manning, or Robert of Brunne. Neither of these is of much historical merit; neither is much more than a translation from earlier Latin and French authors. They illustrate, however, the increasing demand for the means of historical teaching in the vernacular. The same thing is strongly shown by the increasing number of versions, sometimes in verse, sometimes in prose, of portions of the Holy Scriptures, and other works designed for the purposes of religious instruction.

But the revival of national spirit is manifested more plainly still by the lighter literature of the period. At an earlier date the literature of mere pleasure, as distinguished from that designed for instruction, was all, or nearly all, in French. But at this period, writers were busy turning the most popular of the French romances into English; and, as might be expected, they were not only translated but imitated, and to such an extent that a considerable quantity of the vernacular poetry of that age has been handed down to us; while, of course, that which we possess must be but a very small part of that which once existed. Such was, in brief outline, the history of literature in England before the great era of which Chaucer is the most distinguished representative. The literature of his age will form the subject of the next succeeding lessons.

LESSONS IN MUSIC.—XXII.

MODULATION—TRANSITION—"MELCOMBE"—MENTAL EFFECTS OF TRANSITION.

THE subject of "transition" or "modulation," on which we have now to speak, will be deeply interesting to those who have studied the "mental effects" of notes as developed in the preceding lessons. We shall first *describe* this musical change, and then show our pupils how to *test* our description by their own ears. If we had them under oral instruction, we should first make their ears conscious of the change, and then persuade them to analyse it, trace its origin, and describe it. As we cannot compel our pupils to pass through this discipline, we trust that they will be their own masters in this respect, and remember that music is not to be learnt by the eye, but by the ear. If you do nothing but *read* a verbal *description* of a musical fact, you can only be said then to have learnt the *description;* the musical fact itself you can know nothing of until you have *heard* it.

Sometimes, in the course of a tune, the notes are so ordered as to direct the ear to a new GOVERNING or KEY-NOTE, diverting the mind for a time from considering the original key-note as the principal key-note or the principal note of rest and close. The music is then said to have passed into a new key, and the several notes exchange the mental effects which they possessed as members of the old key for those which are proper to their position in the new key. This is called TRANSITION, and is usually effected by an alteration in one or more of the notes.

"Modulation" is another name commonly given to this magical change of musical intention and effect, which, at the call of some single new note characteristically heard as it enters the music, causes all the other sounds to acknowledge a new ruler and sovereign, and suddenly assuming the new offices he requires, to minister in their places around him. Modulation means, more properly, simply singing in "mode" or key, which of course includes the singing which passes into various "modes" or keys, but is also applicable to correct performance in one mode.

The note most frequently chosen to become a new governing (or key) note is SOH, the fifth of the common scale. The ear is usually *made to feel* that SOH (the fifth) is treated as the key-note, by the introduction of *a new* note instead of the FAH of the original key. This new note occupies the same position in respect of SOH which TE holds to DOH; and so, having become the new DOH, it would be properly called TE. When, however, it is desirable to indicate the new note alone, and to distinguish it from the DOH of the original key, it is named FE.

In the diagram on the next page, we have endeavoured to illustrate the consequences of this change in the new effects produced on the mind. The central column represents the principal key of the tune in which you are singing, with those adjectives by which we have, in previous lessons, designated the mental effects of the notes of the scale placed on either side of each note. These descriptive words, however, must be taken with all the limitations arising from rate of movement, harmonic accompaniment, etc., to which we before referred. With this understanding, the right-hand column will show how the notes change their mental effect at the call of the new note, now called FE, and direct the ears to what before was SOH, as a new key-note—a new DOH. The "steady, calm" note begins to produce the effect which we describe as "weeping and sorrowful." The "hopeful rousing" note changes to the "grand and clear" effect, and so on. Let the pupil sing the following tune "Melcombe" to the figures "one, two, three, four, five, six, seven, eight—one, two," etc., or get it sung to him. In singing this

*

EXERCISE 38.—**MELCOMBE.** KEY F. M. 50.

:s	s :f	m :r	d :l	s :s	d^1 :t
See	how be-	neath the	moon - beam's	smile, Yon	lit - tle
THUS	MAN, the	sport of	bliss and	care, Ris-	es on
:m	m :r	d :t_1	d :f	m :f	m :r

l :s	s :fe	s :m	m :f	s :m
bil - low	heaves its	breast, And	foams and	spar - kles
Time's e-	vent - ful	sea; *And*	*hav - ing*	*swelled a*
d :t_1	l_1 :l_1	s_1 :d	d :l_1	t_1 :d

r :m	f :f	m :r	s :f	m :r	d
for a-	while, And	mur - m'ring	then sub-	sides to	rest.
mo - ment	*there,* Thus	melts in-	to e-	ter - ni-	ty.
t_1 :d	r :t_1	d :s_1.f_1	m_1 :l_1	s_1.d :t_1	d

exercise as directed, or in listening to it when sung by another, let the pupil notice the effect of the second "eight" as compared with the first. Do you not feel that it has become, in mental effect, no longer SOH but DOH? Notice again the effect on your mind of the first two notes in the third line, immediately after the FE has been heard. Is not ME softened and more sad? Is it not the "steady, calm" note, partaking of the "weeping, sorrowful" character? After the next paragraph we shall be able to pursue the tune a step farther.

THE MENTAL EFFECTS OF TRANSITION PROXIMATELY DESCRIBED.

grand	**SOH**	*clear*	STRONG	**DOH**	FIRM	*desolate*	FAH	*awe-inspiring*
desolate	FAH	*awe-inspiring*	SENSITIVE	TE	PIERCING	*steady*	**ME**	*calm*
steady	**ME**	*calm*	WEEPING	LAH	SORROWFUL	*hopeful*	RAY	*rousing*
hopeful	RAY	*rousing*	GRAND	**SOH**	CLEAR	*strong*	**DOH**	*firm*
strong	**DOH**	*firm*	DESOLATE	FAH	AWE-INSPIRING	*sensitive*	TE	*piercing*
sensitive	TE	*piercing*	STEADY	**ME**	CALM	*weeping*	LAH	*sorrowful*
weeping	LAH	*sorrowful*	HOPEFUL	RAY	ROUSING	*grand*	**SOH**	*clear*
grand	**SOH**	*clear*	STRONG	**DOH**	FIRM.	*desolate*	FAH	*awe-inspiring.*

The note FAH—the fourth in the common scale—is also very frequently taken, by transition, as a key-note. The whole "intention" of the music is diverted to FAH as its new centre, and the tune is said to have passed into the FAH key. This transition is indicated to the ear by the introduction of a new note instead of the TE of the original key. This new note stands in the same relation to LAH (the sixth) which FAH holds to ME. It is the FAH of the new key, but is called TA when it is wished to distinguish it from the FAH of the previous key. This FAH key is represented by the left-hand column of the diagram above. Let the pupil put these remarks to the test in connection with the tunes "Oberlin" and "Saul;" or by studying the following phrase:—

:d^1	t :s	d^1 :ta	l :s	f :—
:d^1	t :s	d^1s :f	m :r	d :—

The second method of solfaing need not at present be noticed. Only ask yourselves, in connection with the first method of solfaing, "do LAH really sound like the *weeping*, and FAH like the *desolate* notes they were?" The note SOH is called in books of musical science the "dominant," and the new key first described is called the key of the "dominant." FAH being called the "subdominant," the second of the new keys described is called the "key of the subdominant." It may also be noticed that FE—the *distinguishing* note of the dominant key—is often called "the sharp fourth," as though it were only the fourth of the original key made "sharper" or higher. So indeed it appears in the old notation, but it is not truly the fourth of any key, but the *seventh* of a new key. So also TA—the *distinguishing* note of the subdominant key—is often called "the flat seventh," as though it were merely the seventh of the original key made "flat" or lower, whereas it is, in truth, the *fourth* of a new key.

The pupil will have noticed, in the third line of the tune "Melcombe," that immediately the FAH of the original key is heard instead of FE, the music is felt to have returned to the original key, and the SOH is instantly restored to its more brilliant character. Thus the "return" from the SOH key is made by a transition, which has the same effect as passing into the FAH key, and you will also notice that a "return" from the FAH key has also the same effect as transition into a SOH key.

In simple music, the tune is seldom carried, by transition, more than one remove from the original key, and soon returns to it. In lengthened pieces of music, however, the tune sometimes passes from key to key, in this manner, till it is several removes from the original key, and then returns, through the same keys, till it reaches the original key again. And sometimes it passes *immediately* into a more distant key.

It will be observed that the notes FE and TA produce on the mind the effects proper, respectively, to the TE and FAH of the original key, but somewhat softened. "It is clear," says M. Jeu de Berneval, "that the whole artifice of these two modulations depends on the properties of the *subdominant* (FAH) and *sensible* (TE) which exchange their respective offices." In other words, these transitions present TE to the ear where it was expecting FAH, and FAH where it expected TE.

Occasionally, in the course of a tune, a note is introduced which is somewhat less than half a tone higher or lower than some given note of the scale. It is called a chromatic (the Greek for *colouring*) note, and the interval between it and the note of the scale from which it springs is called a chromatic degree. When a note is thus *raised* a chromatic degree, we distinguish it by the vowel *e*. Thus FAH becomes FE, and RAY becomes RE. When a note is *lowered* a chromatic degree, the vowel *aw* is given to the syllable. Thus TE becomes TAW, ME MAW, etc., written TA and MA.

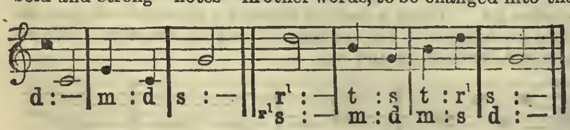
FAH : FE | SOH : — | ME : MA | RAY : —

It is usual, in elementary works, to treat this chromatic interval as the foundation of a *scale*, called "the chromatic scale," in which each tone of the common scale is divided into a chromatic degree and a "diatonic semitone." In one form of this "scale" (that with "sharps" in the old notation) the chromatic note leaves the larger interval above it, and in the other below; but the real musical *fact* is, that these chromatic notes are only *occasional variations* from the common arrangement of notes. Why then puzzle us with a *whole scale* of them? "*No piece of music*," says Dr. Bryce, "*is ever composed in the chromatic scale*." Then how could Dr. Bryce, as a philosopher, elevate these exceptions to the dignity of a rule? Why should they be called a scale at all?

In transition, the music usually passes into the new key through some note which, as far as relates to its pitch, is common to both keys. Thus you will see, from the diagram above, that we can pass into the key of SOH (the dominant) through the note ME, which is convertible into LAH of the new key, or through SOH (convertible into DOH), as well as through other notes which have a corresponding pitch in both keys. But if we were to pass directly from FAH, which cannot form part of the new key, to FE (which "distinguishes" it), the note FE would then seem to spring as a chromatic note from FAH, and would not necessarily suggest the formation of a new key. For the same reason, we could not well produce the effect of transition by passing into the key of FAH (the "subdominant") from TE to TA. Nevertheless, in modern music, many cases occur of a more "*sudden*" or "irregular" transition, in which the music passes directly from FAH to FE or from TE to TA. See two cases in tunes well known—one in the "May Fly," and the other in "Lightly Tread." Both are sol-faed in the "Tonic Sol-fa Reporter," No. 4. "Natural modulation," says Sir John Goss, "that is, modulation into related keys, may be performed either *gradually* or *suddenly*. The gradual method is that in which we take some *doubtful chord* (or chord which may be considered to belong either to the key we are in or to that into which we are going), and from this chord proceed to a *modulating chord*, or chord which clearly marks the change of key, by exhibiting a new sharp or flat." Dr. Marx calls this preparatory chord the "mediating chord." See also Dr. Crotch and Mr. Hickson.

This "convertible" note, from which transition is taken, should be indicated, in solfaing, by pronouncing the syllabic name it bears in the old key together with that which it takes in the new. Thus ME converted into LAH of the new key would be pronounced M'LAH, DOH converted into SOH would be pronounced D'SOH, and so with the rest. The mention of the first syllabic name gives help to the ear (by association) *in striking* the note, and the sliding into the new syllable prepares the ear for the interval by which we *leave* the note, and makes us feel our place in the new key. In writing, this "convertible" note may have the initial of its first syllabic name placed before and above that of its second and new name. Thus $^{m}l_1$, or ^{d}s or ^{s}r. When music is solfaed in this, the more perfect way of denoting transition, FE of course becomes the new TE, and TA is the new FAH. As the old notation, however, does not mark the "doubtful" or "convertible" note, and leaves us unprepared for the change until we come actually upon a distinguishing note of the new key, we are often obliged to translate that distinguishing note by the syllables TE or TA, and continue solfaing as though we were still in the old key. This, however, is very unsatisfactory, except where the transition is only momentary, and there is an immediate return to the old key.

Transition may be indicated, without the occurrence of the "distinguishing" notes to which we have referred, by the marked use of those notes of the scale which are not the "bold and strong" notes, as *though they were meant* to be bold and strong. In the second part of the following phrase, for instance, the ear naturally supposes SOH, TE, and RAY to have become "bold and strong" notes—in other words, to be changed into the



DOH, ME, and SOH of a new key. The "modulator" will show you that that new key is the key of SOH, the dominant.

And in the ensuing phrase you are compelled to feel that the peculiar use of LAH and FAH has made *them* "bold and strong" notes, or, in other words, placed you in the key of FAH, the "subdominant."

LESSONS IN GREEK.—XXVI.

VERBS IN ω—THE PURE VERB λυω, *I loose* (ACTIVE VOICE).

THE Greek λυω and the English *loose* are obviously connected in form as well as meaning. From the same root is our *to lose*, which is the same word as *loose*, differently spelt and pronounced. To *lose* is the effect of *loosing*.

Below is given in full, as an example of a verb pure, the conjugation of the verb λυω, *I loose* or *unbind*. But as the pure verbs do not possess the second tenses—that is, the second perfect active, the second pluperfect active, the second future passive, and the second aorist active, middle, and passive—examples of these second forms are taken from two mute verbs, namely, τριβω, *I rub*, and λειπ-ω (root, λιπ), *I leave*; and from one liquid verb, namely, φαιν-ω (root, φαν), *I show*. By this means a complete example is presented.

CONJUGATION OF A PURE VERB IN -ω.

Active Voice.—Paradigm.

INDICATIVE MOOD.

		Present.—Stem λυ-.	*Imperfect.*—Stem ε-λυ-.
Sing.	1.	λυ-ω,* *I loose*, or *am loosing*.	ε-λυ-ον,* *I was loosing*.
	2.	λυ-εις, *thou art loosing*.	ε-λυ-ες, *thou wast loosing*.
	3.	λυ-ει, *he is loosing*.	ε-λυ-ε, *he was loosing*.
Dual.	2.	λυ-ετον,* *you two are loosing*.	ε-λυ-ετην, *you two were loosing*
	3.	λυ-ετον,* *they two are loosing*.	ε-λυ-ετην, *they two were loosing*.
Plur.	1.	λυ-ομεν, *we are loosing*.	ε-λυ-ομεν, *we were loosing*.
	2.	λυ-ετε,* *you are loosing*.	ε-λυ-ετε, *you were loosing*.
	3.	λυ-ουσι, *they are loosing*.	ε-λυ-ον,* *they were loosing*.

		Future.—Stem λυ-σ-.		*First Aorist.*—Stem ε-λυ-σ-.
Sing.	1.	λυ-σ-ω,* *I shall loose, etc.*		ε-λυ-σ-α, *I loosed, etc.*
	2.	λυ-σ-εις.		ε-λυ-σ-ας.
	3.	λυ-σ-ει.		ε-λυ-σ-ε.
Dual.	2.	λυ-σ-, etc.	(*Like the Present.*)	ε-λυ-σ-ατην.
	3.	λυ-σ-		ε-λυ-σ-ατην.
Plur.	1.	λυ-σ-		ε-λυ-σ-αμεν.
	2.	λυ-σ-		ε-λυ-σ-ατε.
	3.	λυ-σ-		ε-λυ-σ-αν.

		Perfect 1st.—Stem λε-λυ-κ-.	*Pluperfect* 1st.—Stem ε-λε-λυ-κ-.
Sing.	1.	λε-λυ-κ-α, *I have loosed, etc.*	ε-λε-λυ-κ-ειν, *I had loosed, etc.*
	2.	λε-λυ-κ-ας.	ε-λε-λυ-κ-εις.
	3.	λε-λυ-κ-ε.*	ε-λε-λυ-κ-ει.
Dual.	2.	λε-λυ-κ-ατον.*	ε-λε-λυ-κ-ειτην.
	3.	λε-λυ-κ-ατον.*	ε-λε-λυ-κ-ειτην.
Plur.	1.	λε-λυ-κ-αμεν.	ε-λε-λυ-κ-ειμεν.
	2.	λε-λυ-κ-ατε.	ε-λε-λυ-κ-ειτε.
	3.	λε-λυ-κ-ᾱσι.	ε-λε-λυ-κ-εισαν or εσαν.

		Perfect Second.	*Pluperfect Second.*
Sing.	1.	πε-φην-α,† *I have appeared.*	ε-πε-φην-ειν,‡ *I had appeared.*

Aorist Second.—Stem ε-λιπ-.

Sing.	1.	ε-λιπ-ον.	(*Like the Indicative Imperfect.*)
	2.	ε-λιπ-ες, etc.	

SUBJUNCTIVE MOOD.

		Present.—Stem λυ-.	*First Aorist.*—Stem λυ-σ-.	
Sing.	1.	λυ-ω,* *I may loose, etc.*	λυ-σ-ω,* *I may have loosed, etc.*	
	2.	λυ-ῃς.	λυ-σ-ῃς.	
	3.	λυ-ῃ.	λυ-σ-	
Dual.	2.	λυ-ητον.	λυ-σ-	(*Like the Present Subjunctive.*)
	3.	λυ-ητον.	λυ-σ-	
Plur.	1.	λυ-ωμεν.	λυ-σ-	
	2.	λυ-ητε.	λυ-σ-	
	3.	λυ-ωσι.	λυ-σ-	

† The flexions are the same as in the First Perfect.
‡ The flexions are the same as in the First Pluperfect.

Perfect First.—Stem λε-λυ-κ.		*Perfect Second.*
Sing. 1. λε-λυ-κ-ω, *I may have* [*loosed, etc.*		πε-φην-ω,† *I may have ap-* [*peared.*
2. λε-λυ-κ-ῃς.		
3. λε-λυ-κ-	(*Like the Present Subjunctive.*)	
Dual. 2. λε-λυ-κ-		*Aorist Second.*—Stem λιπ-.
3. λε-λυ-κ-		*Sing.* 1. λιπ-ω, *I may have* [*left.*
Plur. 1. λε-λυ-κ-		2. λιπ-ῃς, etc.
2. λε-λυ-κ-		(*Like the Pres. Subjunctive.*)
3. λε-λυ-κ-		

OPTATIVE MOOD.

Present.—Stem λυ-.	*Future.*—Stem λυ-σ-.
Sing. 1. λυ-οιμι, *I might loose, etc.*	λυ-σ-οιμι, *I would loose, etc.*
2. λυ-οις.	λυ-σ-, etc.
3. λυ-οι.	λυ-σ-
Dual. 2. λυ-οιτην.	λυ-σ-
3. λυ-οιτην.	λυ-σ- (*Like the Present.*)
Plur. 1. λυ-οιμεν.	λυ-σ-
2. λυ-οιτε.	λυ-σ-
3. λυ-οιεν.	λυ-σ-

First Aorist.—Stem λυ-σ-.	*Pluperfect 1st.*—Stem λε-λυ-κ-.
Sing. 1. λυ-σ-αιμι, *I might have* [*loosed, etc.*	λε-λυ-κ-οιμι, *I might have* [*loosed.*
2. λυ-σ-αις or -ειας.	λε-λυ-κ-οις, etc.
3. λυ-σ-αι* or -ειε.	λε-λυ-κ-
Dual. 2. λυ-σ-αιτην.	λε-λυ-κ-
3. λυ-σ-αιτην.	λε-λυ-κ- (*Like the Optative Present.*)
Plur. 1. λυ-σ-αιμεν.	λε-λυ-κ-
2. λυ-σ-αιτε.	λε-λυ-κ-
3. λυ-σ-αιεν or -ειαν.	λε-λυ-κ-

Pluperfect 2nd.	*Aorist 2nd.*—Stem λιπ-.
Sing. 1. πε-φην-οιμι.	1. λιπ-οιμι (*Like the Op-*
(*Like the 1st Pluperfect.*)	2. λιπ-οις *tative Present.*)

IMPERATIVE MOOD.

Present.—Stem λυ-.	*First Aorist.*—Stem λυ-σ-.
Sing. 2. λυ-ε, *loose thou, etc.*	λυ-σ-ον,* *loose thou, etc.*
3. λυ-ετω.	λυ-σ-ατω.
Dual. 2. λυ-ετον.*	λυ-σ-ατον.
3. λυ-ετων.	λυ-σ-ατων.
Plur. 2. λυ-ετε.*	λυ-σ-ατε.
3. λυ-ετωσαν or -οντων.	λυ-σ-ατωσαν or -αντων.*

Perfect First.—Stem λε-λυ-κ-.	*Perfect Second.*
Sing. 2. λε-λυ-κ-ε.*	πε-φην-ε.*
3. λε-λυ-κ-ετω.	(*Like the 1st Perfect.*)
Dual. 2. λε-λυ-κ-ετον.	
3. λε-λυ-κ-ετων.	*Aorist Second.*—Stem ε-λιπ-.
Plur. 2. λε-λυ-κ-ετε.	*Sing.* 2. λιπ-ε.
3. λε-λυ-κ-ετωσαν or οντων.	(*Like the Present Imperative.*)

INFINITIVE MOOD.

Present.	λυ-ειν, *to loose.*
Future.	λυ-σ-ειν, *to be about to loose.*
First Aorist.	λυ-σ-αι, *to have loosed.*
Perfect First.	λε-λυ-κ-εναι, *to have loosed.*
Perfect Second.	πε-φη-νε-ναι, *to have appeared.*
Aorist Second.	λιπ-ειν, *to have left.*

PARTICIPLES.

Present.	λυ-ων, *loosing.*
Future.	λυ-σ-ων, *about loosing.*
First Aorist.	λυ-σ-ας, *having loosed.*
Perfect First.	λε-κυ-κ-ως, *having loosed.*
Perfect Second.	πε-φην-ως, *having appeared.*
Aorist Second.	λιπ-ων, *having left.*

The connection of the parts will become obvious if we put the stems together.

STEMS.

Present,	*Imperfect,*	*Future,*	*First Aorist,*	*First Perfect,*
λυ.	ελυ.	λυσ.	ελυσ.	λελυκ.

First Pluperfect,	*Second Perfect,*	*Second Pluperfect,*	*Second Aorist,*
ελελυκ.	πεφην.	επεφην.	ελιπ.

The first thing which the student should do is to make himself familiar with the stems. Having got the stems, he will easily acquire the rest.

After he has learnt to recognise the connection and derivation of the several parts, and so formed some idea of the perfect simplicity of the whole, let him commit the entire paradigm to memory; and let him not pass on until he has accomplished the task, and he will find that the effort will save a world of trouble.

It is customary in Greek grammar to give three parts of the verb as the principal parts, or those parts from which the others may be formed; viz., the Present, the Future, and the Perfect. The connection of the other parts with these three is shown in the table of stems given above. This may be seen in the following examples—τιω, *I honour*; βουλευω, *I advise*; and λουω, *I wash*:—

Present.	*Future.*	*Perfect.*
τιω,	τισω,	τε-τικα.
βουλευω,	βουλευσω,	βε-βουλευκα.
λουω,	λουσω,	λε-λουκα.

Here we have the same parts in their stems:—

Present Stem.	*Future Stem.*	*Perfect Stem.*
τι-,	τισ-,	τε-τικ-.
βουλευ-,	βουλευσ-,	βε-βουλευκ-.
λου-,	λουσ-,	λε-λουκ-.

From these the other parts are readily formed. Take τισ- as an example:—

τισ-.

τισ-ω, τισ-οιμι, τισ-ειν, τισ-ων, ετισ-α, τισ-αιμι, τισ-αι, τισ-ας, etc.

What these parts are the student must learn from the paradigm.

He may be assisted in becoming acquainted with the verb in various ways. Let him, with that view, study this table of

THE PERSONAL TERMINATIONS OF THE ACTIVE VOICE.

PRINCIPAL TENSES.

	Singular.	*Dual.*	*Plural.*
Ind. Pres. and Fut.	-ω, -εις, -ει.	-ετον, -ετον.	-ομεν, -ετε, -ουσι.
The Subj. entire.	-ω, -ῃς, -ῃ.	-ητον, -ητον.	-ωμεν, -ητε, -ωσι.
Ind. Perfect.	-α, -ας, -ε.	-ατον, -ατον.	-αμεν, -ατε, -ασι.

HISTORIC TENSES.

	Singular.	*Dual.*	*Plural.*
Ind. Imperf.	-ον, -ες, -ε.	-ετον, -ετην.	-ομεν, -ετε, -ον.
Aorist First.	-α, -ας, -ε.	-ατην, -ατην.	-αμεν, -ατε, -αν.
Pluperfect.	-ειν, -εις, -ει.	-ειτην, -ειτην.	-ειμεν, -ειτε, -εισαν or -εσαν.
Optative ο / α	-ιμι, -ις, -ι.	-ιτην, -ιτην.	-ιμεν, -ιτε, -ιεν.

IMPERATIVE.

	Singular.	*Dual.*	*Plural.*
Present and Perfect.	-ε, -ετω.	-ετον, -ετων.	-ετε, -ετωσαν.
Aorist.	-ον, -ατω.	-ατον, -ατων.	-ατε, -ατωσαν.

Observe certain characteristics, and see how they are preserved in their several forms. Thus σ is the characteristic of the future. Accordingly, σ is found in the future indicative, in the future subjunctive, in the future infinitive, and in the future participle. From the future the first aorist is immediately derived, and so the σ appears in its forms. In the first aorist forms, however, the σ is connected, not with ο, but with α, forming σα. This, then, may be considered as the characteristic of the first aorist; and this characteristic runs through all the forms of that tense. Thus, when the characteristic of a tense is known, it is easy to ascertain what part of the tense any particular form is, and how it stands connected with other parts of the same stem, as well as with other stems, and with the common root.

Several of the forms of the verb recur, and they are distinguished in the paradigm by an asterisk. Let the student collect these and compare them together, until he is familiar with them, assigning each to their several positions in the verb. Thus, λυσω is either the first person singular indicative future active, or it is the first person singular of the aorist first subjunctive. Λυσαι occurs three times, as (1) the second person singular imperative aorist first middle, (2) the third person singular optative aorist first active, and (3) as the infinitive of the first aorist active.

As an exercise, let the student write out in full, in the active voice, the three verbs, τιω, βουλευω, and λουω, given above. Having written them carefully several times over from the copy, let him write them out from memory, beginning with one tense, then taking two tenses, then three tenses at a time, until he can accomplish the whole.

Let him also perform, in writing, the ensuing exercises, giving from memory the Greek forms required, and assigning, also from memory, the English significations.

EXERCISE 74.—GREEK-ENGLISH.

1. Λυων. 2. Λυσειν. 3. Λυει. 4. Λελυκα. 5. Ελελυκειν. 6. Λυσω. 7. Λυσοιτην. 8. Λυσοις. 9. Λυετω. 10. Λυετε. 11. Ελυον. 12. Λυσει. 13. Λυομεν. 14. Ελυετην. 15. Λυοιμι. 16. Ελυσα. 17. Λελυκε. 18. Ελυσε. 19. Λυσαιμι. 20. Λυσον. 21. Λυσατων. 22. Λυσας. 23. Λελυκω. 24. Λελυκας. 25. Ελελυκεσαν. 26. Ελυσαν. 27. Λελυκασι. 28. Λυσαιτε. 29. Λυσῃς. 30. Πεφηνας. 31. Ελιπες. 32. Λιπῃς. 33. Λιποις. 34. Λιπετω. 35. Λιπων. 36. Πεφηνεναι. 37. Επεφηνεις. 38. Πεφηνοι. 39. Λυσειε. 40. Λυσειαν.

EXERCISE 75.—ENGLISH-GREEK.

1. I have appeared. 2. Ye two left. 3. He might leave. 4. Ye might leave. 5. They loose. 6. They may loose. 7. They might loose. 8. Ye might have loosed. 9. Loose thou. 10. Let them loose. 11. I have loosed. 12. Ye will loose. 13. They may have loosed. 14. He might have loosed. 15. To loose. 16. To be about to loose. 17. Being about to loose. 18. Having loosed. 19. He may loose. 20. They two had loosed. 21. Ye two might loose. 22. Ye two may loose. 23. They have appeared. 24. Ye two have appeared. 25. He has appeared.

The student must also accustom himself to parse—that is, to assign or declare the several parts of the verbs (and of all words), as well as the grammatical relations they bear to other words. At present, however, we have to do with such exercises as will best aid him to thoroughly master the conjugation of the verb. In regard, then, to the active voice now set forth, as well as to other parts to be hereafter given, he should write down very carefully (and correct what he writes by the paradigm) the several parts of the Greek-English exercise, distinguishing (1) the root, (2) the augment, (3) the tense-stem, (4) the tense, (5) the mood-vowel, (6) the tense-stem with the mood-vowel, (7) the person-ending, (8) the tense-stem, together with the mood-vowel and the person-ending. Take as an instance εβουλευσατο, *he took counsel.* The word may be divided thus, ε-βουλευ-σ-α-το. Of these elements, βουλευ is the root; ε is the augment; ε combined with βουλευ forms εβουλευ-, which is the tense-stem of the imperfect indicative active; the σ, the tense-characteristic of the first aorist, and thus the stem of this part will be εβουλευσ-; the α is the mood-vowel of the indicative first aorist, giving us εβουλευσα-; finally, the το is the person-ending of the third person singular of an historic tense of the middle voice, namely, εβουλευσα-το, being the third person singular number first aorist middle voice, from βουλευομαι; the active form of which is βουλευω, and the chief parts are βουλευω, βουλευσω, βεβουλευ-κα; for, in all instances, the root must be given as found in the Lexicons, and the principal parts, as well as (1) the person, (2) the number, (3) the mood, (4) the tense, (5) the voice, of every verb and every form of every verb that is met with.

The participles in the paradigm are—present, λυων; future, λυσων; second aorist, λιπων first aorist, λυσας; first perfect, λελυκως; second perfect, πεφηνως. Of these, λυων, λυσων, and λιπων are declined like ων, which occurs in Lesson XXIV.; and πεφηνως is declined like λελυκως. The forms of λυσας and λελυκως will serve as a pattern for the rest.

DECLENSION OF THE PARTICIPLE λυσας, λυσασα, λυσαν, *about loosing.*

	MASC.	FEM.	NEUT.
Singular.			
Nom.	λυ-σας,	λυ-σασα,	λυ-σαν.
Gen.	λυ-σαντος,	λυ-σασης,	λυ-σαντος.
Dat.	λυ-σαντι,	λυ-σασῃ,	λυ-σαντι.
Acc.	λυ-σαντα,	λυ-σασαν,	λυ-σαν.
Dual.			
Nom. and Acc.	λυ-σαντε,	λυ-σασα,	λυ-σαντε.
Gen. and Dat.	λυ-σαντοιν,	λυ-σασαιν,	λυ-σαντοιν.
Plural.			
Nom.	λυ-σαντες,	λυ-σασαι,	λυ-σαντα.
Gen.	λυ-σαντων,	λυ-σασων,	λυ-σαντων.
Dat.	λυ-σασι,	λυ-σασαις,	λυ-σασι.
Acc.	λυ-σαντας,	λυ-σασας,	λυ-σαντα.

THE PARTICIPLE λελυκως, λελυκυια, λελυκος, *having loosed.*

	MASC.	FEM.	NEUT.
Singular.			
Nom.	λελυ-κως,	λελυ-κυια,	λελυ-κος.
Gen.	λελυ-κοτος,	λελυ-κυιας,	λελυ-κοτος.
Dat.	λελυ-κοτι,	λελυ-κυιᾳ,	λελυ-κοτι.
Acc.	λελυ-κοτα,	λελυ-κυιαν,	λελυ-κος.
Dual.			
Nom. and Acc.	λελυ-κοτε,	λελυ-κυια,	λελυ-κοτε.
Gen. and Dat.	λελυ-κοτοιν,	λελυ-κυιαιν,	λελυ-κοτοιν.
Plural.			
Nom.	λελυ-κοτες,	λελυ-κυιαι,	λελυ-κοτα.
Gen.	λελυ-κοτων,	λελυ-κυιων,	λελυ-κοτων.
Dat.	λελυ-κοσι,	λελυ-κυιαις,	λελυ-κοσι.
Acc.	λελυ-κοτας,	λελυ-κυιας,	λελυ-κοτα.

If the formation of the present tense of λυω be compared with its Latin representative, *solvo*, their similarity will at once be noticed. *Solvo* is the root of the English words *solve, solution, dis-solve, dis-solution.*

THE GREEK λυω AND THE LATIN *solvo* COMPARED.

PRESENT TENSE ACTIVE.

	Indicative Mood.		*Subjunctive Mood.*	
	Greek.	*Latin.*	*Greek.*	*Latin.*
Sing. 1.	λυ-ω, *I loose;*	solv-o.	λυ-ω, *I may loose;*	solv-a-m.
2.	λυ-εις,	solv-i-s.	λυ-ῃ-ς,	solv-a-s.
3.	λυ-ει,	solv-i-t.	λυ-ῃ,	solv-a-t.
Plur. 1.	λυ-ομεν,	solv-i-mus.	λυ-ω-μεν,	solv-a-mus.
2.	λυ-ετε,	solv-i-tis.	λυ-η-τε,	solv-a-tis.
3.	λυ-ουσι,	solv-u-nt.	λυ-ω-σι,	solv-a-nt.

The occurrence of *s* as the constant sign of the second person singular should be observed. This *s* is the origin of our *s* in the second person singular, and is found in the French also—*e.g.*, tu aimes (Latin, amas; English, thou lovest); tu aimeras (Latin, amabis).

READINGS IN LATIN.—III.

SALLUST.

CAIUS CRISPUS SALLUSTIUS, the Roman historian, was born B.C. 86, and was a contemporary of Cæsar and the orator Cicero. At a comparatively early period of his life he began to take a prominent part in the political affairs of Rome, and filled several of the highest offices in the state; but having amassed a considerable fortune in the province of Numidia, whither he had been sent as governor, he retired from public life, and spent the remainder of his days in luxurious ease, dying B.C. 34.

The works of Sallust which have come down to us are two historical pieces, or monographs, as they are called—that is, narratives of a separate series of connected events—one on the conspiracy of Catiline, the other on the war with Jugurtha. He is also said to have written a more complete contemporary history of Rome, in five books, of which some extracts and detached sentences are all that remain to us.

Sallust is the first Roman author who appears to have paid any very great attention to style in his writings. His diction is by no means obscure; but he delights in strong antitheses and short, nervous sentences, making a frequent use of the historical infinitive in his descriptions. He appears also to have affected ancient formations and methods of spelling.

The "Catilina," from which our first extracts are taken, is an account of a conspiracy against the government of Rome by Lucius Sergius Catilina, a profligate noble of broken fortunes, who, supported by a body of followers in similar circumstances, discontented and turbulent like himself, hoped to recruit his fortunes out of the general state of anarchy and disorder which it was his object to create. The character of the man is vigorously drawn by Sallust in the following lines:—

SALLUST.—"CATILINA," V.

Lucius Catilina, nobili genere[1] natus, fuit magnâ vi et animī et corporis, sed ingenio[2] malo pravoque.[3] Huic ab adolescentia bella intestina,[4] cædes, rapinæ, discordia civilis, grata fuere; ibique[5] juventutem suam exercuit. Corpus[6] patiens inediæ, vigiliæ, supra quam cuiquam credibile est: animus audax, subdolus, varius, cujus rei libet[7] simulator ac dissimulator;[8] alieni appetens, sui profusus; ardens in cupiditatibus satis eloquentiæ, sapientiæ parum.[9] Vastus[10] animus immoderata, incredibilia, nimis alta semper cupiebat. Hunc post dominationem Lucii Sullæ[11] lubido maxima[12] invaserat reipublicæ capiendæ; neque id quibus modis assequeretur, dum sibi regnum pararet,[13] quidquam pensi habebat.[14] Agitabatur magis magisque in dies animus ferox, inopia rei familiaris,[15] et conscientia scelerum; quæ utraque his artibus[16] auxerat quas supra memoravi. Incitabant præterea corrupti civitatis mores, quos pessima ac diversa inter se[17] mala luxuria atque avaritia, vexabant.

NOTES.

1. Nobili genere, *a distinguished family*. Several members of the *gens Sergia*, to which Catilina belonged, had made themselves famous in former years, and the family claimed descent from the Trojan hero, Sergestus, who was said to have come into Italy with Æneas. See Virg., *Æn.*, v. 121: "Sergestusque, domus tenet a quo Sergia nomen."

2. Vi—ingenio, a descriptive ablative. "The ablative of a substantive, combined witn an adjective, is subjoined to a substantive [Catilina] by way of description, either immediately or with the verb *esse* [as here], to denote the quality or character of a person or thing." (Madvig, *Lat. Gr.*)

3. Pravo, *crooked*, *distorted*, as distinguished from malo, which means bad in its essence.

4. Bella intestina, cædes, etc. The way these different substantives are thrown together without any connecting particles, is a characteristic of Sallust's style.

5. Ibique, *and in them*. Sc. iis rebus, the wars and broils just mentioned.

6. Corpus (supply fuit ei), *he had a constitution*, etc.

7. Cujus rei libet; sc. cujuslibet rei. Sallust is fond of thus separating the words. So Catil. lii., "cujus rei cunque," for "cujuscunque rei."

8. Simulator, dissimulator. Simulo is to pretend that a thing is what it is not; dissimulo, to pretend a thing is not what it is, so to conceal. The difference between the two is given in this line—

"Quod non es simulas, dissimulasque quod es."

9. Satis—parum are both used as (lit.) substantives. Satis (fuit ei) eloquentia, *he had a sufficiency of eloquence, he was fairly eloquent.*

10. Vastus, empty, desert, waste, and so *monstrous, shocking.*

11. Lucii Sullæ. Sulla, as supreme dictator, gained almost absolute power in Rome after the overthrow of his rival, Caius Marius, B.C. 82.

12. Maxima, *more than any other man has felt.*

13. Dum pararet, *so long as he was preparing.*

14. Quidquam pensi habebat, *did not care at all*. Pensus, from pendo, to weigh, signifies prized, esteemed, valued. Pensi is the genitive of price; so in the "Jugurtha," chap. xli., "Neque pensi neque sancti habere," *to hold neither as esteemed nor holy.*

15. Inopia rei familiaris, *want of property.*

16. Artibus, sc. the evil courses he had taken to. The "bella, cædes," etc., in which "juventutem suam exercuit."

17. Diversa inter se, *contrary one to the other.*

The plot was fortunately discovered, mainly by the vigilance of the orator Cicero, who was one of the consuls at the time. Catilina fled the city, and put himself at the head of an army he had raised. An army under Petreius was sent against him, and the final blow was dealt to the plot by the death of Catilina in the battle described in the following extract:—

SALLUST.—"CATILINA," lx.

Sed ubi, omnibus rebus exploratis, Petreius tuba signum dat, cohortes paullatim incedere jubet: idem facit hostium exercitus.[1] Postquam eo ventum est unde[2] a ferentariis[3] prœlium committi posset maximo clamore[4] cum infestis[5] signis concurrunt; pila omittunt;[6] gladiis res agitur. Veterani, pristinæ virtutis memores, comminus acriter instare:[7] illi[8] haud timidi resistunt: maxima vi certatur. Interea Catilina cum expeditis[9] in primâ acie versari, laborantibus succurrere, integros pro sauciis accersere, omnia providere, multum ipse pugnare, sæpe hostem ferire; strenui militis et boni imperatoris officia simul exsequebatur. Petreius ubi videt Catilinam, contra ac[10] ratus erat, magna vi tendere[11] cohortem prætoriam[12] in medios hostes inducit; eosque perturbatos atque alios alibi[13] resistentes interficit, deinde utrimque ex lateribus adgreditur. Manlius et Fæsulanus in primis[14] pugnantes cadunt. Postquam fusas copias seque cum paucis relictum videt Catilina, memor generis atque pristinæ dignitatis, in confertissimos[15] hostes incurrit, ibique pugnans confoditur.

NOTES.

1. Hostium exercitus, the army of the conspirators with Catilina at their head.

2. Ventum est unde (supply *in locum*), *when they had come to a place from whence.*

3. Ferentarii (der. fero), *light troops who fought with missile weapons.*

4. Clamore, the ablative of manner. "The ablative of a substantive, in connection with an adjective, denotes the accompanying circumstances under which a thing is done. Sometimes the preposition *cum* is added." (Madvig, *Lat. Gr.*)

5. Infestis, *hostile*. So opposing of Cæsar (*Bell. Gall.*, vii. 51), "legiones infestis signis constiterunt."

6. Concurrunt—pila omittunt. The short, disjointed sentences are characteristic of the writer's style, and add force and vividness to the description.

7. Instare, the historical infinitive. Also a favourite construction with Sallust, as noted above. A few lines below we find a number of them. "The present infinitive is often used in the description of actions and emotions that follow in rapid succession." (Madvig.)

8. Illi, *the other party; sc. the enemy*. Of two things, ille always refers to the more remote.

9. Expeditis, literally *unimpeded, disengaged;* and so *light-armed troops.*

10. Contra ac, *differently to what he had thought he would*. Ac, or atque, is found in the same way after secus, alius, etc.

11. Magna vi tendere, *exerting himself vigorously.*

12. Cohortem prætoriam. The picked body-guard attached to the general was so called.

13. Alios alibi, *some in one direction, some in another.*

14. In primis: either *are among the first to fall*, or *fall fighting among the foremost.*

15. Confertissimos, *the part where the enemy's ranks*—that is, the army of the republic—*were thickest.*

The "Jugurtha," from which our next extract is taken, is an account of a war waged against a Numidian prince of that name, who had endeavoured by treachery to seize the possessions of his kinsmen, to whom the Roman people had been appointed protectors. The extract describes an episode in the war, part of an engagement between the troops commanded by Jugurtha and Bomilcar, and the Roman army under Metellus:—

SALLUST.—"JUGURTHA," lii.

Eo modo inter se duo imperatores, summi viri certabant: ipsi pares, ceterum opibus[1] disparibus. Nam Metello virtus militum erat, locus adversus; Jugurthæ alia omnia, præter milites opportuna.[2] Denique Romani, ubi intelligunt neque sibi perfugium esse, neque ab hoste copiam pugnandi fieri, et jam die[3] vesper erat; adverso colle,[4] sicuti præceptum fuerat, evadunt. Amisso loco, Numidæ fusi fugatique, pauci interiere; plerosque velocitas et regio hostibus ignara tutata sunt. Interea Bomilcar, quem elephantis et parti copiarum pedestrium præfectum ab Jugurtha supra diximus, ubi eum Rutilius prætergressus est, paullatim suos in æquum locum deducit; ac dum legatus ad flumen, quo præmissus erat, festinans pergit quietus, uti res postulabat, aciem exornat; neque remittit, quod ubique[5] hostis ageret, explorare. Postquam Rutilium consedisse jam, et animo vacuum,[6] accepit, simulque ex Jugurthæ prœlio[7] clamorem augeri; veritus ne legatus, cognitâ re, laborantibus suis auxilio[8] foret, aciem, quam, diffidens virtuti militum, arcte[9] statuerat, quo hostium itineri obficeret, latius porrigit.

NOTES.

1. Opibus, either a descriptive ablative, or an ablative absolute.

2. Opportuna (ob portus), *opposite the harbour*, and so, *convenient.*

3. Die is the old form of the genitive *diei, the evening of the day.*

4. Adverso colle, ablative of place.

5. Quod ubique. Supply hostis ageret with both of these. *What the enemy was doing, and where he was doing it.*

6. Animo vacuum, *freed from anxiety*. Vacuum governing an ablative, as if equivalent to the participle of a verb signifying deficiency, which, according to the regular rule, would take an ablative.

7. Prœlio, the part of the field where Jugurtha was.

8. Suis auxilio, double dative.

9. Arcte, *in close array.*

Translation of VIRGIL, "ÆNEID," Book iv., Lines 173—188.

(See page 83.)

Off at once speeds Rumour through the great cities of Libya. Rumour, a cursed thing, than which no other flies so fast; her nimbleness gives her strength, and she gathers power as she goes. Small at first and timid, soon she rises into the air, and stalks along the ground, and hides her head amid the clouds. She it was whom Earth her mother, stung by the anger of the gods, brought forth, her last offspring, as a sister to Cœus and Enceladus, swift of foot, and untiring of wing. A monster hideous and huge, who has for every feather on her body a watchful eye beneath—most strange to tell—for every eye a tongue, for every tongue a busy mouth and ears attent. By night she flies hissing in the darkness midway beneath earth and sky; by day she sits sentinel on the top of some tall pile or lofty tower, and makes great cities afraid; as apt to cling to what is false and distorted as to proclaim the truth.

LESSONS IN ITALIAN.—XIII.

We now set before our readers some exercises for practice, with another of the colloquial exercises to which reference has been already made.

Vocabulary.

Acqua, water.
Allegrezza (*ts*), joy.
Amicizia, friendship.
Anima, mind, soul.
Animale, animal.
Arte, art.
Assicurazione (*ts*), security, insurance.
Aurora, aurora, dawn.
Azione, action.
Ballerina (f.), dancer.
Bastone, stick.
Beccheria, slaughter-house, shambles.
Carrozza (*ts*), carriage, coach.
Chiesa, church.
Ciera, mien, look, air of the face.
Città, town, city (no change in the pl.).
Collina, hill.
Con, with.
Disgrazia, misfortune, disgrace (*per dis-gra-zia*, unfortunately).
Erba, herb.
Faccia, face (*di-re in fác-cia*, to tell one to one's face).
Fanciullo, child.
Fiume, river.
Foresta, forest.
Idea, idea, notion.
Immaginazione, imagination.
Inferriata, iron-grate.
Insalata, salad.
Insegna, sign, arms, colours.
Locanda, inn, hotel.
Memoria, memory.
Opinione, opinion.
Osteria, public-house, tavern.
Paglia, straw.
Penna, pen.
Per, for, through, on account of.
Porta, gate, door.
Rupe, rock.
Schioppettiere, arquebusier, rifleman.
Sciocchezza (*ts*), folly.
Scolare, pupil.
Settimana, week.
Slitta, sledge.
Spianata, plain, esplanade.
Stolto, fool.
Strada, street, road.
Su, *sopra*, upon.
Unghia, nail.
Valle, valley.
Vigna, vineyard.
Vite, vine.

Exercise 4.

1. La me-mô-ria. 2. Dél-la ciê-ra. 3. Al-la col-lí-na. 4. Dál-la spia-ná-ta. 5. Le bec-che-rí-e. 6. Dél-le lo-cán-de. 7. Al-le pôr-te. 8. Dál-le strá-de. 9. In fác-cia. 10. Nél-la ví-gna. 11. Nél-le fo-rê-ste. 12. Con pá-glia. 13. Cól-la ví-te. 14. Cól-le pén-ne. 15. Per dis-grá-zia. 16. Per la vál-le. 17. Per le scioc-chéz-ze. 18. Súl-la car-rôz-za. 19. Súl-le rú-pi. 20. L' au-rô-ra. 21. Dell' al-le-gréz-za. 22. All' o-pi-nió-ne. 23. Dall' o-ste-rí-a. 24. Le i-dê-e. 25. Dell' êr-be. 26. Al-le ár-ti. 27. Dál-le cit-tà. 28. In i-slít-te. 29. Nell' im-ma-gi-na-zió-ne. 30. Nél-le á-ni-me. 31. Con á-cqua. 32. Coll' ún-ghia. 33. Cól-le in-sé-gne. 34. Per a-mi-cí-zia. 35. Per l' as-si-cu-ra-zió-ne. 36. Per le a-zió-ni. 37. Sull' in-sa-lá-ta. 38. Súl-le in-fer-riá-te. 39. Un fan-ciúl-lo. 40. U-no stól-to. 41. Un a-ni-má-le. 42. U-na set-ti-má-na. 43. D' un fiú-me. 44. Ad ú-no schiop-pet-tiê-re. 45. Da ú-na bal-le-rí-na. 46. In ú-na chiê-sa. 47. Con un ba-stó-ne. 48. Per ú-no sco-lá-re. 49. Su d' un sás-so, só-pra un sás-so.

Vocabulary.

Com-prá-to, bought.
E-gli ha, he has.
E-gli-no han-no, they have.
I-o hô, I have.
Il giar-dí-no, the garden.
Lo zí-o, the uncle.
La zí-a, the aunt.
Nói ab-biá-mo, we have.
Nô-stro (m.), our.
Tu hai, thou hast.
Ve-dú-to, seen.
Vô-stro (m.), your.
Vói a-vé-te, you have.

Exercise 5 (Colloquial).

1. I-o hô un lí-bro e u-na pén-na. 2. Tu hai un buôn lí-bro e ú-na buô-na pén-na. 3. Hô un buôn fra-têl-lo. 4. Hai ú-na buô-na so-rêl-la. 5. Hô un gran lí-bro, mí-a so-rêl-la ha án-che un gran lí-bro. 6. Mí-o fra-têl-lo ha ú-na píc-co-la pén-na. 7. Hai tu ú-na so-rêl-la? 8. Hô ú-na so-rêl-la ed un fra-têl-lo. 9. Hai tu la mí-a pén-na? 10. Hô il tú-o lí-bro e la tú-a pén-na. 11. Ab-biá-mo un buôn pá-dre ed ú-na buô-na má-dre. 12. Ab-biá-mo án-che un buôn fra-têl-lo ed ú-na buô-na sorêl-la. 13. Il giar-dí-no è grán-de. 14. Hô un píc-co-lo lí-bro. 15. Hai tu án-che un lí-bro? 16. Ab-biá-mo un gran giar-dí-no. 17. Il mí-o píc-co-lo fra-têl-lo ha un buôn lí-bro. 18. La mí-a píc-co-la so-rêl-la ha án-che un buôn lí-bro. 19. Ab-biá-mo un gran lí-bro ed ú-na píc-co-la pén-na. 20. A-vé-te un buôn pá-dre ed ú-na buô-na má-dre. 21. A-vé-te vói án-che un fra-têl-lo? 22. Hô un lí-bro. 23. Hô com-prá-to un buôn lí-bro. 24. Ab-biá-mo ve-dú-to un gran giar-dí-no. 25. Mí-o fra-têl-lo ha án-che ve-dú-to un gran giar-dí-no. 26. Hô com-prá-to ú-na pén-na. 27. Hai tu com-prá-to ú-na buô-na pén-na? 28. Hai tu ve-dú-to il mí-o lí-bro? 29. Hô ve-dú-to il tú-o lí-bro e la tú-a pén-na. 30. A-vé-te vói ve-dú-to la mí-a píc-co-la so-rêl-la? 31. Mí-o pá-dre ha com-prá-to un giar-dí-no. 32. Tú-a so-rêl-la ha com-prá-to un píc-co-lo lí-bro.

Vocabulary.

A being, *un És-se-re* (*un Én-te*), m.
Agreeable, *di-let-té-vo-le*, m.
Air, *á-ria*, f.
And, *e*.
And frequently at length injure, *e per fí-ne dan-nég-gia-no án-che spés-so*.
And injures, *e guá-sta*.
Anger, *í-ra*, f.
Animal, *an-i-má-le*, m.
Are, *só-no*.
Beauty, *bel-léz-za* (*ts*), f.
Bird, *uc-cél-lo*, m.
Body, *cór-po*, m.
Brings, *ré-ca*.
Cause, *ca-gió-ne*, f.
Creation, *cre-a-zió-ne*, f.
Creature, *cre-a-tú-ra*, f.
Demands, *vuó-le*.
Deprives him, *lo prí-va*.
Enemy, *ne-mí-co*, m.
Envy, *in-ví-dia*, f.
Equilibrium, *e-qui-lí-brio*, m.
Evident proof, *pró-va ma-ni-fé-sta*, f.
Excess, *ec-cés-so*, m.
Existence, *es-i-stén-za*, f.
Father, *pá-dre*.
Fish, *pé-sce*, m. (with the pl.)
Fruit, *frút-to*, m.
Give more, *dán-no più*.
God, *Id-dí-o*, *Dí-o*.
Health, *sa-lú-te*, f.
Heaven, *cié-lo*, m.
His most precious good, *il sú-o mi-gliór bé-ne*, m.
His power, *la sú-a fór-za*, f.
Homage, *o-mág-gio*, m.
Humour, *flú-i-do*, m.
Hypocrisy, *i-po-cri-sí-a*, f.
Incontinence, *in-con-ti-nén-za*, f.
Intellect, *in-gé-gno*, m.
Intemperance, *in-tem-pe-rán-za*, f.
Is generally, *è or-di-na-ria-mén-te*.
Is infinite, *è in-fi-ní-to*.
It weakens, *és-so in-de-bo-lí-sce*.
Large tree, *grán-de ál-be-ro*, m.
Light, *lú-ce*, f.
Like, *có-me*.
Looks for, *cér-ca*.
Lord, *Si-gnó-re*, m.
Lust, *pia-cé-re*, m.
Man, *uó-mo*, m.
Mechanism, *me-cca-nís-mo*, m.
Misfortune, *in-fe-li-ci-tà*, f.
Nature, *na-tú-ra*, f.
Necessary (translate, the necessary), *ne-ces-sá-rio*, m.
Nerve, *nér-vo*, m.
Only requires, *non do-mán-da che* (that which is).
Order, *ór-di-ne*, m.
Outburst, *a-gi-ta-zió-ne*, f.
Passion, *pas-sió-ne*, f.
Plant, *pián-ta*, f.
Pleasantness, *gio-con-di-tà*, f.
Powerfully disturb, *scon-cér-ta-no vio-len-te-mén-te*.
Preserver, *con-ser-va-tó-re*, m.
Pride, *or-gó-glio*, m.
Reason, *ra-gió-ne*, f.
Renders, *rén-de*.
Requires, *es-i-ge*.
Riches, *ric-chéz-za* (*ts*), f. (with the pl.)
Scope, *scó-po*, m.
Sea, *má-re*, m.
Self-love, *a-mór pró-prio*, m.
Shadow, *óm-bra*, f.
Star, *stél-la*, f.
Superfluous, *su-pér-fluo*, m.
Supreme, *su-pré-mo*.
System, *si-sté-ma*, m.
Than, *che*.
The greatest damage, *il più gran dán-no*, m.
Useful, *ú-ti-le*, m.
Vice, *ví-zio*, m.
Virtue, *vir-tù*, f.
Weak, *dé-bi-le*.
Which, *che*.
Who, *che*.
Wisdom, *sa-pién-za*, f.
Work, *ó-pe-ra*, f.
World, *món-do*, m.

Exercise 6.

1. Hypocrisy is a homage which vice renders to virtue. 2. Nature only requires that which is necessary. 3. Reason demands the useful, self-love looks for the agreeable, passion requires the superfluous. 4. Large trees give more shadow than fruit. 5. God is the Father of men and the Preserver of the creatures. 6. The stars of the heaven, the birds of the air, the fish of the sea, the plants, the animals, are works of the Lord. 7. The scope of the creation is infinite, the intellect of man weak. 8. The wisdom of God is like the light of heaven. 9. The order, the beauty, and the pleasantness of the world are evident proofs of the existence of a Supreme Being. 10. The excess of the passions is generally the cause of the misfortune of men. 11. The outbursts of anger, of envy, and of pride, powerfully disturb the equilibrium of the humours, the system of the nerves, and frequently at length injure the mechanism of the body. 12. The lust of intemperance and incontinence is the enemy which brings to man the greatest damage; it weakens his powers, deprives him of riches, and injures his most precious good, the health.

We now come to some illustrative exercises of the use of *di*. That he may clearly understand the difference between the two languages, the pupil will do best, wherever it is allowable, to translate these exercises by English compound nouns, or by combinations of nouns, or by adjectives preceding nouns.

Vocabulary.

Abito, dress.
Acconciatura, ornament, head-dress.
Aceto, vinegar.
Appello, appeal.
Argento, silver.
Arrosto, roast meat.
Barile, cask, barrel.
Bicchiere, glass.
Biglietto, note, ticket.
Birra, beer.
Bollo, official seal, stamp.
Borgogna, Burgundy.
Bottiglia, bottle.
Braccio, m. (pl. *le bráccia*, f.), arm, ell, yard.
Butirro, butter.
Caffè, coffee.
Calza (*ts*), stocking.
Calzoni (*ts*), m. pl., trousers.
Campana, bell, clock (which strikes).
Cane, dog.
Capo, head, chief.
Cappotto, great coat or cloak.
Carne, meat.
Carta, paper, card.
Casa, house.
Cassa, box.
Cava, pit, mine, quarry.
Cavallo, horse.
Centinajo, hundred-weight.
Certificato, certificate.
Che, that.
Chicchera, cup.
Cinque, five.
Colpo, blow, shot.
Coltello, knife.
Corpo, body.
Correzione, correction.
Corsa, course, race.
Dieci, ten.
Diritto, duty.
Disegno, drawing.
Domani, to-morrow.
Finestra, window.
Fior, (for *fió-re*), flower.
Formaggio, cheese.
Francesco, Francis.
Gennajo, January.
Gente, people.
Ghirlanda, garland.
Giorno, day.
Giovanni, John.
Giuoco, game.
Giuseppe, Joseph

Giusto, just.
Gran (for *grán-de*), great, large.
Grande, great.
Grano, corn.
Guardia, guard (*corpo di gardia*, main guard, or main guard-house).
Ho comprato, I have bought.
Ignorante, ignorant.
Impero, empire.
Infinità, innumerable multitude.
Inghilterra, England.
Irlanda, Ireland.
Isola, island.
Lana, wool.
Latte, milk (*fior di latte*, cream).
Levar (for *le-vá-re*, to rise), rising.
Libbra, pound.
Lotto, lottery.
Lupo, wolf.
Maestro, master, teacher.
Maggio, May.
Mantello, cloak.
Manzo, young ox.
Marmo, marble.
Mese, month.
Miglio, n. (pl. *le mí-glia*, f.), (Italian) mile (of 3,000 paces), also an English, German, or French mile.
Misura, measure.
Moggio, bushel.
Monte, mountain, pawnbroker's (or Mont de Piétà).
Muta, team.
Nome, name.
Numero, number.
Oglio, oil.
Opera, work (*capo d' opera*, master-piece).
Ora, hour.
Ordine, order (military).
Pajo, m. (pl. *le pá-ja*, f.), pair.
Pane, bread.
Panno, cloth.
Pecora, sheep.
Penna, pen.
Pezzo, piece.
Pietra, stone.
Pipa, (tobacco) pipe.
Pistola, pistol.
Piuma, feather.
Posta, post.
Prendetemi, take me.
Presa, pinch.
Presidio, *guarnigione*, garrison.
Punta, point.
Punto, point.
Quantità, quantity.
Quarto, fourth part, quarter (of a pound).
Rada, road, roadstead.
Razza, race, species, kind.
Regno, kingdom.
Sardegna, Sardinia.
Scarpa, shoe.
Scherma, fencing.
Sciampagna, champagne.
Scozia, Scotland.
Sei, six.
Sei, thou art (*pezzo d' ignorante*, blockhead, dunce).
Sentesi, one hears, is heard.
Sicilia, Sicily.
Sol (for *só-lo*), sole, only, single.
Sole, sun.
Stivale, boot.
Strada, road, way, route.
Struzzo, ostrich.
Suo, his.
Tabacco, tobacco, snuff.
Tassa, tax.
Tazza (*ts*), cup.
Tè (pronounced *tè*), tea.
Tela, linen.
Tocco (pronounced *tóc-co*), piece, bit.
Tocco, touch, blow, stroke.
Tonnellagio, commodity preserved in casks (*diritto di-tonnellagio*, tonnage).
Tramontar, (for *tra-mon-tá-re*, to set, disappear), setting.
Tratto, throw, cast, stroke.
Tribunale, tribunal, court.
Truppa, troop.
Ufficio, office.
Vecchio, old.
Vena, vein.
Ventina, number of twenty, score.
Vetro, glass, pane.
Vino, wine.
Vista, sight, view.
Zecchino, sequin (gold coin current at Venice and in Turkey, about 9s.).
Zio, uncle.
Zucchero, sugar.

EXERCISE 7.

1. Il man-têl-lo del-lo zí-o. 2. L' á-bi-to di Gio-ván-ni. 3. La cá-sa di mí-a so-rêl-la. 4. Il le-vár, il tra-mon-tár del só-le. 5. Il nó-me di Giús-to, di Grán-de. 6. Lá-na di pê-co-ra. 7. Pún-to di ví-sta. 8. La cá-sa di cor-re-zió-ne. 9. Sên-te-si un cól-po di pis-tô-la. 10. Cá-va di piè-tra e di már-mo. 11. Il sú-o cá-po d' ò-pe-ra. 12. Il côr-po di guár-dia. 13. Con un sol trát-to di pén-na. 14. Un tóc-co di cam-pá-na. 15. Vé-tro di fi-nê-stra. 16. Fiór di-lát-te. 17. U'-na ghir-lán-da di fió-ri. 18. Pêz-zo d' i-gno-rán-te che sêi! 19. La pún-ta di col-têl-lo. 20. U'-na vé-na d' ar-gên-to. 21. Do-má-ni è giór-no di pô-sta. 22. Ma-ê-stro di di-sé-gno, di schér-ma. 23. Tri-bu-ná-le d' Ap-pêl-lo. 24. Bi-gliét-to di lôt-to, del món-te. 25. La pô-sta di ca-vál-li. 26. Cer-ti-fi-cá-to d' uf-fí-cio. 27. Im-pê-ro d' Aú-stria. 28. Ré-gno d' In-ghil-têr-ra, di Scô-zia, d' Ir-lán-da. 29. La cit-tà di Lôn-dra, d' E-din-búr-go, di Dub-lí-no, di Man-cê-stria, di Li-ver-pú-la, di Bir-min-ghê-mio, di Gla-scô-via. 30. Il mé-se di Gen-ná-jo, di Mág-gio. 31. Il nó-me di Giu-sêp-pe, di Fran-cé-sco. 32. L' í-so-la di Si-cí-lia, di Sar-dé-gna. 33. Un quár-to d' ó-ra. 34. U'-na ráz-za di cá-ni. 35. Cór-sa di ca-vál-li. 36. Le trúp-pe di pre-sí-dio, di guar-ni-gió-ne. 37. La rá-da di Triê-ste. 38. Il di-rít-to di ton-nel-lág-gio. 39. Tás-sa di ból-lo. 40. Un giuô-co di cár-te. 41. Piú-me di strúz-zo. 42. L' ac-con-cia-tú-ra del cá-po. 43. L' ór-di-ne del giór-no. 44. Diê-ci brác-cia di té-la, di pán-no. 45. Un ba-rí-le d' ô-glio, di a-cé-to. 46. U'-na líb-bra di cár-ne, di for-mág-gio. 47. U'n cen-ti-ná-jo di zúc-che-ro, di caf-fè. 48. Un môg-gio di grá-no. 49. Un pêz-zo di pâ-ne, un tôc-co d' ar-ró-sto. 50. U'n quàr-to di bu-tír-ro. 51. Un bic-chiê-re di ví-no, di bír-ra. 52. Hô com-prá-to diê-ci bot-tí-glie di Bor-gô-gna e sêi di Sciam-pá-gna. 53. U'-na cás-sa di pí-pe. 54. U'n gran nú-me-ro di lú-pi. 55. U'-na quan-ti-tà di pê-co-re, di mán-zi. 56. U'-na in-fi-ni-tà di gên-te. 57. U'n pá-jo di scár-pe vêc-chie. 58. Dú-e pá-ja di sti-vá-li, a cal-zó-ni, di cál-ze. 59. U'-na ven-tí-na di zec-chí-ni. 60. Cín-que mí-glia di strá-da. 61. U'-na chíc-che-ra di caf-fè. 62. U'-na táz-za di tè. 63. U'-na pré-sa di ta-bác-co. 64. Pren-dé-te-mi la mi-sú-ra d' un cap-pôt-to e d' un pá-jo di cal-zó-ni. 65. U'-na mú-ta di ca-vál-li.

KEY TO EXERCISES IN LESSONS IN ITALIAN.—XI.

EXERCISE 2.

1. The father and the mother. 2. The brother and the sister. 3. The father is good, the mother is good. 4. The good father, the good mother. 5. The brother is good, the sister is good. 6. The good brother, the good sister. 7. My father; my good father. 8. My mother; my good mother. 9. My father is good; my mother is good. 10. My brother and my sister. 11. My good brother and my good sister. 12. My brother is good, my sister is good. 13. A father, a mother, a brother, a sister. 14. A good father, a good mother, a good brother, a good sister. 15. My father is a good father, my mother is a good mother. 16. My brother is a good brother, my sister is a good sister. 17. Thy father is good, my father is also good. 18. Thy mother is good, my mother is also good. 19. Thy father has a good sister, thy mother has a good brother. 20. My brother is thy father. 21. My father is also thy father, and my mother is also thy mother. 22. The book is good, the pen is good. 23. My book is small, my pen is large. 24. Thy father has a good book, thy sister has a good pen. 25. My brother is tall, my sister is little. 26. Thy little brother and thy little sister. 27. Thy sister has my pen, and thy brother has my book. 28. Thy little book is a good book.

KEY TO EXERCISES IN LESSONS IN ITALIAN.—XII.

EXERCISE 3.

1. Il levar del sole. 2. Lo spuntar del giorno. 3. Il ritorno della primavera. 4. Il calore dell' aria. 5. La bellezza del fiore. 6. L' oscurita della notte. 7. L' abisso dell' errore. 8. La fertilità dei campi. 9. I colori del arcobaleno. 10. I sensi del uomo. 11. Gli errori di giovani. 12. Il danaro è l' anima di commercio. 13. L' uso è il legislatore delle lingue. 14. Il padrone del giardino non è qui. 15. Il palazzo appartiene al principe. 16. Ecco le camere dello zio. 17. Gli abiti appartengono alla cugina, e non alla zia. 18. Il fratello dice alla sorella la volonta del padre. 19. I fancinlli devono sempre obbedire ai genitori. 20. I medici dicono, il disordine accorcia la vita. 21. Il moto giova al corpo e allo spirito. 22. La fisonomia è lo specchio dell' anima. 23. La quiete dell' anima è il colmo della felicità. 24. La temperanza è il tesoro del savio. 25. Il vero ornamento del soldato è il coraggio. 26. L' esercizio conduce alla perfezione. 27. L' interesse, il piacere, e la gloria, sono le tre motivi delle azione e della condotta degli uomini.

MECHANICS.—XXI.

MOTION OF FALLING BODIES.

WE are now in a position to examine the laws of motion of falling bodies. At first sight, however, this appears a difficult matter, since different bodies fall with different degrees of velocity. If we take a stone and a piece of thin paper, and let them fall at the same time, the stone will reach the ground before the paper. Most people would say the reason was that the stone was heavier than the paper, but this clearly is not the true reason, for if we take two stones of different weights and let them fall, both will take the same time. The fact is, that they are not falling through an empty space, but through the air, and this offers a resistance to their fall, which increases with the surface they present. If we take a piece of gold, and letting it fall from any height, notice how long it takes to reach the ground, and then beat it out into a thin leaf, its weight will not be at all diminished, yet it will fall with much less speed on account of its increase of surface. The most conclusive proof that this is the real reason is afforded by what is called the guinea and feather experiment, as shown in Fig. 97.

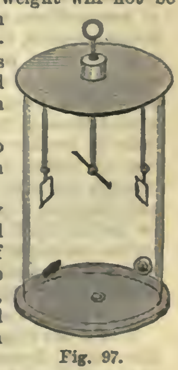


Fig. 97.

A brass cap is made to fit air-tight on to the top of a tall glass cylinder, from which the air can be exhausted by an air-pump.

Through this cap a small rod passes, by turning which two small flaps can be allowed to fall. Now let a guinea or other piece of money be laid on one and a feather on the other. If the rod be turned both will fall, but the gold will outstrip the feather and reach the ground first, because it meets with less resistance in proportion to its weight.

Now replace the guinea and the feather on the flaps, as at first, but this time carefully exhaust the air from the receiver; on turning the rod and watching, both will be found to fall in exactly the same time.

All bodies, then, fall at the same rate, and acquire the same velocity in falling, except so far as they are impeded by other causes.

A balloon, if we could make it strong enough not to burst, would in a vacuum fall in exactly the same time as a ball of lead.

If we take a number of balls made of different substances and arrange them side by side in a box, the bottom of which turns on a hinge, and allow it to fly open, the balls will travel in a straight line and all reach the ground together. A little consideration shows that it is very natural that it should be so. If we have a number of equal balls, made, for instance, of lead, each will fall in the same time. Now let two or more be rolled into one, and the large one will fall in the same time that the small ones composing it did, though it is heavier, for there is obviously no reason why the mere change of shape should alter the speed.

We want to know now what is the actual velocity with which a body falls; and this is often a useful thing to know, for by it we can ascertain the height of a tower or the depth of a well. We have only to drop a stone from the top, and notice how long it takes to reach the bottom, and from this we can calculate the height.

A falling body is acted on by the attraction of the earth. Now after any given time—say, for instance, one second—it has acquired a certain velocity with which it would continue to move if the attraction ceased. It does not cease, however, and hence the body must fall with a constantly increasing velocity.

This we can calculate by means of Atwood's machine. We can, by diminishing the weight of the bar, decrease the velocity in any proportion we like, and thus are able to measure the space passed over.

If the bar weighs as much as the weights do, then the moving force is one-half of the mass moved, and the velocity with which it descends is one-half of the velocity it would have were it free to fall from its own weight alone. But to make the speed more easily measurable, let us further diminish the weight of the bar as compared with the weights. If we make W and W′ to weigh $7\frac{7}{8}$ oz. each, and the bar, F, $\frac{1}{4}$ oz., we shall have as convenient a proportion as we well can. The total mass moved will in this case be 1 pound, and the moving force $\frac{1}{4}$ oz., or $\frac{1}{64}$ of the mass; the velocity with which W falls will therefore be $\frac{1}{64}$ of that of a falling body.

Now raise W with the bar on it to the catch, and allowing it to start at one tick of the pendulum, note how far it falls before the next. The easiest way of doing this is to fix the ring a little way under W, and, by shifting it up and down, ascertain the place at which the second tick of the pendulum occurs at exactly the same time as the sound of the bar striking on the ring. This distance will be found to be 3 inches. Of course, you must measure from the height of the under side of the bar, for that is the part which strikes the ring. This, then, is the space passed over in the first second, and if we multiply this by 64, we find that 16 feet is the space a body, left free, will by its own weight fall through in the first second. More exact experiments show that the amount is $16\frac{1}{10}$ feet, but we may take 16 as near enough for most practical purposes. We have thus found the distance W passes in one second; but we want to know what momentum it has acquired, that is, what space it would, from the velocity it has received, pass over in the next second, supposing gravity were to cease to act altogether. As it falls with an accelerating velocity, it must be moving more quickly at the end of the second than at the beginning, and thus its velocity at the end must be greater than 3 inches. To ascertain this we leave the ring as before, 3 inches under the bar. Now when W passes through the ring, the bar rests on it, being too long to pass, and therefore W falls from its own momentum alone. If, then, we fix the shelf, E, at such a distance under D that the weight strikes upon it at the third tick, the distance between D and E will be that which W passes over from its momentum, and this space we shall find to be 6 inches, or just double that passed over in the first second.

Now if the ring had been removed, and the bar left on during this second, it would, by the second law of motion, have caused W to fall through an additional 3 inches. It ought then to fall through 6 inches from its own momentum, and 3 inches from the force of gravity, making in all 9 inches; and if we place the stage 12 inches below the catch, we shall find that such is the case. Thus it passes 3 inches in the first second, and 3 times 3 inches, or 9 inches, in the second. By again arranging the shelf and ring, we shall find that the momentum acquired after two seconds is double that acquired after one, for it will carry W through 12 inches in the third second.

Similarly in this second it will move 12 inches from momentum, and 3 inches from gravity, making in all 15 inches, or 5 times 3, and its momentum at the end will be 18 inches.

Now if we arrange these results in a tabular form, we shall find some simple laws which regulate them. Instead, however, of putting down 3, 6, 9, etc., we will use 1, 2, 3. The proportion is just the same, and if we had made the bar $\frac{1}{16}$ instead of $\frac{1}{64}$ of the mass, these are the distances in feet which would have been moved over.

Seconds.	Space passed over in the second.	Velocity at end.	Total space passed over to end of second.
1	1	2	$1 = 1^2$
2	3	4	$4 = 2^2$
3	5	6	$9 = 3^2$
4	7	8	$16 = 4^2$
5	9	10	$25 = 5^2$
6	11	12	$36 = 6^2$

We see, thus, that the velocity increases in the exact proportion of the number of seconds the body has been falling; that the spaces passed over in successive seconds are proportional to the successive odd numbers; and that the total space fallen through in any number of seconds is proportional to the square of that number.

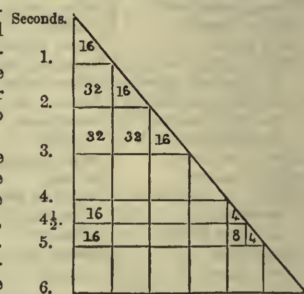


Fig. 98.

Now we saw that the space any body falls through in the first second is 16 feet. Hence in the second it is 48, or 16×3, in the third 80, or 16×5. Generally, then, if we multiply the numbers in the above table by 16, we shall have those applicable to the case of falling bodies. This may be more clearly represented by Fig. 98. In this diagram vertical height represents the time in seconds; breadth, the velocity; and area the total space passed over. At the end of the first second it shows the space passed over to be 16, and the velocity is represented by the horizontal line drawn through 1, which we call 32.

We can thus see at a glance the space passed over in any given second, or the velocity at any given time. In the same way, if we draw a line midway between 4 and 5 to represent $4\frac{1}{2}$ seconds, we can find the space passed over and the velocity acquired in that time. The figure, in fact, gives us a good idea of the action of a uniform accelerating force.

Suppose, for instance, we drop a stone down a well and find it is $4\frac{1}{2}$ seconds before we hear the splash, we know the depth is 324 feet. The stone falls 16, 48, 80, and 112 feet in the first, second, third, and fourth seconds, and 68 in the last half second; these together make 324; or we may take the square of $4\frac{1}{2}$, and multiply it by 16, and thus get the same result.

Again, suppose we want to know the velocity any body acquires in falling for 6 seconds, we have only to multiply 32 by 6, and we find it to be 192 feet per second.

ANSWERS TO EXAMPLES IN LESSON XX.

1. $60 \times 10 \times 70 = 42{,}000$ units.
2. The work done per minute is $\frac{2240 \times 20 \times 400}{60}$ or 298,666 units. Hence the H.P. required is $\frac{298{,}666}{33{,}000}$, which is a little over 9.
3. It would raise it from a depth of 663 feet.
4. About 47 lbs. per hour.
5. About $5\frac{1}{2}$ days by means of a windlass, or $3\frac{1}{2}$ days by ascending a ladder and allowing his own weight to raise it.

ELECTRICITY.—I.

HOW GENERATED—DIFFERENT THEORIES—CONDUCTORS AND NON-CONDUCTORS—PITH-BALL AND GOLD-LEAF ELECTROSCOPES.

THE department of Natural Philosophy or Physics to which we are now to turn our attention is one of great practical importance. It is one, too, in which nearly all the apparatus required may be made by the student himself, if he possess a little mechanical skill and perseverance; and a large number of experiments may be tried at but little cost. We can promise our readers, as they accompany us, instructions how to perform such experiments as will enable them and their friends to spend many a pleasant evening, and at the same time give them a thorough insight into the principles of the science. In fact, there are few things which cause a winter evening to pass more pleasantly than a good electrical machine.

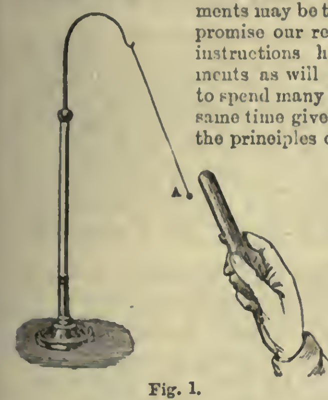


Fig. 1.

There are few of the sciences that have such varied and extensive applications in the arts and manufactures as this has. By it our thoughts are flashed with lightning speed to distant places; our messages are instantaneously transmitted, even, if needs be, in our handwriting; our clocks are regulated with the utmost accuracy; our lighthouses, streets, and buildings are illuminated; our plate is silvered or gilt; our fuzes are exploded; our bells are rung; and a thousand other things, of great importance to us in daily life, are done. We may truly say, then, it is an important science.

Like most other important things, this science had a very simple commencement. Several centuries before the Christian era, it was found by some Greek philosophers that if a piece of amber was rubbed on a piece of cloth or silk it acquired the property of attracting light substances, such as fragments of paper or feathers. No further advance was made in the subject, nor was much notice taken of it, except that it was attributed to a peculiar property supposed to exist in the amber. This property was called electricity, from *electron*, the Greek word for amber.

Many other substances beside amber are now found to possess this same property of attracting light bodies when rubbed. In fact, all bodies may be said to possess it to a greater or less extent. The simplest mode of trying the experiment is to take a piece of sealing-wax, and rubbing it violently on cloth or flannel, hold it near some small scraps of paper. It may be seen rather better by taking a piece of glass tube half or three-quarters of an inch in diameter, and rubbing it with a piece of silk, and then holding it to the paper.

We may mention here that for many electrical experiments pieces of glass tubing are very useful. A pound or two of different sizes should therefore be obtained. In large towns scientific instrument-makers usually supply it at a moderate price, or it may be obtained at any glass-works. If we want to cut it to any length, we need merely make a slight groove with a triangular file at the required place, and it will easily break off pretty evenly. The ends may be rounded by holding them in the flame of gas, or better still, of a spirit lamp.

The effect produced by rubbing the glass tube may be considerably increased by smearing on the silk rubber a little electrical amalgam. This is a compound of mercury, tin, and zinc, which has the property of greatly increasing the quantity of electricity produced. There are different recipes for the preparation of this compound, and either of the following will act well:—Tin 1 part, zinc 2, mercury 6; or, tin 1, zinc 1, mercury 2. If a quarter or half an ounce be taken of the tin, and proportional quantities of the other ingredients, it will be sufficient for general purposes. The tin and zinc should be melted together in an iron ladle, and should then be poured with the mercury into a wooden box well rubbed with chalk, and the whole shaken till it cools. Care is required lest the mercury should spirt about when mixed with the hot metal. When cold, the amalgam may be pounded, and from time to time a little should be mixed up with lard and smeared on the silk.

If now we rub a piece of glass tube violently with this, we shall notice the following effects:—Light bodies will as before be attracted towards it, and as soon as they have touched it will fly away; if we hold the finger close to the tube, and draw it along, a faint crackling noise will be heard, and, in the dark, sparks or bluish light will be seen; on bringing the tube close to the face, a sensation nearly resembling that of cobwebs will be felt, and at the same time a faint smell as of burning sulphur will be perceived. These, then, are the main effects produced by the electricity, and some of them may be seen in other ways. If we take two rounded fragments of quartz, such as may often be picked up on a beach, and rub them together in the dark, we shall observe a similar light and odour. So, too, on a frosty night, if we take up a black cat which has become warm by lying in front of a fire, and stroke it, we shall see and hear small sparks freely given off from its coat, and at times, if one hand be held near the neck and the other gently passed along the back, small shocks will be felt. Some people observe a similar effect if their hair be dry and they brush it vigorously.

Now the question naturally suggests itself, what is the cause which produces these effects—that is, what is electricity? To this we can give no answer. We may say it is an imponderable fluid, or we may call it a subtle but powerful physical agent; but these are merely terms invented to hide and conceal our ignorance. All that we really know is, what are the effects it produces, and the means of procuring it.

Electricity may be obtained in several different ways; the most important are friction, chemical action, heat, pressure, magnetism, and some vital operations. The two former are the most common modes of producing it; there is, however, a difference in the effects according to the mode by which it is obtained, and hence that produced by friction is known as *statical* or *frictional* electricity, while that produced by chemical action is called *dynamical* or *voltaic* electricity. We shall deal first with the former of these, or frictional electricity.

We have seen that electricity is generated when we rub a piece of glass tube or sealing-wax: we want, however, an easy plan of indicating its presence, and the simplest is by the electric pendulum represented in Fig. 1. A piece of glass tube, ten or twelve inches long, is fixed vertically in a small stand; to the top of this is fitted a wooden cap with a bent wire ending in a hook or loop inserted in it. A small ball, A, cut out of the pith of the elder, is fixed to a silk thread, and suspended by this from the hook. Instead of the glass support, a piece of wire may be used, bent over as in the figure; but it does not answer quite as well. The reason why elder pith is chosen is on account of its extreme lightness. It is readily obtainable, and with a sharp knife may easily be cut into the shape of a ball. If now an excited glass tube be held near it, the ball will immediately be attracted and rise towards the tube. As soon, however, as it has touched it, the electricity is shared between them, and the ball is now repelled as strongly as it was before attracted. If two balls thus mounted be each allowed to touch the tube, it will be found that they, too, repel one another.

Fig. 2.

Now vary the experiment, by bringing an excited rod of sealing-wax near the balls when thus charged; and we shall find that they will at once be attracted towards it, though they are repelled by the glass tube.

In the same way we shall find that two balls, mounted on separate stands, and both excited by contact with the sealing-wax, repel each other; but if one be excited by the glass tube and the other by the wax, instead of repelling, they will attract one another. This seems to show that there are two different kinds of electricity, one produced by the friction of glass and the other

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by the friction of sealing-wax, and that bodies charged with the same kind repel each other, while those charged with opposite kinds are mutually attracted. These two kinds are distinguished as *vitreous* and *resinous*, the former being produced by the friction of glass, the latter by that of resinous bodies. The terms *positive* and *negative* are sometimes used instead of the above.

Two different theories have been proposed to account for these effects, and as they help us to understand the explanations usually given of electrical phenomena, we must just refer to them here. The first, started by Franklin, supposes that electricity is a subtle fluid, of which all bodies possess naturally a certain amonnt. If this normal state be disturbed, and the body possess a larger amount, it is positively electrified; if it possess less, it is negatively electrified. The fluid is further supposed to be powerfully self-repelling, but to attract particles of matter not charged with it.

The other theory is, that there are two different kinds of electricity. When these are associated together, they fully neutralise one another, and in this state pervade all bodies. If by friction, or in any other way, this fluid be decomposed, one kind or the other will be in excess, and the body will then be charged with vitreous or resinous electricity as the case may be. We need not attempt to decide which of these theories is correct. Most of the phenomena we shall observe may, however, be explained by either; we shall therefore nse the terms positive or vitreous, and negative or resinous indiscriminately, and shall sometimes represent positive electricity by the sign *plus* (+), and negative by the sign *minus* (−).

The pith ball we have already used furnishes ns an easy way of telling which electricity a body is charged with. We have merely to communicate a portion of the charge to it, and then to bring an excited glass rod near it. If it be repelled, we at once learn that it, like tho glass, is charged with positive electricity; while if it is attracted, we know as surely that the body must be negatively electrified.

By trying a series of experiments in this way, we shall find that when a glass tube is rubbed with a piece of silk, the silk becomes charged with electricity as well as the glass, but that the electricity is of the contrary kind, the silk being negative, while the glass is positive. This rule holds good whenever two bodies are rubbed together; both will be electrified, but the one will be +, and the other −.

When the ball is allowed to touch the excited glass or wax, and has become charged, it will continne to be repelled for some little time. The effect, however, gradually becomes weaker, and then ceases.

When it is thus charged, touch it with different bodies, and notice the effects. Let it touch the finger, for instance, and the repulsion will then cease, and it will be attracted again by the glass as at first. If we use a piece of wire, exactly the same effect will be seen; if, however, we substitute a rod of glass or of sulphur for the wire, a different effect will be observed, the ball continuing to be repelled as before. It is clear, then, that there is a difference between the wire and the glass in the effect they produce on the charged ball, the former appearing to remove all the charge, while the latter allows it to remain intact; and such is in reality the case. There are many bodies, the metals among them, along which electricity can easily pass and escape—these are termed *conductors;* on the other hand, there are many substances like glass and sulphur, which obstruct its passage and keep it confined, and these are called *insulators* or *non-conductors.* It must be remembered that the terms *conductors* and *non-conductors* are only relative, for they graduate so slowly into one another, that no well-defined line can be drawn to separate them. By experimenting with rods made of a number of different snbstances, wo shall be able to form an idea of their relative conducting powers. The following table gives us some of the results of a series of such experiments. The best conductors are placed first, while those near the end may be classed as good insulators:—

All the metals.	Oils.	Fur.
Charcoal.	Alcohol.	Silk.
Strong acids.	Paper.	Gutta percha.
Most minerals.	Dry wood.	Resinous bodies.
Solutions of salts.	Ice.	Sulphur.
Water.	Dry air.	Amber.
Moist animal and vegetable substances.	Glass.	Shellac.

The fact of water, and therefore moist air, being a good conductor, explains a difficulty that will often be experienced in working an electrical machine. Sometimes the attempt is made to show its power in a room full of people, or where the air is fully charged with moisture, and failure is then almost certain, as the moisture of the breath or the air carries off most of the electricity. Hence in working a machine every part of it should be thoroughly warmed, to avoid the condensation of moisture on the glass. The best effects, too, will be obtained on a frosty evening, as then the amount of watery vapour in the air is very small.

Having seen that different bodies have different powers of conducting electricity, we nnderstand why it is that electricity does not appear to be produced by the friction of all bodies. If we rub a piece of metal, and hold it near the ball, no effect is produced, the reason being that the electricity is conducted away by the metal as soon as it is generated. If, however, we fix the metal to a rod of glass or some other non-conductor, and then rub it with a piece of silk, we shall find that it attracts the ball in the same way as the rod of glass did. We see, too, now the reason why we used a piece of silk to suspend the pith ball.

It is on account of glass being a good insulator that it is so freqnently used in the construction of electrical apparatus. To prevent the condensation of moisture on it, it is sometimes coated with sealing-wax, varnish, or shellac. The former of these is very commonly used, both for increasing the insulation and giving a finished appearance to the work. The student may easily make it for himself. Some fragments of red sealing-wax may be put into spirits of wine (methylated spirit is much cheaper, and answers equally well), and dissolved by gentle heat. A quicker plan of making it is to pnt the spirit into a wide-mouthed bottle, and having lighted the stick of wax, let it melt and drop in. The spirit soon becomes heated and burns, keeping the wax alight and rapidly dissolving it. This varnish may be easily laid on with a brush, and is a great improvement to the look of the apparatus.

The pith-ball electroscope, already referred to, supplies a simple mode of testing the presence of electricity. If two balls be suspended side by side from the same snpport, they will, when charged with electricity, repel one another and stand apart; and thus we have a very easy way of showing the intensity with which any body is charged. Neither of these electroscopes is, however, nearly delicate enough for many purposes, and a different kind of instrument has accordingly been constructed to indicate the presence, and to some extent the intensity, of a charge.

This instrument, which is represented in Fig. 2, is known as the gold-leaf electroscope. A glass vessel, shaped like a bottle without a bottom, is taken and fixed to a stand, and a cap or cork, with a piece of glass tube passed tightly through it, is fitted to its mouth. A circular disc of brass about three or four inches in diameter is now screwed on a piece of wire, the lower end of which is slightly flattened out on an anvil. This wire is then passed through the tube, the space round it being filled with shellac, and two small strips of gold leaf are gummed to the flattened end of the wire so as to hang side by side. Inside the cylinder, two strips of tinfoil connected with the stand are pasted, so that, if a strong charge be imparted to the brass plate, the leaves may diverge till they touch these strips, and thus lose their surplus electricity.

If now the brass plate have any degree of electricity imparted to it, it will at once pass along the wire to the pieces of gold leaf, and these being thus similarly electrified, will repel each other, and stand apart, as shown in the figure. The glass tube and shellac render the insulation nearly perfect, and thus, if the instrument be dry, the presence of even a very trifling amount of electricity will be at once rendered manifest. It is not even necessary for the electrified body to touch the plate, for holding it near will cause the leaves to diverge. With this instrument, too, we can tell whether the electricity is positive or negative. We first touch the plate with an excited tube. The leaves at once diverge, and as there is no means of escape for the electricity, they continue to diverge long after the tube is removed. Now bring the body whose charge we wish to examine near, and if the leaves diverge to a greater extent than before, we see at once that it, like the glass, is positively electrified. If, on the contrary, the leaves have a tendency to diverge less, we know that the body is negatively charged.

An instrument of this kind may be very easily constructed. If a brass plate cannot be procured, one of tin or zinc may be substituted; care must, however, be taken to make the edges as smooth as possible. A lamp chimney, too, will answer instead of the receiver, or a wide-mouthed bottle or flask may be used, but in that case a small opening should be filed or ground at the bottom through which a narrow piece of tinfoil may pass to join the strips pasted on the sides. Common Dutch metal likewise will answer for the leaves instead of gold leaf.

A great number of experiments can be tried with this instrument, showing in how many ways electricity is constantly being produced.

If we take a small piece of fur, and gently strike it across the brass disc, the leaves will at once diverge; the corner of a silk handkerchief will produce a similar effect. Whenever two bodies are rubbed together, both become electrified, one positively and the other negatively; they must, however, be separated before the electricity will manifest itself. Whether a body when rubbed becomes charged with positive or negative electricity, depends on the substance with which it is rubbed. Cat's skin, however, becomes positively electrified by friction with almost all bodies. If it be rubbed on polished glass, the glass is negatively charged, though it becomes positively charged by friction with woollen cloth or silk. If, however, ground glass be used instead of polished, it is negative, and the silk or cloth positive.

Other causes besides friction evolve electricity. If certain minerals are warmed, their electricity seems to be decomposed, and one portion of them becomes + and another −. This was seen first with tourmaline, a piece of which, if placed in hot ashes, repels the particles of dust round it. To observe it, we should fix a piece to a rod of glass, or suspend it by silk, and, having warmed it, allow different parts of it to come in contact with the plate of the electroscope. Many other substances act in a similar way, and are said to be pyro-electric.

Pressure, too, causes electrical excitement. The substances to be placed together should be fixed to insulating handles, and removed as rapidly as possible after the pressure, in order to prevent the fluids again combining. Cork and caoutchouc become thus electrified if pressed together. Two differently-coloured silk ribbons do so likewise, and a disc of wood may be charged by merely pressing it on an orange. Many other effects of this kind will be found out by the student.

Many crystalline and laminated substances, if divided or broken, exhibit similar effects. This may be seen with a piece of mica or a lump of sugar. All these experiments tend to show that electrical phenomena are more common than is usually supposed.

READINGS IN GREEK.—II.

EURIPIDES.

AMONG the amusements in which the ancient Greeks were wont to indulge, dramatic entertainments held a prominent place from a very early period in the history of the country. Greece was, in truth, the birthplace of the drama, and some of the most famous Greek poets were those who excelled in this branch of literature. Foremost among the dramatic poets of Greece stand the names of Æschylus, Sophocles, and Euripides, the three great tragic poets, and Aristophanes, the unrivalled writer of comedies. Of these Euripides must come first on our list, though he was last of the three tragic poets in the order of time, and can hardly claim precedence on the score of merit; but he wrote at a time when the language had attained a more settled and perfect form, and his writings, being consequently not so difficult to interpret as those of Æschylus and Sophocles, are put first into the student's hands. Greek plays were made up of two elements, the speeches and dialogues on the one hand, and on the other the chorus. In the first of these the action of the play was carried on, while the choral odes which were interspersed throughout the piece were sung by a band of choristers (χορευται), who did not as a rule interfere with the business of the stage, though occasionally they were employed as interlocutors. The speeches and dialogue were almost always written in the Iambic metre, while the measure of the choric odes is very variable, though most frequently it is some variety of Anapæstic metre.

Our first extract is taken from Euripides' play of "Hecuba," which describes the miseries that befell Hecuba, the wife of Priam, in her captivity among the Greeks after the taking of Troy. Hecuba is lying on the ground, bewailing her miseries, and surrounded by the chorus in the character of Trojan captives. Talthybius, the Grecian herald, enters to bring her a message from Agamemnon:—

EURIPIDES.—"HECUBA," 482—505.

ΤΑΛ. Ποῦ τὴν ἄνασσαν δή ποτ' οὖσαν Ἰλίου
Ἑκάβην ἂν ἐξεύροιμι, Τρῳάδες κόραι;
ΧΟ. Αὕτη πέλας σου, νωτ' ἔχουσ' ἐπὶ χθονί,
Ταλθύβιε, κεῖται, ξυγκεκλεισμένη πέπλοις.
ΤΑΛ. Ὦ Ζεῦ, τί λέξω; πότερά σ' ἀνθρώπους ὁρᾶν
ἢ δόξαν ἄλλως τήνδε κεκτῆσθαι μάτην
ψευδῆ, δοκοῦντας δαιμόνων εἶναι γένος,
τύχην δὲ πάντα τα' ν βροτοῖς ἐπισκοπεῖν;
οὐχ' ἥδ' ἄνασσα τῶν πολυχρύσων Φρυγῶν;
οὐχ' ἥδε Πριάμου τοῦ μέγ' ὀλβίου δάμαρ;
καὶ νῦν πόλις μὲν πᾶσ' ἀνέστηκεν δορί,
αὕτη δὲ δούλη, γραῦς, ἄπαις, ἐπὶ χθονὶ
κεῖται, κόνει φύρουσα δύστηνον κάρα.
Φεῦ, φεῦ, γέρων μὲν εἰμ'· ὅμως δέ μοι θανεῖν
εἴη, πρὶν αἰσχρᾷ περιπεσεῖν τύχῃ τινί·
ἀνίστασ' ὦ δύστηνε, καὶ μετάρσιον
πλευρὰν ἔπαιρε, καὶ τὸ πάλλευκον κάρα.
ΕΚ. Ἔα· τίς οὗτος σῶμα τοὐμὸν οὐκ ἐᾷς
κεῖσθαι; τί κινεῖς μ' ὅστις εἶ, λυπουμένην.
ΤΑΛ. Ταλθύβιος ἥκω, Δαναϊδῶν ὑπηρέτης,
Ἀγαμέμνονος πέμψαντος, ὦ γύναι, μέτα.
ΕΚ. Ὦ φίλτατ' ἆρα κἄμ' ἐπισφάξαι τάφῳ
δοκοῦν Ἀχαιοῖς, ἦλθες; ὡς φίλ' ἂν λέγοις·
σπεύδωμεν, ἐγκονῶμεν· ἡγοῦ μοι γέρον.

NOTES.

ΤΑΛ. is the abbreviation of Ταλθύβιος. ΧΟ. is for Χόρος. ΕΚ. for Ἑκάβη.

482. Δή is used with interrogatives to increase the force of the question, and often denotes that a definite answer is expected.

483. Ἂν adds indefiniteness to the question, *Where in the world.*

487. Ἢ δόξαν, etc., *or that it is merely that false things which but pretend to be a race of deities have gained this reputation groundlessly.* Ἄλλως, *otherwise than it should be*, and thus *fruitlessly*, and hence it comes to mean *merely.*

488. Ψευδῆ, *creatures which are but fictions*, and as being thus applied to persons has δοκοῦντας agreeing with it where one would more naturally expect δοκοῦντα. This is called a *constructio* κάτα σύνεσιν—*according to the sense* of the passage. Thus we find τέκνα, a neuter, as meaning persons, agreeing with masc. or fem. adjectives and participles.

491. Μέγ' ὀλβίου, *highly prosperous.* Μέγα, neut. adjective, is used as an adverb.

492. Ἀνέστηκεν, *has been laid waste.* Ἀνίστημι, *to make to rise up, to make people leave their homes*, and in the intransitive tenses it has generally a hostile sense—*to be unpeopled.* The 2 aor., perf., and plup. act. of ἵστημι and its compounds are intransitive.

496. Εἴη, *may it happen to me to die, may death be my lot.*

Περιπεσεῖν, *before I fall in with, encounter.*

497. Μετάρσιον goes with ἔπαιρε, *raise on high*; lit., *raise it so as to be on high.* This is called the *proleptic* or anticipatory use of the adjective, the property expressed by it not existing in the subject till after the action of the verb is completed. So εὔφημον κοίμησον στόμα, where the adjective is equivalent to the expression ὥστε εὔφημον εἶναι, *so as to be civil.*

502. Πέμψαντος—μέτα. Supply σέ. *Having sent me to fetch you.* Μετα in composition often has this sense. Compare μεταθέω, *I run after*; μεταστείχω, *I go after, pursue.*

503. Κἄμε, *me also*; as well as her daughter Polyxena, who had already been sacrificed.

504. Δοκοῦν. Nom. absolute. *It having seemed good to the Greeks.*

Ὡς φίλ' ἂν λέγοις, *what a welcome message you would be bringing.*

505. Ἡγοῦ μοι, *lead the way for me.*

The "Bacchæ" (Bacchanals), which describes the terrible vengeance taken by the frenzied worshippers of Dionysus, or Bacchus, upon Pentheus, king of Thebes, who had dared to interfere with their orgies, supplies our next extract. A messenger who has come from beholding the horrid sight is giving an account of it to the terror-stricken Thebans. The extract is only part of a very long speech, and is chiefly remarkable for the exceeding beauty and vigour of the description:—

EURIPIDES.—"BACCHÆ," 1036—1062.

'Επεὶ Θεράπνας τῆσδε Θηβαίας χθονὸς
λιπόντες ἐξέβημεν 'Ασωποῦ ῥοάς,
λέπας Κιθαιρώνειον εἰσεβάλλομεν,
Πενθεύς τε κἀγώ, δεσπότῃ γὰρ εἱπόμην,
ξένος θ' ὅς ἡμῖν πομπὸς ἦν θεωρίας·
πρῶτον μὲν οὖν ποιηρὸν ἵζομεν νάπος,
τά τ' ἐκ ποδῶν σιγηλὰ καὶ γλώσσης ὕπο
σώζοντες, ὡς ὁρῷμεν οὐχ ὁρώμενοι·
ἦν δ' ἄγκος ἀμφίκρημνον, ὕδασι διάβροχον
πεύκαισι συσκιάζον, ἔνθα Μαινάδες
καθῆντ' ἔχουσαι χεῖρας ἐν τερπνοῖς πόνοις.
* * * * *
Πενθεὺς δ' ὁ τλήμων, θῆλυν οὐχ ὁρῶν ὄχλον
ἔλεξε τοιάδ', "ὦ ξέν' οὗ μὲν ἕσταμεν
οὐκ ἐξικνοῦμαι Μαινάδων ὄσσοις μόθον
ὄχθον δ' ἐπεμβὰς ἢ 'λάτην ὑψαύχενα
ἴδοιμ' ἂν ὀρθῶς Μαινάδων αἰσχρουργίαν;"
τοὐντεῦθεν ἤδη τοῦ ξένου τι θαῦμ' ὁρῶ·
λαβὼν γὰρ ἐλάτης οὐράνιον ἄκρον κλάδον,
κατῆγεν, ἦγεν, ἦγεν εἰς μέλαν πεδον.
κυκλοῦτο δ' ὥστε τόξον, ἢ κυρτὸς τροχὸς,
τορνῷ γραφόμενος περιφορὰν ἕλκει δρόμου·
ὣς κλῶν' ὄρειον ὁ ξένος χεροῖν ἄγων
ἔκαμπτεν εἰς γῆν, ἔργματ' οὐχὶ θνητὰ δρῶν.

NOTES.

1036. Θεράπνας either means *abodes*, or is the name of a place, in which case the additiou of τῆσδε Θηβ. χθ. must be understood as intended to distinguish it from Therapnæ in Thessaly and Laconia.

1037. 'Ασωπός, a river of Bœotia. Κιθαίρων was a mountain in the neighbourhood.

1040. Ξένος. This was Dionysus in disguise.

1042. The construction is σώζοντες σιγηλὰ τά τ' ἐκ ποδων, etc., *keeping silent the noise of our footsteps and voices.*

1044. 'Αμφίκρημνον, *with cliffs all around it.* Διάβροχον, *watered* (διά βρεχω, *to wet through*).

1045. Συσκιάζον, *making a shade*, by the pines which grew there. Μαινάδες, the Bacchanals. From μαίνομαι, *I rave.*

1053. Οὐκ ἐξικ., *I cannot reach with my eyes the rout of the Mænads.*

1058. Κατῆγεν, ἦγεν. The repetitiou of the ἦγεν deuotes the successive efforts made to pull the tree down. *Dragged it down, down, down.* This figure of speech is called *anaphora.*

1059. Κυκλοῦτο. The augment is left out, as is generally the case in the speeches of ἄγγελοι (*messengers*), probably to denote rapidity of manner in telling the tale.

Ὥστε τόξον, sc. κυκλοῦται.

Τροχός. The bending of the pine is likened to the curve of the wheel which is marked out by the τορνός on the timber out of which it is to be cut. Τορνός is the instrument used for drawing a circle or the arc of one, like a compass.

1060. Περιφορὰν, etc., *draws the circumference of its course.*

1061. Ὡς, equivalent to οὕτως, *thus.*

Our last extract is a fragment of a chorus from the "Medea," in praise of Athens:—

"MEDEA," 820—841.

'Ερεχθεῖδαι τὸ παλαιὸν ὄλβιοι
καὶ θεῶν παῖδες μακάρων,
ἱερᾶς χώρας ἀπορθήτου τ'
ἀποφερβόμενοι
κλεινοτάταν σοφίαν,
ἀεὶ διὰ λαμπροτάτου
βαίνοντες ἁβρῶς αἰθέρος,
ἔνθα ποθ' ἁγνὰς
ἐννέα Πιερίδας
Μουσας λέγουσι
ξανθὰν 'Αρμονίαν φυτεῦσαι.
Τοῦ καλλινάου τ' ἀπὸ Κηφισοῦ ῥοὰς
τὰν Κύπριν κλῄζουσιν ἀφυσ-
σαμέναν, χώρας καταπνεῦσαι
μετρίας ἀνέμων
ἡδυπνόους αὔρας·
ἀεὶ δ' ἐπιβαλλομέναν
χαίταισιν εὐώδη ῥοδέ-
ων πλόκον ἀνθέων
τᾷ σοφίᾳ παρέδρους
πέμπειν ἔρωτας,
παντοίας ἀρετᾶς ξυνέργους.

NOTES.

820. 'Ερεχθεῖδαι. The Atheuians are so called as being descended from Erectheus, one of the mythical heroes of Attica.

821. Θεῶν. Erecthcus was said by the legends to be the son of the god Hephæstus.

822. 'Απορθήτου. It was the boast of the Athenians that in the course of the numerous invasions of Greece their land had always remained intact. It is a singular fact that within three or four months after the production of this play, Attica was ravaged for the first time by the Lacedæmonians under Archidamus.

825. Λαμπροτάτου refers to the pure air and clear atmosphere of Attica.

826. 'Αβρῶς. Compare with this the account given by Pericles of the Athenian character (Thuc. ii. 40):—"For we combine elegance of taste with simplicity of life," etc.

830. 'Αρμονίαν is the subject of φυτεῦσαι. According to the more generally received mythology, Mnemosyne was mother of the Muses.

832. 'Αφυσσαμέναν. 1 aor. mid. part. from ἀφύσσω.

836. 'Επιβαλλομέναν, middle, *ever wreathing her hair with the fragrant garland of the roses' bloom.*

839. Παρέδρους, *that sit by*, and so, *help and assist.*

TRANSLATION OF EXTRACT II. IN LAST READING.

XENOPHON.—"ANABASIS," Book I., Chap. 3.

And in this region the country was a plain throughout, as even as the sea, and full of wormwood. If any other kiuds of shrubs or reeds grew there, they had all an aromatic smell; but no trees appeared. Of wild creatures, the most numerous were wild asses, and uot a few ostriches, besides bustards and gazelles, which our horsemen sometimes chased. The asses, when they were pursued, having gained ground of the horses, stood still, for they exceeded them in speed; and when these came up with them, they did the same thing again; so that our horsemen could take them by no other method but by dividing themselves into relays, and succeeding oue another in the chase; and when they were caught their flesh was found to be very like that of deer, but tenderer. But no one caught an ostrich, and those of the cavalry who pursued them soon desisted, for the creatures led them away a good distauce, flying before them at full speed, and using their wings like sails to aid the speed of their feet. But if one is quick it is possible to catch the bustard, for they fly only a short distance like partridges, and soon become exhausted, and their flesh is very palatable.

LESSONS IN FRENCH.—LVI.

§ 34.—REMARKS ON THE PERSONAL PRONOUNS.

(1.) THE French, as well as the English, use the second person plural for the second person singular, in addressing one person.

(2.) The second person singular, however, is used, as in English, in addressing the Supreme Being:—

Grand Dieu! *tes* jugements sont remplis d'équité. DES BARREAUX.	*Great God, thy judgments are full of equity.*

(3.) It is also used in poetry, or to give more energy to the expression:—

O mon souverain roi! Me voici donc tremblante et seule devant *toi*. RACINE, *Esther*.	*O my sovereign king! Here I am, trembling and alone before thee.*

(4.) It is used by parents to children, and also among intimate friends.

(5.) The pronoun **il*** is used impersonally, in the same manner as the English pronoun *it*:—

il pleut, *it rains*; il gèle, *it freezes.*

(6.) Observe that the personal pronouns of the third person are not used for the indirect object, in reference to inanimate objects. The relative pronouns **en**, *of* or *from it* [§ 40 (17)], **y**, *to it* [§ 40 (18)], are used instead of the personal pronouns. Thus, in speaking of a *house*, we do not say, Je lui *ajouterai une aile*. We must say:—

J'y ajouterai une aile. *I will add a wing to it (thereto).*

* The impersonal pronoun **il** is derived from Latin *illud*; whilst the personal pronoun of the third person masculine, **il**, is derived from *ille*.

In speaking of an author, we may say:—

Que pensez-vous *de lui?*	*What do you think of him?*

But in speaking of his book, we should say:—

Qu'*en* pensez-vous?	*What do you think of it (thereof)?*

(7.) The word **même**, plural **mêmes**, may be used after the pronoun in the sense of *self, selves*:—

le roi *lui-même*,	*the king himself.*
la reine *elle-même*,	*the queen herself.*
les princes *eux-mêmes*,	*the princes themselves.*
les princesses *elles-mêmes*,	*the princesses themselves.*

(8.) The pronouns **moi, toi, lui, eux**, are often used after the verb or before the pronoun subject, for the sake of emphasis:—

je le dis, *moi*,	*I say so*, or *I do say so.*
il le dit, *lui*,	*he says so*, or *he does say so.*
lui, il le désire autant que vous,	*as for him, he wishes it as much as you do.*

(9.) The same pronouns, **moi, toi, lui, eux**, are used instead of the nominative pronouns **je, tu, il, ils**, for the English pronouns *I, thou, he, they*, when those pronouns have a verb understood after them, as in answer to a question or after a comparative:—

Qui est arrivé ce matin? *Moi.*	*Who arrived this morning? I.*
Vous écrivez mieux que *lui.*	*You write better than he.*
Vous lisez aussi bien que *moi.*	*You read as well as I.*

(10.) The same pronouns are used in exclamatory sentences before a verb in the infinitive; before relative pronouns; before adjectives, past or present participles, and after the verb *to be*, used impersonally:—

Moi, lui céder!	*I, yield to him!*
Eux, aller à Londres!	*They, go to London!*
Moi qui suis malade . . .	*I who am sick* . . .
Lui que je connais.	*He whom I know.*
Eux dont la conduite . . .	*They, whose conduct* . . .
Lui, courageux et dévoué, partit à l'instant.	*He, courageous and devoted, immediately set out.*
Lui parti, la bande se dispersa.	*He gone, the band dispersed.*
Eux, voyant qu'il était mort, s'enfuirent.	*They, seeing that he was dead, ran away.*
C'est *moi*; c'est *lui.*	*It is I; it is he.*
Ce sont *eux.*	*It is they.*

(11.) These same pronouns are also used instead of the nominatives **je, tu**, etc., when the verb has several subjects, whether all pronouns, or nouns and pronouns, in which case the verb may be immediately preceded by one of the pronouns **nous** and **vous**, representing in one word all the preceding subjects; **nous** being used when there is a pronoun of the first person among the subjects; and **vous** when there is a pronoun of the second and none of the first:—

Votre père et *moi, nous* avons été longtemps ennemis l'un de l'autre. FÉNELON.	*Your father and I were a long time enemies.*
Ton frère et *toi, vous* m'avez trompé. MONTESQUIEU.	*Thy brother and thou have deceived me.*

(12.) The recapitulating pronoun and the verb sometimes come first in the sentence:—

Nous avons, *vous* et *moi*, besoin de tolérance. VOLTAIRE.	*You and I have need of tolerance.*

(13.) Finally the same pronouns, **moi, toi, lui, eux**, are used instead of **je, tu, il, ils**, when the several subjects of various verbs have performed different actions connected together, or tending to the same end:—

Tandis qu'*ils* défendaient le pays, *lui* le gouvernait sagement.	*Whilst they were defending the country, he governed it wisely.*

(14.) The reflective pronoun **se**, *himself*, etc., is used for both genders, and for both numbers; for persons and for things; and always accompanies a verb:—

Les yeux de l'amitié *se* trompent rarement. VOLTAIRE.	*The eyes of friendship are seldom deceived (deceive themselves).*

(15.) The same pronoun has sometimes a reciprocal and sometimes a reflective meaning, according to the context:—

ils *se* flattent,	*they flatter themselves.*
ils *se* flattent,	*they flatter one another, each other.*

In this case the indefinite pronoun **l'un l'autre** is placed after the verb, or the word **entre** prefixed to it for the sake of clearness:—

Ils s'aiment *l'un l'autre*, or ils s'*entr'*aiment.	*They love one another.*

(16.) **Soi**, *himself, itself*, etc., is of both genders and numbers, and is applied to persons and things. It is used in reference to a noun or a pronoun relating to a particular individual or object, and in general and indeterminate sentences:—

On a souvent besoin d'un plus petit que *soi*. LA FONTAINE.	*We have often need of one inferior to ourselves.*
Cet homme ne parle que de *soi*.	*This man only speaks of himself.*
Le vice est odieux de *soi*.	*Vice is odious in itself.*

For additional rules on personal pronouns, see Syntax, § 95, and following.

§ 35.—POSSESSIVE PRONOUNS.

(1.) The possessive pronouns, which are formed from the personal pronouns, represent, in the radical part, the *possessor*, while in termination they always agree with the thing possessed. Some relate to one person, some to several.

(2.) POSSESSIVES RELATING TO ONE PERSON.

The object possessed being in the—

Singular.		*Plural.*		
Masc.	*Fem.*	*Masc.*	*Fem.*	
1. le mien,	la mienne,	les miens,	les miennes,	*mine;*
2. le tien,	la tienne,	les tiens,	les tiennes,	*thine;*
3. le sien,	la sienne,	les siens,	les siennes,	*his, hers, its.*

(3.) TWO OR MORE PERSONS.

The object possessed being in the—

Singular.		*Plural.*	
Masc.	*Fem.*	*Masc. and Fem.*	
1. le nôtre,	la nôtre,	les nôtres,	*ours;*
2. le vôtre,	la vôtre,	les vôtres,	*yours;*
3. le leur,	la leur,	les leurs,	*theirs.*

LESSONS IN GERMAN.—XLVIII.

SECTION C.—EXERCISES IN SPEAKING AND WRITING GERMAN.

THE manner in which the words in the following lists are to be used for the purpose of exercising the student in speaking and writing German is as follows. The student selects some particular word, say, der Schneider, and endeavours to produce in German a sentence constructed according to the principles embraced in any given lesson. Thus (Section X., Vol. I., page 67) Ihr Freund, der Schneider, hat das schöne, neue Tuch des, etc.; or, dieser Schneider ist alt, etc.; or, der Schneider macht gute Röcke, etc.; or, ist der Schneider noch hier? etc. As the student advances, he may incorporate *two, three, four*, or any given number of these words in an exercise. As a model for an exercise containing several different terms, something like the following (Section XV., Vol. I., page 118) may be given:—1. Gute Enkel sind die Freude des Großvaters und der Großmutter. 2. Den guten Vorsätzen folgen gute Thaten. 3. Meine schönen Blumen blühen. 4. Diese rothen Rosen riechen. 5. Er hat zwei große Schränke, drei Kisten und sechs Kübel. 6. In dem Saale dieses Schlosses sind viele Kronenleuchter, Lampen, und Kerzen. 7. Diese kleinen, runden Hüte sind schön. 8. Gute, treue und wahre Freunde sind ein großes Geschenk eines guten und gütigen Gottes.

EXERCISE AFTER SECTION XXV. (Vol. I., page 238).

1. Die Kinder gehen in den Garten, um Rosen, Nelken und Lilien zu brechen. 2. Die Eulen und Fledermäuse können das Licht der Sonne nicht leiden. 3. Aufmerksame Schüler können leicht die deutsche Sprache lernen. 4. Kennen Sie jene Zimmerleute und Maurer? 5. Ja, sie haben von meinem Vater Korn, Weizen und Gerste gekauft. 6. Man sagt, daß Tabak

Mais und Reis in Nord-Amerika gut gedeihen. 7. Jener Wundarzt weiß zu leben und sich das Leben angenehm zu machen. 8. Ein geschickter Arzt kennt die Theile des menschlichen Körpers.

Besides the stock of words the student has already acquired from the vocabularies given in the preceding lessons, and others which he may acquire from the following lists, a dictionary may also be made available. The following connected view of the different declensions of the adjectives and nouns will be found convenient for ready reference.

TERMINATIONS OF ADJECTIVES.

OLD DECLENSION (§ 28, 29).

	Singular. Masc.	Fem.	Neut.	Plural, all genders.
Nom.	-er	-e	-es	-e.
Gen.	-en, -es	-er	-en, -es	-er.
Dat.	-em	-er	-em	-en
Acc.	-en	-e	-es	-e.

NEW DECLENSION (§ 30, 31).

	Singular. Masc.	Fem.	Neut.	Plural, all genders.
Nom.	-e	-e	-e	-en.
Gen.	-en	-en	-en	-en.
Dat.	-en	-en	-en	-en.
Acc.	-en	-e	-e	-en.

MIXED DECLENSION (§ 32, 33).

	Singular. Masc.	Fem.	Neut.	Plural, all genders.
Nom.	-er	-e	-es	-en.
Gen.	-en	-en	-en	-en.
Dat.	-en	-en	-en	-en.
Acc.	-en	-e	-es	-en.

TERMINATIONS OF NOUNS.

OLD DECLENSION.

	Singular.	Plural. (1.) Rules 2, 4.	(2.) Rules 1, 3.	SECT. XV. (3.) Rule 4.	(4.) Rules 7, 8.
Nom.	-	-e	-	-er	-en, -n.
Gen.	-es, -s	-e	-	-er	-en, -n.
Dat.	-e, -	-en	-n,	-ern	-en, -n.
Acc.	-	-e	-	-er	-en, -n.

NEW DECLENSION.

	Singular.	Plural. (5.) Rules 5, 6.
Nom.	-, -	-en, -n.
Gen.	-en, -n	-en, -n.
Dat.	-en, -n	-en, -n.
Acc.	-en, -n	-en, -n.

VOCABULARY OF WORDS.

1. PROFESSIONS AND TRADES. Handwerke und Gewerbe.

Apothe'ker, *m.* -s,* pl. -, apothecary.
Barbier', *m.* -s, pl. -e, barber.
Bau'meister, *m.* -s, pl. -, architect.
Bild'hauer, *m.* -s, pl. -, sculptor.
Bischof, *m.* -s, pl. Bischöfe, bishop.
Böttcher, *m.* -s, pl. -, cooper.
Brauer, *m.* -s, pl. -, brewer.
Buch'binder, *m.* -s, pl. -, bookbinder.
Buch'drucker, *m.* -s, pl. -, printer.
Capellan', *m.* -s, pl. -e, chaplain.
Chirurg', *m.* -en, -s, pl. -en, surgeon.
Dach'decker, *m.* -s, pl. -, slater.
Färber, *m.* -s, pl. -, dyer.
Fisch'händler, *m.* -s, pl. -, fishmonger.
Fleischer, *m.* -s, pl. -, butcher.
Fuhrmann, *m.* -es, -s, pl. -leute, carrier, wagoner.
Geist'liche, *m.* -n, pl. -n, clergyman.
Gerber, *m.* -s, pl. -, currier.
Glaser, *m.* -s, -, pl. -, glazier.
Goldschmied, *m.* -es, -s, pl. -e, goldsmith.
Hand'schuhmacher, *m.* -s, pl. -, glover.
Hirt, *m.* -en, pl. -en, herdsman.
Hufschmied, *m.* -es, -s, pl. -e, farrier.
Juwelier', *m.* -es, -s, pl. -e, jeweller.
Köhler, *m.* -s, pl. -, collier.
Küfer, *m.* -s, pl. -. (See Böttcher.)
Künstler, *m.* -s, pl. -, artist.
Kup'ferschmied, *m.* -es, -s, pl. -e, brazier.
Kup'ferstecher, *m.* -s, pl. -, engraver.
Mäher, *m.* -s, pl. -, mower.
Markt'schreier, *m.* -s, pl. -, quack.
Maurer, *m.* -s, pl. -, mason.
Mes'serschmied, *m.* -es, -s, pl. -e, cutler.
Metzger, *m.* -s, pl. -. (See Fleischer.)
Musikant', *m.* -en, pl. -en, musician, fiddler.
Nacht'wächter, *m.* -s, pl. -, watchman.
Nä'herin, *f.* -, pl. -nen, seamstress.
Natur'forscher, *m.* -s, pl. -, naturalist.
Obst'händlerin, *f.* -, pl. -nen, fruitwoman.
Papst, *m.* -es, pl. Päpste, pope.
Perrü'ckenmacher, *m.* -s, pl. -, hairdresser.
Pfarrer, *m.* -s, pl. -, vicar, parson.
Pfer'dehändler, *m.* -s, pl. -, horsedealer.
Philosoph', *m.* -en, pl. -en, philosopher.
Pre'diger, *m.* -s, pl. -, preacher.
Priester, *m.* -s, pl. -, priest.
Redner, *m.* -s, pl. -, orator.
Sattler, *m.* -s, pl. -, saddler.
Schau'spieler, *m.* -s, pl. -, actor.
Schlosser, *m.* -s, pl. -, locksmith.
Schmied, *m.* -es, -s, pl. -e, smith.
Schneider, *m.* -s, pl. -, tailor.
Schorn'steinfeger, *m.* -s, pl. -, chimney-sweeper.
Schrift'steller, *m.* -s, pl. -, author.
Schuh'flicker, *m.* -s, pl. -, cobbler.
Schul'lehrer, *m.* -s, pl. -, schoolteacher.
Seiler, *m.* -s, pl. -, rope-maker.
Specerei'händler, *m.* -s, pl. -, grocer.
Stick'erin, *f.* -, pl. -nen, embroideress.
Tag'löhner, *m.* -s, pl. -, day-labourer.
Tapezie'rer, *m.* -s, pl. -, upholsterer.
Trödler, *m.* -s, pl. -, fripperer.
Tuch'händler, *m.* -s, pl. -, draper.
Uhr'macher, *m.* -s, pl. -, watchmaker.
Wä'scherin, *f.* -, -nen, washerwoman.
Weber, *m.* -s, pl. -, weaver.
Wechsler, *m.* -s, pl. -, money-changer.
Wundarzt, *m.* -es, pl. -ärzte. (See Chirurg.)
Zahnarzt, *m.* -es, pl. -ärzte, dentist.
Zuck'erbäcker, *m.* -s, pl. -, confectioner.

2. MAN. Der Mensch.

Alter, *n.* -s, old age.
Amme, *f.* -, pl. -n, wet-nurse.
Braut, *f.* -, pl. Bräute, bride.
Bräu'tigam, *m.* -s, pl. -e, bridegroom.
E'hefrau, *f.* -, pl. -en, wife.
E'hemann, *m.* -es, -s, pl. -männer, husband.
Enkel, *m.* -s, pl. -, grandson.
En'kelin, *f.* -, pl. -nen, granddaughter.
Fami'lie, *f.* -, pl. -n, family.
Geburt', *f.* -, birth.
Gemahl', *m.* -es, -s, pl. -e, } consort.
Gemah'lin, *f.* -, pl. -nen, }
Groß'mutter, *f.* -, pl. -mütter, grandmother.
Groß'vater, *m.* -s, pl. -väter, grandfather.
Jugend, *f.* -, youth.
Jungfrau, *f.* -, pl. -en, virgin.
Jüngling, *m.* -s, pl. -e, young man.
Kindheit, *f.* -, childhood, infancy.
Nach'kommen, pl., descendants.
Pathe, *m.* -n, pl. -n, godfather.
Pathe, *f.* -, pl. -n, godmother.
Pfle'gevater, *m.* -s, pl. -väter, foster-father.
Schwie'germutter, *f.* -, pl. -mütter, mother-in-law.
Schwie'gersohn, *m.* -es, -s, pl. -söhne, son-in-law.
Schwie'gervater, *m.* -s, pl. -väter, father-in-law.
Stief'mutter, *f.* -, pl. -mütter, stepmother.
Stiefsohn, *m.* -es, -s, pl. -söhne, stepson.
Stief'vater, *m.* -s, pl. -väter, stepfather.
Ur'enkel, *m.* -s, pl. -, great-grandson.
Ur'großvater, *m.* -s, pl. -väter, great-grandfather.
Verlo'bung, *f.* -, pl. -en, betrothment.
Vor'fahren, pl. ancestors.
Waise, *f.* -, pl. -n, orphan.
Wittwe, *f.* -, pl. -n, widow.
Wittwer, *m.* -s, pl. -, widower.
Zwilling, *m.* -s, pl. -e, twin.

3.—ARTICLES OF DRESS. Kleidungsstücke.

Aermel, *m.* -s, pl. -, sleeve.
Armband, *n.* -es, -s, pl. -bänder, bracelet.
Atlas, *m.* -sses, pl. -sse, satin.
Barchent, *m.* -s, pl. -e, dimity.
Batist', *m.* -es, pl. -e, cambric.
Baum'wolle, *f.* -, cotton.
Bein'kleider, pl. pantaloons.
Besatz', *m.* -es, pl. -sätze, trimming.
Beutel, *m.* -s, pl. -, purse, bag.
Brille, *f.* -, pl. -n, spectacles.
Brust'nadel, *f.* -, pl. -n, brooch.
Bürste, *f.* -, pl. -n, brush.
Degen, *m.* -s, pl. -, sword.
Diamant', *m.* -en, pl. -en, diamond.
El'fenbein, *n.* -es, -s, ivory.
Fächer, *m.* -s, pl. -, fan.
Flor, *m.* -es, -s, pl. Flöre, crape.
Frack, *m.* -es, -s, pl. Fräcke, dress coat.
Franse, *f.* -, pl. -n, fringe.
Futter, *n.* -s, lining.

* The letter or letters set off by a hyphen (thus, -s, or -es) is that used in forming the genitive. Where the genitive singular is like the nominative, and where the plural is like the singular, no note is made of it. Where, however, the plural differs from the singular either in termination or otherwise, the difference is duly marked.

Geschmei'de, *n.* -s, jewellery.
Granat', *m.* -es, -s, pl. -e, } garnet.
Grana'te, *f.* -, pl. -n, } garnet.
Gürtel *m.* -s, pl. -, sash.
Haar'nadel, *f.* -, pl. -n, hair-pin.
Halsband, *n.* -es, -s, pl. -bänder, necklace.
Halstuch, *n.* -es, -s, pl. -tücher, neckcloth.
Haube, *f.* -, pl. -n, cap.
Hemd, *n.* -es, -s, pl. -en, shirt.
Hosen, pl. breeches.
Ho'senträger, *m.* -s, pl. -, braces, suspenders.
Kama'schen, pl. gaiters.
Kamm, *m.* -es, -s, pl. Kämme, comb.
Kappe, *f.* -, pl. -n, cap.
Kleid, *n.* -es, -s, pl. -er, dress, gown.
Kopfputz, *m.* -es, head-dress.
Kragen, *m.* -s, pl. -, collar.
Leinwand, *f.* -, linen.
Locke, *f.* -, pl. -en, curl.
Musselin', *m.* -es, -s, pl. -e, muslin.
Mütze, *f.* -, pl. -n. (See Kappe.)
Na'delkissen, *n.* -s, pl. -, pincushion.
Näh'nadel, *f.* -, pl. -n, needle.
O'berrock, *m.* -es, -s, pl. -röcke, frock-coat.
Ohrring, *m.* -es, -s, pl. -e, earring.
Pelzwerk, *n.* -es, -s, pl. -e, fur.
Perle, *f.* -, pl. -n, pearl.
Poma'de, *f.* -, pl. -n, pomatum.
Riech'fläschchen, *n.* -s, pl. -, smelling bottle.
Ring, *m.* -es, -s, pl. -e, ring.
Sammet, *m.* -s, pl. -e, velvet.
Schachtel, *f.* -, pl. -n, box.
Scheere, *f.* -, pl. -n, scissors, shears.
Schlafrock, *m.* -es, -s, pl. -röcke, dressing-gown.
Schleier, *m.* -s, pl. -, veil.
Schloß, *n.* -es, pl. Schlösser, clasp.
Schürze, *f.* -, pl. -n, apron.
Seide, *f.* -, pl. -n, silk.
Socke, *f.* -, pl. -n, sock.
Son'nenschirm, *m.* -es, -s, pl. -e, parasol.
Spitze, *f.* -, pl. -n, lace.
Sporn, *m.* -es, -s, pl. Sporen, spur.
Steck'nadel, *f.* -, pl. -n, pin.
Stie'felknecht, *m.* -es, -s, pl. -e, boot-jack.
Strumpf, *m.* -es, -s, pl. Strümpfe, stocking.
Taft or Taffet, *m.* -es, -s, pl. -e, taffeta.
Tasche, *f.* -, pl. -n, pocket.
Un'terhosen, pl. drawers.
Weste, *f.* -, pl. -n, vest.
Wichse, *f.* -, pl. -n, blacking.
Zahn'bürste, *f* -, pl. -n, tooth-brush.
Zahn'stocher, *m.* -s, pl. -, tooth-pick.

KEY TO EXERCISES IN LESSONS IN GERMAN.

Exercise 137 (Vol. II., page 406).

1. Die Mutter warnte den Sohn. = Der Sohn wurde von der Mutter gewarnt. 2. Romulus gründete Rom. = Rom wurde von Romulus gegründet. 3. Die Gallier verbrannten es. = Es wurde von den Galliern verbrannt. 4. Herr G. componirte dieses Lied, und Herr N. sang es. = Dieses Lied wurde von Herrn G. componirt, und von Herrn N. gesungen. 5. Wir lieben und suchen geschickte Leute. = Geschickte Leute werden geliebt und gesucht; aber unwissende Leute werden gewöhnlich verachtet. 6. Man vernachlässigt oft seine Pflichten, indem man an seine Vergnügungen denkt 7. Die heiligsten Pflichten sind oft vernachlässigt worden, indem wir dem Vergnügen zu sehr ergeben waren. 8. Dem Sieger war der Hut mit Blumen geschmückt worden. 9. Die Tapfersten des Heeres werden belohnt werden, je nachdem ihre Thaten anerkannt werden. 10. Deine Schwester wird von ihrem Lehrer geliebt und gelobt, weil sie fleißig und aufmerksam ist; aber du wirst von dem deinigen getadelt werden, weil du nicht gern arbeitest. 11. Karl ist bestraft worden, weil er seine Aufgabe nicht vollendet hatte. 12. Wir wurden von unserm Lehrer gelobt, weil wir fleißig waren. 13. Unser Freund ist bestraft worden, weil er nachlässig gewesen war. 14. Du hast das Vergnügen gehabt, einige Tage bei deinen Freunden auf dem Lande zuzubringen; du bist von ihnen gelobt und belohnt worden, weil dein Lehrer dir ein vortheilhaftes Zeugniß gegeben hat. 15. Sein Bruder würde besser empfangen worden sein.

Exercise 138 (Vol. III., page 42).

1. It is said that the actor will give a representation. = It is said that a representation will be given by the actor. 2. The neighbour believes that the boy deceives his parents. = The neighbour believes that the parents are deceived by the boy. 3. The children said that the huntsman was shooting the stag = The children said that the stag was shot by the huntsman. 4. They fear that the dog may bite the people. = They fear that the people may be bitten by the dog. 5. They presume the friend has deceived his friend. = They presume the friend has been deceived by his friend. 6. The father thought that the children had played the piece. = The father thought that the piece had been played by the children. 7. He told me that the girls had plucked the flowers in his garden. = He told me that the flowers in his garden had been plucked by the girls. 8. The old soldier exclaimed that he would never forget his commander-in-chief. = The old soldier exclaimed that his commander-in-chief would never be forgotten by him. 9. The mother said she would dig in the garden this afternoon. = The mother said that it would be dug by her in the garden this afternoon. 10. I should like to know whether you would have honoured him. = I should like to know whether he would have been honoured by you. 11. I thought he certainly would have won the game. = I thought the game would certainly have been won by him. 12. The oracle predicted that he would conquer. 13. He told me he was loved and esteemed by everybody. 14. He affirms that the riddle has been solved by him. 15. History mentions that Troy was demolished by the Hellenic princes. 16. He told him that he would be willing to do everything on his account. 17. The friend complained that he was visited so little by me. 18. They say Hungary was subdued by bribery, not by force of arms. 19. My neighbour told me that this man's exterior presented nothing remarkable, but his mind was adorned by a great many excellent qualities. 20. The aged Cato concluded every speech with the words, "Besides, I am of opinion that Carthage should be demolished." 21. It is supposed that the fort has been occupied by the enemy, but that the garrison will have been pardoned. 22. The youth said that much would yet be accomplished by him. 23. The afflicted father believes that his son may have been shot by the infuriated enemy. 24. The friend affirmed that the calamity had been brought on by the fault of her neighbour. 25. The poor man complained that he had been forcibly carried away.

Exercise 139 (Vol. III., page 42).

1. Es wurde gesagt, daß Jedermann diese Kinder lieben würde. = Es wurde gesagt, diese Kinder würden von Jedermann geliebt werden. 2. Der Lehrer glaubt, die Schüler könnten ihre Aufgabe gelernt haben. = Der Lehrer glaubt, die Aufgabe könnte von den Schülern gelernt worden sein. 3. Der Gärtner sagte, er würde morgen in dem Garten graben. = Der Gärtner sagte, es würde morgen von ihm in dem Garten gegraben werden. 4. Wir wünschen, daß ihr eure Freunde liebet und achtet. = Wir wünschen, daß eure Freunde von euch geliebt und geachtet werden. 5. Wir glaubten nicht, daß wir je von unsern Lehrern würden gelobt worden sein, und daß wir sie in Allem würden zufrieden gestellt haben. 6. Es ist unmöglich, daß Sie die Nachricht vor uns können erhalten haben, ausgenommen, sie wäre Ihnen durch den Telegraphen mitgetheilt worden. 7. Wie ist es möglich, daß dieses Unternehmen von Ihnen hätte vollendet werden können? 8. Wir zweifeln sehr, daß wir je für unsere Mühe belohnt werden, und daß die Versprechungen je erfüllt werden können. 9. Wie war es möglich, daß jenes Volk schlecht regiert wurde, da es einen so weisen und guten Fürsten hatte? 10. Der arme Sclave klagte, daß er gewaltsam fortgeschleppt worden sei, und im Uebermaße seines Schmerzes rief er aus: „O wäre ich nie geboren!"

Exercise 140 (Vol. III., page 43).

1. Do you not know what disease your niece died of? 2. As far as I have heard, she died of consumption. 3. Many have died of cholera this year. 4. Do they not know who stole the silver spoons? 5. No; but they suspect one of the men-servants of the house. 6. At first they suspected an old waiting-woman. 7. He suspects me of having intentionally offended him. 8. I really do not know upon whom to cast my suspicion, and upon what to support it. 9. After I shall have dressed and breakfasted I will visit him. 10. After he had dined he read the paper. 11. After he had bathed he took a walk. 12. He even came after ten o'clock in the evening to visit me. 13. After midnight we shall continue our journey. 14. There are people who after this life expect no other. 15. I rejoice more for his sake than for mine. 16. I undertook the journey on your account. 17. The father is sad on your account. 18. You need not be ashamed on our account. 19. My brother had no longer any command over himself. 20. Have you seen Mr. N. or his lady? 21. I have not only seen, but also spoken to him. 22. A loyal soldier prefers dying to becoming a traitor.

LESSONS IN BOTANY.—XXXVIII.

SECTION CXVI.—ON ENDOGENOUS PLANTS.

Having devoted thus much consideration to Exogenous plants, it is time for us to pay some attention to Endogenous ones. The distinctions between these two great divisions have already been so fully mentioned in our remarks on the "Structure of the Stem of Vegetables" (Vol. I., p. 81), that it will be unnecessary to say much more here.

In the study of any subject it is always desirable for the mind to grasp a certain general outline, previous to entering upon minor characteristics. Having, then, determined the conditions of distinction between exogens and endogens, let us now devote our sole attention to the latter, and see if we can recognise any broad groupings between endogens themselves. Tulips, daffodils, and lilies are all endogens, as their leaves will abundantly testify, without the necessity of our taking any further trouble; so are grasses and sedges. Here, then, we may recognise a natural division at once. The former have flowers composed of sepals and petals, just like the plants we have already discussed; but as for grasses and sedges, they would be pronounced by an inexperienced person flowerless; indeed, they are flowerless in the ordinary acceptation of the term—that is to say, they have neither calyx nor corolla—but their reproductive organs are protected by peculiar modifications of those changeable bodies, "bracts." This character of inflorescence is said to be "glumaceous," and the floral appendage of a grass is said, in the language of botany to be a glume (Latin, *gluma*, a husk).

In the few remarks which we have to make on endogenous plants, we shall not follow the systematic plan of giving them precise botanical characteristics, but shall generalise with a view of enabling the reader to regard the members of this division under a broad aspect. In addition, then, to the great characteristics of the endogenous division already enumerated, it remains now to be mentioned that the leaves of endogenous plants are not attached to the parent stem, like those of exogens, by a joint or axil; and that the calyx, corolla, and reproductive organs have a tendency to the number three, or of some multiple of that number; whereas the corresponding parts of exogens assume for the most part the number five, or its multiples. Not that the rule is invariable, but it is very general. By examinining lilies (Fig. 277), tulips, etc., and comparing them with exogens, the reader will satisfy himself of the correctness of this remark.

The common garden asparagus is regarded by botanists as a lily, as in like manner are the gigantic dragon-trees, as was noticed in our remarks on the "Scientific Classification of Vegetables" (Vol. I., p. 55).

For the most part endogenous plants have no branches, but send one trunk or stem aloft. On the opposite page is a figure of the Banana (tribe *Musaceæ*), a good example of the stem of an endogen. To this, however, there are a few exceptions. Asparagus is branched, as everybody knows. The dragon-tree is also branched, and so is the doom-palm of Upper Egypt.

GRAMINACEÆ, OR GRASSES.

Let us now proceed to an examination of the grasses—vegetables which constitute a most valuable and very well-characterised natural order, designated by the botanical term *Graminaceæ* (Latin, *gramen*, grass).

The grasses, though generally unpretending in aspect, are, without doubt, more useful than any vegetable productions whatever. The smaller species clothe our fields with verdure, and afford nourishment to cattle. The large species furnish us with bread and sugar; for at this period of our botanical investigations the reader need not be informed that wheat, barley, rice, maize, oats, rye, and the sugar-cane are all grasses. The slightest inspection of a leaf of one of this tribe suffices to indicate that grasses are endogenous plants. An examination of the seed affords similar information. These matters scarcely require notice, their perception is so evident. The flower of a grass, however, is a very curious arrangement of parts, unlike anything which has yet come under our notice, petals and sepals being altogether absent, and the external parts of the flower being exclusively composed of green or brown scales, called *glumes*; hence grasses are said to possess a glumaceous flower. These scales, to which the term *glume* is applied, are no other than bracts, which we have already seen to be capable of such extraordinary metamorphoses, becoming in the oak an acorn-cup, in the pine-apple the part we eat.

Grasses are not excluded from any quarter of the globe; but the number of individuals, though not of species, is greatest in the northern temperate regions. As we approach the equator the number of individuals decreases proportionately with an increase in the number of species. The stem, too, becomes woody, the leaves enlarge, and the organs of reproduction are frequently checked in their development, owing to this luxuriance of vegetation. The cultivated cereals have become so transported from one land to another, that it is now quite impossible to determine with certainty the native regions of many species. Oats and rye are mostly cultivated towards the north; barley and wheat in more temperate regions; maize in America, and rice in Asia. The seed, or, more correctly speaking, the fruit, of these afford sustenance to the greater portion of the human species. The analogy of the chemical composition of grasses indicates not less than their external characteristics their mutual affinity, pointing out the whole family as essentially nutritive vegetables. Their herbaceous, or, in larger species, their woody stem, is enveloped in a shiny coat of silica, or flinty matter. Internally, the stem contains phosphate of lime, albumen, sugar, and mucilage. The grain, as we will at present denominate the so-called seed, contains starch and gluten in abundance, mixed with a certain quantity of sugar, the amount of which increases towards the period of germination, also a little fixed oil and various saline matters.

277. LILIES.—1, LILIUM TESTACEUM; 2, LILIUM SPECIOSUM; 3 METHONICA LEOPOLDI; 4, CUMMINGIA TRIMACULATA.

Innocuity and the presence of nutritive principles are the grand characteristics of grasses physiologically considered. Yet to this description certain species offer an exception; darnel-grass (*Lolium temulentum*) is strongly poisonous, owing to the presence of the chemical principle *loline*. *Festuca quadridentata*, a species which grows abundantly in Peru, is mortal to cattle which browse upon it. Another species, a *Calamagrostis*, is juiceless, and when swallowed by animals injures their throats, rather on account of the flinty matter with which it is profusely coated than because of any poisonous principle. Finally, the rhizome of certain species of the genus *Bromus* is purgative. Amongst the chemical principles contained in many species of grasses, various odorous matters should not be forgotten. Every person is acquainted with the agreeable odour diffused by hay. This odour depends on the presence of coumarin in a species of grass called *Anthoxanthum odoratum.* The sugar-cane, moreover, is delicately odorous; its tender shoots filling an apartment with an agreeable fragrance; but the odorous principle is most highly developed in the lemon-grass of the West Indies, the leaves of which smell so exactly like those of the verbena, or lemon-plant, that it is difficult by the test of odour to distinguish between the two. In either case the odorous principle depends on the presence of a volatile oil; indeed, much of the essential oil commonly sold as that of verbena is really derived from the West Indian lemon-grass.

The sugar-cane is supposed to be a native of the south-eastern portion of Asia. It was totally unknown to the ancient Greeks and Romans, as in like manner was sugar. From South-Eastern Asia the cane was introduced into Arabia; from Arabia it travelled into Egypt, Asia Minor, Sicily, Italy, and Spain. From the latter country it was transported to St. Domingo and the mainland of America. Sugar had preceded the cane in Europe by a considerable period; but there is reason to suppose that the substance, although absolutely identical in composition with that of the cane, was derived, not from it, but from the juice of palm-trees. In Ceylon the art of manufacturing sugar from the juice of palm-trees has been known to the natives from time immemorial. The manufacture of sugar, however, from the cane was in that island a European introduction. Nevertheless, the Cingalese possessed the cane, and used it by way of dessert. This use of the sugar-cane still prevails in many countries, Large districts of land in Andalusia are devoted at this very time to the growth of the sugar-cane; not so much with the object of obtaining sugar from the juice, as of furnishing an agreeable dessert.

The corn-bearing grasses are appropriately denominated *cereals*, or plants of Ceres, the corn-goddess of the ancient Greeks and Romans. Amongst these wheat takes the first rank. It is more nutritive than either of the others, and is adapted to climes and tracts of greater diversities of character. Rice may be correctly described as a tropical water-grass; the conditions necessary to its development being a hot atmosphere and a swampy soil. These conditions only exist in a few spots, and fortunately, too, for they are most unfavourable to the health of man.

The sugar-cane frequently grows to an elevation of twenty feet, and is as thick as a man's arm; but these dimensions sink into insignificance when compared with the bamboo, which is a veritable tree-grass, giving off lateral branches, and often rising to the elevation of thirty or forty feet.

SECT. CXVII.—CYPERACEÆ, OR SEDGE TRIBE.

This is a natural order very nearly allied to the grasses, from which they differ, however, in yielding no important product, and in having triangular, whereas grasses have cylindrical stems.

MUSA PARADISIACA, THE BANANA: AN EXAMPLE OF AN ENDOGENOUS TREE.

SECTION CXVIII.—ARACEÆ, THE ARUM TRIBE.

These vegetables possess a very peculiar floral organisation, their flowers being monœcious, or having the male and female organs in separate flowers. The reader's attention should be directed to the *spadix* as the pole-like floral elevation is called, projecting out of a peculiar sheath-like envelope (a bract), termed a *spathe*. This peculiarity points out an alliance between these humble denizens of swamps and hedge-rows and the magnificent palm-trees, princes of the tropical forest, as they have been appropriately termed. They, too, are supplied with this peculiar inflorescence.

SECTION CXIX.—PALMACEÆ, OR THE PALM TRIBE.

These are not only the largest of all endogenous plants, but certain species are magnificent forest trees, which add a charm to the tropical forest altogether peculiar, and furnish a number of useful products to man—oil, wine, dates, cocoa-nuts, hemp; astringent matter, sugar, and spirit; all these substances, and many others, are furnished by palms.

Palms are essentially tropical vegetables, and all, except two, are trees of considerable, often of very great size. There exist, however, two dwarf species, natives of temperate climes. One, the *Chamærops humilis*, grows in Greece, Italy, Spain, and the south of France; while the other, *Chamærops Palmetto*, is a native of North America.

Most tropical localities possess each its peculiar species of palm-trees, which are fond of their habitats; seldom thriving when far removed, even though their removal be to a climate and soil apparently similar to those of their native region. There are two exceptions, however, to this rule, and they refer to two very important members of the tribe, namely, the date palm and the cocoa-nut palm. The latter now flourishes in almost every tropical land, the former is even grown with considerable success so far north as Southern Italy and Spain. At Elche, in Valencia, there is a forest composed exclusively of date palms, originally planted there by the Saracens. The fruit arrives at moderate ripeness, but is inferior to the date of Barbary. The greater number of palm-trees like the vicinity of water, and the cocoa-nut palm will not grow when removed beyond a certain distance from the sea, whence it happens that there are no cocoa-nut palms in Central Africa.

LESSONS IN BOOKKEEPING.—XXVII.

(6) LEDGER. (6)

COMMISSION.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Dec.	31	To Profit and Loss . .	11	175	5	10	July	4	By N. Herschell . .	2	0	17	6
							,,	8	,, J. Henderson . .	,,	3	10	0
							Aug.	7	,, Schofield, Halse, & Co.	4	74	5	0
							,,	12	,, R. Sykes . . .	,,	3	0	0
							,,	21	,, J. Roberts . . .	,,	72	2	0
							Nov.	24	,, Import Goods . .	9	4	13	4
							,,	30	,, Do. . .	,,	16	18	0
			£	175	5	10				£	175	5	10

CHARGES.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Aug.	31	To Cash	3	41	3	0	Aug.	7	By Schofield, Halse, & Co.	4	51	8	0
Sept.	25	,, Do.	5	162	8	11	,,	21	,, J. Roberts . . .	,,	21	0	0
Oct.	23	,, Do.	7	65	17	7	Nov.	24	,, Import Goods . .	9	137	3	5
							,,	30	,, Do. . .	,,	59	18	1
			£	269	9	6				£	269	9	6

R. HASTIE AND CO.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Aug.	23	To Bills Payable . .	3	60	0	0	Aug.	10	By Export Goods . .	3	60	0	0

EXPORT GOODS.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Aug.	16	To Sundries . . .	3	2889	2	3	Aug.	7	By Schofield, Halse, & Co.	4	1284	18	3
							,,	12	,, R. Sykes . . .	,,	60	0	0
							,,	21	,, J. Roberts . . .	,,	1544	4	0
			£	2889	2	3				£	2889	2	3

(7) LEDGER. (7)

TUELON AND CO.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Sept.	12	To Cash	5	32	2	0	Aug.	16	By Export Goods . .	3	65	12	0
Oct.	2	,, Do.	7	33	10	0							
			£	65	12	0				£	65	12	0

W. PHILLIPS.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Sept.	15	To Cash	5	278	15	11	Aug.	16	By Export Goods . .	3	535	11	5
Oct.	2	,, Do.	7	256	15	6							
			£	535	11	5				£	535	11	5

J. PARKER.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Sept.	15	To Cash	5	42	0	0	Aug.	3	By Export Goods . .	3	42	0	0

MATHESON AND CO.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Sept.	15	To Cash	5	328	5	4	Aug.	3	By Export Goods . .	3	328	5	4

T. BARKER.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Sept.	15	To Cash	5	367	10	0	Aug.	16	By Export Goods . .	3	618	6	6
Oct.	2	,, Do.	7	250	16	6							
			£	618	6	6				£	618	6	6

J. OSWALD AND CO.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Sept.	29	To Cash . . .	5	240	0	0	Aug.	14	By Export Goods . .	3	240	0	0

(8) LEDGER. (8)

W. SILVER AND CO.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Oct.	4	To Cash	7	87	10	0	Aug.	16	By Export Goods . .	3	87	10	0

R. SYKES.

Dr.													Cr.
1881.				£	s.	d.	1881.				£	s.	d.
Aug.	12	To Sundries . . .	4	63	0	0	Oct.	24	By Bills Receivable . .	7	160	0	0
Dec.	31	,, Balance Account .	11	97	0	0							
			£	160	0	0				£	160	0	0

*

Dr. **W. SMITH AND CO.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Oct.	5	To Bills Payable	7	675	12	0	Aug.	16	By Export Goods	3	675	12	0

Dr. **J. ROBERTS.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Aug.	21	To Sundries	4	2503	2	0	Oct.	6	By Bills Receivable	7	1926	10	0
							Dec.	31	„ Balance Account	11	576	12	0
			£	2503	2	0				£	2503	2	0

Dr. **INTEREST.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Sept.	8	To Cash	5	6	1	9	Sept.	29	By Cash	5	75	9	0
Dec.	31	„ Schofield, Halse, & Co.	10	18	10	0	Oct.	3	„ Do.	6	28	8	1
„	„	„ Profit and Loss	11	195	16	6	Dec.	31	„ Do.	10	116	11	2
			£	220	8	3				£	220	8	3

Dr. **DAWSON AND HANCOCK.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Sept.	9	To Advre. in Scotch Linen	6	1750	0	0	Dec.	2	By Cash	10	1750	0	0

(9) **LEDGER.** (9)

Dr. **T. ELLIS AND SONS.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Oct.	18	To Bills Payable	7	132	10	0	Dec.	26	By Cash	10	132	10	0

Dr. **W. KNIGHT AND CO.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Oct.	22	To Import Goods	8	910	5	6	Oct.	22	By Brokerage	8	9	3	4
Nov.	22	„ Cash	„	9	3	4	Nov.	22	„ Cash	„	910	5	6
			£	919	8	10				£	919	8	10

Dr. **IMPORT GOODS.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Nov.	24	To Sundries	9	234	0	0	Oct.	22	By W. Knight & Co.	8	910	5	6
„	30	„ Do.	„	676	5	6							
			£	910	5	6				£	910	5	6

Dr. **BROKERAGE.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Oct.	22	To W. Knight & Co.	8	9	3	4	Nov.	24	By Import Goods	9	2	6	9
							„	30	„ Do.	„	6	16	7
			£	9	3	4					9	3	4

Dr. **BALANCE ACCOUNT.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Dec.	31	To Sundries	11	26861	4	8	Dec.	31	By Sundries	11	26861	4	8

Dr. **PROFIT AND LOSS.** Cr.

				£	s.	d.					£	s.	d.
1881.							1881.						
Dec.	31	To Sundries	11	1760	1	4	Dec.	31	By Sundries	11	1760	1	4

	TRIAL BALANCE.	Dr. £	Dr. s.	Dr. d.	Cr. £	Cr. s.	Cr. d.
1	Stock	8753	15	0	32391	17	10
1	Union Bank	31366	0	0	8092	0	0
1	Exchequer Bills	5310	0	0	5810	0	0
2	Three per Cents.	5400	0	0	5722	10	0
2	Ship Victoria	3000	0	0	475	3	0
2	Adventure in Scotch Linen	2467	0	0	2558	6	0
3	Bills Payable	4916	15	0	6067	17	0
4	N. Herschell	1306	13	0	1460	1	6
4	J. Henderson	1322	16	9	1312	17	10
4	Schofield, Halse, & Co.	1620	0	0	1769	0	0
5	Cash	39830	7	1	39829	13	4
5	Petty Cash	87	10	0	„	„	„
6	Commission	„	„	„	175	5	10
6	Charges	269	9	6	269	9	6
8	R. Sykes	63	0	0	160	0	0
8	J. Roberts	2503	2	0	1926	10	0
8	Interest	24	11	9	220	8	3
	£	108241	0	1	108241	0	1

HISTORIC SKETCHES.—XLI.

SWISS INDEPENDENCE.

ONE night in the spring of the year 1307, thirty-three men met in a field, known to this day as the Grütli meadow, on a spot over looking the Swiss lake of the four cantons, and solemnly swore to assert the common cause of the liberties of the three cantons, Schweitz, Uri, and Unterwald, and yet "to do no wrong to the Counts of Hapsburg!" These men were but the representatives of thousands more who, accustomed ever since human memory reported anything of the history of the country to share the freedom of the air they breathed, were moved to the very bottom of their hearts by the appearance of an oppression which threatened to go the length of enslaving them. What came of their vow thus made will be declared in this sketch, but let us first see what the circumstances were under which they felt constrained to bind themselves by the oath at all, and what claim the Counts of Hapsburg had to be so considerately treated in this purely non-aggressive sort of rebellion.

When, about the middle of the eleventh century, Europe in all its parts was beginning to settle down out of the confusion resulting from the overthrow of the western Roman Empire into a general state of feudalism, there was one country among the rest where the feudal conditions could not be enforced with the customary severity. That country was Switzerland. There was not found among the warrior chiefs who carved duchies, counties, and kingdoms for themselves out of the débris of the empire, one bold enough to try his hand at subjugating Switzerland for his own possession. The mountainous character of the ground, the utter absence of communication from place to place, except by paths dangerous to any but expert climbers, the unattractiveness, unrichness of the land, and the stubborn, independent character of its inhabitants, suggested to princes on the look-out to go further afield, and no one pretended to claim rights of sovereignty there. The Emperor of Germany claimed a sort of supremacy over it, but he did not practically urge it, and the people, of whom the majority never heard of his pretension, went on without consulting him or troubling their heads about him. But though there was not any actual King of Switzerland, the country was included within the kingdom of Arles or Burgundy, and the Dukes of Burgundy down to Charles the Bold claimed lordship over it, a claim that was allowed to about the same extent as that of the emperor's was to be feudal lord paramount. In the country, however, there had established themselves many soldier chiefs, who built castles on their estates, and kept up some feudal rules, governing within their own domain almost as sovereign princes, but acknowledging for themselves allegiance to no one. Some of the ecclesiastical dignitaries came within this category. They had enormous estates belonging to their convents, and they governed as lords over such parts of God's inheritance as came under their power, though there existed at the same time in the breasts of the people a spirit of original independence which tempered the severity of the feudal régime. In the towns also the spirit of freedom burned with considerable brilliancy, at least until the aristocratic element imparted by the country nobles invaded them, and even then there were found many hundreds of men who never bowed the knee save to God only.

Chief among the lay nobles of the country were the Counts of Zahringen, Toggenburg, Kyburg, and Hapsburg; while their ecclesiastical rivals in power and influence were the Bishop of Coire, the Abbot of St. Gall, and the Abbess of Seckingen. Besides these, there were many lesser nobles who depended on the greater, or professed a sort of informal allegiance direct to the imperial crown; but all of these, the greater and the less, had been wise in time, and had at their own solicitation become "citizens" of some one or other of the towns, which in return often conferred upon them the honour and title of their "advocate" or protector. The religious houses adopted the like method to obtain the protecting services of some great noble. The existence of the "noble" class on the basis mentioned above was not found to be inconsistent with the existence of a purely democratic class in the towns. On the contrary, the modified character of the aristocracy, the community of interests between it and the democracy, proved to be a source of strength to both parties, and a strong love of country, which was common to both classes, prevented that strength ever being used in the wrong direction. By degrees the wealthier townsmen assumed the rank, though not the title, of nobles, and extended yet farther the element of democratic aristocracy. Switzerland was not, however, a united country in the sense of being one dominion; it was not governed by any one set of laws, nor bound together by any formal ties or treaties; each town, each village, each noble, was self-governing and independent; the bond which knitted the several parts into a whole was the natural bond of necessity, which operated without any prescribed form.

The Counts of Hapsburg were the most considerable of the Swiss nobles, and by virtue of their rank were appointed "advocates" of many religious houses. They possessed large estates themselves, not only in Switzerland but on the Rhine also, so that what with their own property and that which they held in trust for the convents, they wielded a formidable influence either for good or evil. For many years this influence had never been used but for the furtherance of Swiss prosperity, and the people having learnt to love their strong counts, placed themselves to some extent in their hands; or to speak more precisely, the people of Schweitz and of part of Unterwald had made them their "advocates," an office which necessarily bestowed upon them the right to interfere in the administration of affairs, though it did not convey any proprietary or sovereign right.

Rudolph of Hapsburg had carried the fortunes of his family to their maximum height, and was possessed unquestionably of the ascendancy in Switzerland, when he was chosen by the electors to fill the vacant throne of the empire. This was in the year 1273. It so happened that at this time the right of succession to the Duchy of Austria, with several other valuable political fees, became free for disposal, and the new emperor, with the consent of the other princes of the empire, gave the Duchy of Austria to his own son Albert.

Duke Albert was for some reason or other, which appears to have been warranted by facts, hated by the Swiss. He was insolent, overbearing, and disposed to plume himself upon his family grandeur and his wealth rather than upon his Swiss nationality. The Swiss held him to be *not* their friend, and it was with lively concern that they saw him about to succeed to his father's Swiss estates while he lived in his new duchy, uncontrolled by residence among his countrymen, and powerful to do them harm by means of his German subjects. It was probably at his suggestion that the defunct claim of the Imperial Diet or Parliament to bind Switzerland by its laws was revived during Rudolph's tenure of the throne. Certain it is that after his own election* to the empire, on the death of his father's successor, Adolphus of Nassau, he tried to assert the imperial supremacy over Switzerland as part of Germany, and, abusing the privileges which, as Count of Hapsburg and as "advocate" of certain convents, he possessed, he sent imperial commissioners into the valleys of Schweitz, Unterwald, and Uri, to administer criminal justice and to act as stewards on his own and the convents' behalf. These persons were not native Swiss, but Germans who had no sympathy with the people, who despised the simplicity of their life and manners, and who made no secret of their contempt for them generally.

It was not likely such men would get on with the free-minded, high-spirited, and dominion-hating mountaineers. They did the work with which they were charged, disagreeable as it was by its nature, with studied harshness and brutal indifference to the popular feelings; they set aside the customary laws of the district, and introduced their own, which they administered in the most tyrannical fashion. The people were required to perform acts of homage to the Counts of Hapsburg which would have been reckoned degrading to "villeins" born and bred to feudalism; they were made to yield obedience to commands which were an affront to their free understandings, and to contribute towards the expense of riveting the imperial yoke upon their own necks. It was under these circumstances that the meeting took place in the Grütli meadow, and that Stauffacher of Schweitz, Furst of Uri, and Melchthal of Unterwald, bound themselves and their friends by the simple, solemn oath to do themselves right and the Count of Hapsburg no wrong. The people of the three districts flew to arms, and with an ease they little

* The imperial dignity in Germany was elective, the principle of hereditary succession not being recognised. Generally a German was elected, but not always. Francis I. of France and Henry VIII. of England were both candidates in their time.

expected, considering the "tall talk" in which their oppressors indulged, drove the emperor's bailiffs out of the country.

This unlooked-for success did not make them too confident They knew the power and the malice of the Duke of Austria, and that he would be likely to bring the whole force of the empire upon them. They immediately entered into a confederacy or union of the three cantons, by the terms of which each canton, while reserving its right of self-government, was bound to make common cause with the others whenever summoned to do so. They were the forest cantons, the hard, rugged, naturally independent districts, that first set an example of federation upon special, recognised conditions. Fortunately for them their enemy, Count Albert, was soon afterwards assassinated by his nephew, so that they had leisure to consolidate their union. The prince who succeeded Albert on the imperial throne was not unfriendly to the Swiss; but Leopold of Austria, Albert's son, thinking to punish the "cowherds and dairymen" who had dared to rebel against his father, led a considerable body of troops into the forest cantons: the Swiss, however, united as one man, inflamed with anger at the assumption of lordship over them, and goaded to fury by the desperate nature of their case, met the Austrians at Morgarten, opposed untrained valour and unarmed bodies to skilled courage and armour-covered men-at-arms, and utterly defeated their enemies with dreadful slaughter (November 16, 1315).

This victory, which has been called the Marathon of Switzerland, secured the independence of the three cantons, and attracted, after some delay, the contiguous district of Lucerne, which was incorporated with the confederacy. About thirty years later Zurich, Glaris, Zug, and Berne joined the league, and these eight cantons remained till the Swiss revolution in 1830 to enjoy privileges and even sovereignty over many of the surrounding districts. Zurich and Berne were already independent and republican in their form of government before the formation of the union, but they secured additional strength not only for the maintenance of their existing power, but also for the object which they now proceeded to execute, that of curtailing the influence of the rural nobles. Small wars, having this aim in view, were carried on between the towns and the nobles, in which the latter fared badly, the wisest among them making their peace betimes by consenting to sink their rank and dignity, and to secure their property by identifying themselves as "citizens" of the dominant towns. For eighty years there was not any attempt from without to destroy the palladium of liberty which was being reared among the mountains of Helvetia. The nations had other things to do than to attend to so seemingly insignificant a place, and even the Dukes of Austria, while retaining for a time their Swiss hereditary possessions, did not find it convenient to cross swords with their co-protectors after the battle of Sempach (July 9, 1386). In this, the last of a series of encounters with the Austrians, all of which had been bloody and none inglorious for Switzerland, the Austrian knights dismounted and presented their lances as a steel hedge of pricks to the Swiss. It was necessary to break their line, and Winkelried of Unterwald, seeing no other way, commended himself to Heaven, and his wife and children to his country, and gathering as many lances' points as he could embrace, received them in his body, and so opened a way to the ingress of the Swiss with their five-feet-long swords. The Austrians were overthrown, and in the end the dukes alienated to the Swiss the lands and lordships of the Counts of Hapsburg. During this time power had become consolidated, and when the attention of surrounding nations was drawn to the country, by the prompt resentment of some injury done to its people, by the fearless, or, as it was then called, insolent, way in which the Swiss threw back a rebuke or threat, it was found that the people were a sort of human conglomerate, hard and strong flints from which fire might be struck, but against which it would be unwise to hurl oneself. Nevertheless, about the year 1440 it seemed good to the despots and autocrats of the day to undertake the destruction of the home of liberty, as being too near their own dominions to be safe. The princes of Western Germany formed an association, which had the approval of the emperor, for the purpose of subjugating Switzerland, and, the Duke of Burgundy having declined the use of his army, applied to the King of France for help. The King of France was only too glad of a pretext for getting rid of the numerous bands of adventurers who filled every one of his cities with uproar, men who were the offscourings and the refuse of the Anglo-French wars. He raised a large army, in which all these cut-throats were enrolled, and put it under the command of the Dauphin. Away the French prince marched, and laid siege to Basle before the Swiss knew he was coming. The men of Basle defended themselves as best they could, and sent off messengers to the Swiss army for help. Help came in the shape of 2,000 men, who did not hesitate to engage an army of which the advanced guard was ten times more numerous than they. The Swiss fought with desperate valour (26th of August, 1444), and were cut to pieces on the ground where they stood; but the victory cost the Dauphin (afterwards Louis XI.) 8,000 of his best troops, and impressed him so much that he made peace and retired, and subsequently, when he came to the throne, he entered into an alliance with his former foes.

In 1476 the last grand attack was made on Switzerland with the view of bringing her again under feudal bondage. Charles the Bold, the last Duke of Burgundy, proposed the task to himself, both because the Swiss were allies of his inveterate enemy, Louis XI., and because he hated the bare idea of popular freedom. With a splendid army of 36,000 men, furnished with everything necessary for the campaign, he marched into the country and laid siege to Yverdun. The garrison cut their way out and retired to Granson, whither Charles proceeded, and having, after a desperate resistance, induced the garrison to offer to capitulate, he murdered in cold blood the governor and 200 of his officers who had put themselves in his power.

Every man in Switzerland took up arms, and when, shortly after the bloody deed just recited, the Swiss came upon the Burgundian army in the mountain passes near Neuchatel, they smote them hip and thigh to the shout of "Granson! Granson!" so that the splendid army melted like snow off the mountains. Charles strained every nerve to retrieve his loss. He procured money from Flanders and Brabant, melted church bells to make cannon, and hired troops from anywhere to assist him; but it was not till many weeks after his defeat that he was able to take the field, and then it was to make a gambler's last desperate throw. In May, 1476, he laid siege to Morat, the key of Berne and the door to Switzerland. He pressed the garrison so hard that they were about to surrender, when the Swiss army came to their relief. A furious battle ensued, in which rivers of blood were spilt, and the Burgundian army was utterly destroyed, for the Swiss refused to give quarter. Charles fled, and from that day forth abandoned his warlike intentions against the cantons. Not they theirs against him. In January of the following year (1477) they joined the Duke of Lorraine in resisting an attack which Charles was making on his province, and on the 4th of that month they had the satisfaction of again beating their enemy at the battle of Nancy.

In the year 1499 the independence of the Swiss cantons was formally recognised by the emperor, and since that time it was never impeached till Napoleon overran the country, as he did all other countries in Europe, and revolutionised its institutions. The political constitution now in force is that which was settled in 1830, when the lesser cantons were admitted to equal rights with the greater, and certain mediæval privileges and customs which savoured of injustice and obsoletism were swept away.

LESSONS IN ENGLISH.—XXXVIII.

DIVERSE STEMS.

It has been intimated that the French, Italian, and Spanish (and one or two others might be added) are, under the name of the Romance languages, very similar to each other, and similar also to their common mother the Latin. To all these languages the English is indebted. Hence it becomes both interesting and important to see how they are related one to another; and that the rather, because with comparison much may be learnt of the origin and propagation of languages. We therefore place before you a tabular view of

THE LORD'S PRAYER IN

English.	*Latin.*	*French.*	*Italian.*	*Spanish.*
Our	noster	notre	nostro	nuestro
Father	pater	père	padre	padre
Who	qui	qui	che	que
Art	es	es	sei	estas
In	in	au	in	en
Heaven	cœlo	ciel	cieli	los cielos

*

English.	*Latin.*	*French.*	*Italian.*	*Spanish.*
Hallowed Be	sanctificetur	sanctifié soit	sanctificato sia	sanctificado. sea.
Thy	tuum	ton	il tuo	el tu.
Name	nomen	nom	nome	nombre.
Thy	tuum	ton	il tuo	el tu.
Kingdom	regnum	règne	regno	reino.
Come	veniat	vienne	venga	venga.
Thy	tua	ta	la tua	tu.
Will	voluntas	volonté	volonta	voluntad.
Be Done	fiat	soit faite	siaa fatta	hagase.
On	in	sur	in	en.
Earth	terrâ	la terre	terra	la tierra.
As It Is	sicut	comme	come	como.
In	in	an	in	en.
Heaven	cœlo	ciel	cielo	el cielo.
Give	da	donno	dacci	da.
Us	nobis	nous	oggi	nosse.
This Day	hodie	aujourd'hui		
Our	nostrum	notre	il nostro	nuestro.
Daily	quotidianum	quotidien	quotidiano	de cada dia.
Bread	panem	pain	pane	el pan.
And	et	et	e	y.
Forgive	remitte	pardonne	remettici	perdona.
Us	nobis	nous		nos.
Our	nostra	nos	i nostri	nuestras.
Debts	debita	offenses	debiti	deudas.
As	ut	comme	come	como.
We	nos	nous	noi	nosotros.
Forgive	remittimus	pardonnons	rimattiamo	perdonamos.
Our	nostris	à ceux qui	a nostri	a nuestros.
Debtors	debitoribus	nous ont offensé	debitori	deudores.
And	et	et	e	y.
Lead	inducito	indui	indurre	metas.
Us	nos	nous		nos.
Not	neve	ne point	non	no.
Into	in	en	in	en.
Temptation	tentationem	tentation	tentatione	la tentacion.
But	sed	mais	ma	mas.
Deliver	libera	delivre	liberaci	libra.
Us	nos	nous		nos.
From	a	du	dal	de.
Evil	malo	mal	male	mal.

Now, to study this tabular view properly, take each English word in turn, and compare it with the same word, first in Latin, then in French, then in Italian, and then in Spanish. You will gain instruction if you also alter the order, taking the Italian before the French, or the Spanish immediately after the Latin. Now look at these words, *father*, *pater*, *padre*, *padre*, *père*. They are, you see, the same term under small modifications. The same is the case with several other words. And if you omit the English, as belonging to a different family of tongues, and compare the rest together, you will find, with a few exceptions, an almost identity. In the comparison you must make some allowance for idiom; for instance, the article appears in French where it is not placed in Italian, and so you have LA terre, THE *earth*, for terrâ, *earth*, of the Latin, and terra of the Italian. The Spanish carries the article so far as to place it before possessive pronouns, thus, el tu nombre, *the thy name*. The inferiority, too, of the French is seen in that it is unable to render word for word "forgive our debtors," and is obliged to employ a circumlocution, as "pardon those who have offended us." These remarks are offered merely as suggestions relative to the manner in which the table may be studied.

A few instances of words in our tongue borrowed from the Italian and Spanish are subjoined :—

ENGLISH WORDS FROM THE ITALIAN.

Basso-relievo, *bas-relief.*
Bravo, *one who murders for hire.*
Buffalo, *a kind of wild ox.*
Canzonet, *a little song.*
Capuccio, *a capuchin or hood.*
Busto, *a statue.*
Canto, *a section of a poem.*
Burletta, *a musical farce.*
Broccoli, *a kind of cabbage.*
Belladonna, *deadly nightshade.*
Camisado, *an attack in the dark.*
Piano-forte, *a musical instrument.*
Adagio, *slow time in music.*
Tenore, *middle sound.*
Soprano, *a soft sound.*
Violin, *a fiddle.*
Violoncello, *a bass violin.*
Pantaloon, *the buffoon in a pantomime.*
Harlequin, *an outdoor buffoon.*
Gondola, *a small boat.*
Gondolier, *the boatman of a gondola.*
Gonfalon, *a standard.*
Gonfalonier, *a standard-bearer.*
Doge, *the chief magistrate in Venice.*
Mezzotinto, *engraving resembling painting.*
Bandit, *one outlawed, a robber.*
Bagnio, *a bathing-house.*
Sonata, *a tune.*
Piano, *soft in music.*
Forte, *strong in music.*
Piazza, *a walk under a roof supported by pillars.*

ENGLISH WORDS FROM THE SPANISH.

Mulatto, *one of mixed breed.*
Siesta, *an after-dinner nap.*
Tobacco, *a plant used for smoking.*
Guitar, *a stringed instrument of music.*
Fandango, *a lively dance.*
Hidalgo, *one of noble birth.*
Gala, *feasting and merriment.*
Armada, *a sea-armament.*
Brocade, *silk interwoven with gold, etc.*
Olio, *a medley.*
Palisade, *an enclosure of palings.*
Peccadillo, *a petty fault.*
Barricade, *a rough street fortification*

From very various sources words have come into our English. *Razzia* is a very recent term. It came into existence within the last few years, to describe the sweeping destruction with which the French laid waste whole districts of northern Africa, in order to bring the country under their usurpation. According to Fuller, the term *plunder* is of German origin, and was brought hither by the soldiers who returned from the campaigns of Gustavus Adolphus.

From the Arabic we have *divan*, *vizier*, *cipher*, *zero*, *arabesque*; from the Hebrew we have, besides very many proper names, *Jehovah*, *amen*, *Jeremiad*, *lazaretto*, *lazar-house*, *cherub*, *seraph*, *hallelujah*. The birds called *canaries* take their name from the Canary Isles, and our *pheasants* from the Asiatic river Phasis, the banks of which are said to have been their original home. *Philippic*, an invective, comes to us from the title of the orations delivered by Demosthenes against Philip, King of Macedon, of whose designs against the liberty of Greece he was aware. The word *cabal* has two origins. In one sense, and generally, *cabala* is Hebrew, and denotes the science (*falsely so called*) of the Jewish rabbis. In another, it designates a political intrigue, and owes its existence to the initials of the names of Clifford, Ashley, Buckingham, Arlington, and Lauderdale—C. A. B. A. L., the five celebrated cabinet ministers of Charles II. We have in English words the names of natural objects, taken from the names of the places where the objects were produced: for example, *peach*, Fr. pêche, that is Persh, or Persian; *Bergamotte* (Bergamum), *Indigo*, *Mocha*, *Champagne*, *Burgundy*, *Madeira*, *Port*, and other names of wine. We have names of the products of art taken from the places where they were fabricated: for example, *bayonet*, invented at Bayonne, in France; *cachemir* (shawls), from Cachemir, in India; *cambric*, from Cambrai, in France; *cordovan*, leather prepared at Cordova, in Spain; *damask*, from Damascus, in Syria; *muslin*, from Mossul, in Asiatic Turkey; *nankeen*, from Nankin, in China; *pistol*, from Pistoia, in Tuscany; *marocco* (leather), from Marocco, in Barbary. Having shown the connection of the English with the Romance languages, we subjoin another table, showing its connection with the Teutonic languages. The latter is the more needful, because the latter are our cousins-german.

THE LORD'S PRAYER IN TEUTONIC LANGUAGES.

Common English.	*English of Wiclif* (1380).	*German of Luther.*	*Lower Saxon* (1451).	*German* (720 A.D.).	*Gothic Ulphilas* (360).
Our	oure	nns	unser	unseer	unsar.
Father	fadir	fater	fader	fatter	atta.
Who	that		de du	thee	thu.
Art	art		bist	pist	
In	in	in	in	in	in.
Heaven	hevene	dem himmel	den hymelen	himele	himinam.
Hallowed Be	halowid be	geheiliget werde	gehylliget werde	wihi	weihnai.
Thy	thi	dein	dyn	dinan	thein.
Name	name	name	name	namun	namo.
Thy	thi	dein	dyn	din	theins.
Kingdom	kyngdom	reich	ryke	rihi	thiudinassus.
Come	come to	komme	to comme	chweme	quimai.
Thy	thi	dein	dyn	din	theins.
Will	wille	wille	wille	willo	wilja.
Be Done	be don	geschehe	de werde	werde	wairthai.
On	in	uf	in	in	ana.
Earth	erthe	erden	der erde	erdu	airthai.
As It Is	as	wie	also	so	swe jah.
In	in	im	in	in	in.
Heaven	heavene	himm	den hymmele	himele	himinam.
Give	give	gib	gif	kip	gif.

Common English.	*English of Wiclif* (1380).	*German of Luther.*	*Lower Saxon* (1451).	*German* (720 A.D.).	*Gothic of Ulphilas* (360).
Us	to us	uns	uns	uns	uns.
This	this	houte	hyto	hiutu	himma.
Day	day				daga.
Our	oure	nnser	unse	unseer	unsarana.
Daily		täglich	degelike	emozhio	
Bread	breed	brot	brod	broath	hlaif.
And	and	und	unde		jah.
Forgive	forgeve	vergib	forgif	oblaz	aflet.
Us	to ns	uns	uns	uns	uns.
Our	oure	unser	unse	unseero	thatei.
Debts	dettis	schuld	schulde	sculdi	skulano sijaimo.
As	as	wie	also	so	swaswe jah.
We	we	wir	wy	wir	weis.
Forgive	forgiven	vergeben	forgeven	oblazen	afletam.
Our	to our	unsern	unsen	uns	unsaraim.
Debtors	dettouris	schuldigern	schuldeners	skuldikem	skulam.
Lead	lede	führe	enleyde	firletti	briggais.
Us	us	uns	uns	unsih	uns.
Not	not	nicht	nicht	ni	ni.
Into	in to	in	in	in	in.
Temptation	temptacioun	versuchung	bekoringe	khorunka	fraistubnjai.
But	but	sondern	sonder	uzz	ak.
Deliver	delyver	erlöse	lose	erlosi	lausei.
Us	us	uns	uns	unsih	uns.
From	from	von	van	fona	af.
Evil	yvel	dem übel	obele	ubile	ubilin.

This table is full of instruction. Go through it carefully word for word, making dne allowance for diversity of spelling. For instance, our word *come* re-appears in *come to*, *comme*, *to comme*, *chweme*, and *quimai*. In the "bist" of the Lower Saxon, we recognise an old mood common in the south of England in our boyish days, where and when the present tense of the verb *to be* was thus conjugated, *I be*, *thou bist*, *he bees*, *we be*, *you be*, *they be*. The Gothic of Ulphilas offers the most striking points of comparison. We will go through it, and point out the words which still form a part of the English tongue:—Unsar, *our;* thu, *who;* in, *in;* himinam, *heaven;* weihnai, *vowed;* thein, *thy;* namo, *name;* quimai, *come;* wilga, *will;* ana, *on;* airthai, *earth;* gif, *give;* uns, *our;* daga, *day;* unsarana, *our;* hlaif, *loaf;* briggais, *bring;* lausei, *loose;* af, *of;* ubilin, *evil*. It is thus seen that our mother tongue had a snbstantive existence as early as the year of our Lord 360. And it is curious to observe that in this, the oldest form of the Teutonic languages, we find in several instances the nearest approach to our modern words and forms. For example, himinam, *heaven;* thein, *thy*, *thine;* airthai, *earth;* gif, *give;* uns, *us;* daga, *day;* hlaif, *loaf*, the ancient word for *bread;* briggais, *bring;* lausei, *loose*.

LESSONS IN CHEMISTRY.—XXVIII.

ORGANIC CHEMISTRY.

THE characteristics of Organic Chemistry will be best shown by considering the three definitions by which the subject has been described.

1. *It is the Chemistry of bodies which are the products, direct or indirect, of vital organisms.*

In the vast laboratory of Nature, nnder the active superintendence of that mysterious power called "life," innumerable changes are continually being carried on, by which a large number of the different bodies—organic substances—are produced. The immediate cause of these changes is no mere caprice, but certain forms of life, animal or vegetable organisms, have each peculiar powers, to extract from certain substances that food which is necessary for their own existence, and in this process a new arrangement of the elements of the body takes place, thus giving rise to new substances.

But Organic Chemistry does not confine its attention to those substances which are fonnd in actual existence in the world of organisms, bnt it also inclndes within its range the consideration of those bodies which may be found in dealing with the products of vital organism. For example, alcohol is never fonnd in natnre, bnt is produced by the process of fermentation, in which a re-arrangement of elements takes place, and one of the prodncts is alcohol. Hence its consideration is included in this branch of Chemistry.

But this definition has still further to be extended to take in those bodies which can be built up from their elements; that is, bodies which have organic analogies, but which are made by synthesis. For instance, *oxalic acid*, which is purely a vegetable product, being the acid which imparts the sour taste to sorrel, lichens, and other plants, can be produced by heating mercuric cyanide, and allowing the cyanogen to pass into water. Here it is dissolved, and the two compounds react on each other, each being decomposed. One of the products is ammonium oxalate, $2(NH_4)O,C_2O_3$.

Upon the addition of a mineral acid, oxalic acid is liberated.

Or perhaps a more remarkable example is the manner in which Berthelot built up alcohol from its elements. He caused a current of galvanic electricity to pass between charcoal points in an atmosphere of hydrogen. By this means the carbon of the points was made to combine with the hydrogen, forming *acetylene* (C_2H_2). By submitting this acetylene to the action of nascent hydrogen when it was in combination with copper, two atoms more of hydrogen were introduced into the compound, and *ethylene* (C_2H_4) was produced. With sulphuric acid $C_2H_6SO_4$ is formed; and when this is diluted and distilled, alcohol is liberated.

Every year adds to the list of organic bodies which can be built np by inorganic processes; yet the distinction between the two divisions of Chemistry is not thereby impaired.

2. *Organic Chemistry is the Chemistry of the carbon compounds.*

Of the vast number of bodies which are considered under this subject, so widely different in their properties, one and all contain carbon. In most of them hydrogen and oxygen are combined with the carbon. Some also contain nitrogen, and a few contain other elements.

No subject can better reveal the wisdom of the Mind which made all these things. It is wonderful indeed that, by ringing the changes on some four simple bodies, three gases and a solid, such an endless variety of different substances, all exhibiting different properties, can be produced.

Since all organic bodies contain carbon, they are all combustible—all are destroyed by high temperatures. This fact is used as the basis of organic analysis.

3. *Organic Chemistry is the "Chemistry of compound radicals."*

This is Liebig's definition. In Inorganic Chemistry the compounds are generally made up by the union of elements, and the various changes which they undergo are produced by replacing one element by another, according to their atomicities. If in these changes elements only were concerned, then there would be a clear line between the two branches of the subject, but this is not always the case. Thus—

$$AgNO_3 + NaCl = AgCl + NaNO_3.$$

Here the NO_3 acts as an element, being a molecule, or, in the language of Organic Chemistry, a *radical*. The changes which take place in organic bodies are carried on by an interchange of radicals, which play precisely the same part as the elements in Inorganic Chemistry, having their peculiar atomicities, and the replacement taking place accordingly. For example, ethyle (C_2H_5) is monatomic. If the hydrogen of the water type, $\left.\begin{matrix}H\\H\end{matrix}\right\}O$, be replaced by this radical, we have $\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O$, which is ether. If only one H be replaced, $\left.\begin{matrix}H\\C_2H_5\end{matrix}\right\}O$ is the result—alcohol.

Here is the action of sulphuric acid on alcohol:—

$$\left.\begin{matrix}H\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}H\\C_2H_5\end{matrix}\right\}O = \left.\begin{matrix}H\\C_2H_5\end{matrix}\right\}SO_4 + \left.\begin{matrix}H\\H\end{matrix}\right\}O,$$

forming sulpho-vinic acid and water.

The constitution of all known organic bodies may be referred to one of three leading types—

$$\left.\begin{matrix}H\\H\end{matrix}\right\}, \quad \left.\begin{matrix}H\\H\end{matrix}\right\}O, \quad \text{and} \quad \left.\begin{matrix}H\\H\\H\end{matrix}\right\}N.$$

The H in these types is replaced by the radical according to its atomicity. For instance, glycerile (C_3H_5), the radical of glycerine, is tri-atomic. To construct the formula of the latter body, it is necessary to replace one H in the water type, but there must be three atoms of H; thus, $\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_3$. Now insert the radical. $\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}O_3$ is the formula of glycerine.

If the student prosecute this subject he will find that the radicals arrange themselves into groups, the members of which vary from each other by a fixed increment; so that formulæ which at first sight appear inexplicable can not only be readily retained and understood, but the possession of the radical will give the power of building up the ether, the alcohol, the acid, etc., belonging to it; exactly as the root of a word being given, the noun, the verb, the adverb, etc., can easily be arrived at.

Our space, however, being limited, we consider that it will be more beneficial to our readers to enter into the properties and composition of the various products of the animal and vegetable kingdoms which we meet in our daily life, than to dwell on the classification of formulæ, referring the student to the third volume of Miller's "Elements of Chemistry" for a full discussion of the subject.

Organic Analysis.—Since carbon and hydrogen are the staple constituents of organic bodies, the quantities in which they are present are always estimated by the combustion of the body in the presence of oxygen. By this means the carbon is converted into carbonic acid gas, and the hydrogen into water. The means by which this is effected may be thus indicated:—A tube of hard Bohemian glass is arranged on supports, as in Fig. 54, in a trough of sheet iron. The tube is open at B; its other extremity

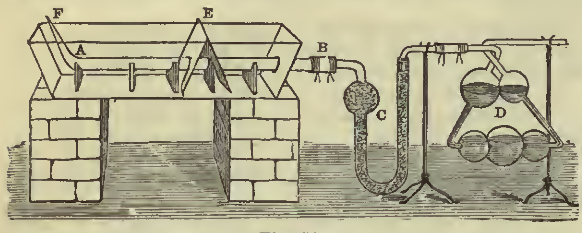


Fig. 54.

is drawn out into a point, F, and bent obliquely. The body to be analysed is carefully dried. The substance from which oxygen is furnished for the combustion is cupric oxide. This is freshly made, and heated to expel all moisture. A quantity is placed in the combustion tube, sufficient to fill some two inches of its extremity, A. The body to be analysed is carefully weighed (about 6 grs. is usually taken); then it is mixed with some of the cupric oxide in a mortar. With the greatest caution it is introduced into the combustion tube. The mortar is rinsed out with more oxide, which is also placed in the tube. The tube is now filled to within two inches of its open end with pure oxide; C, a calcium chloride tube for collecting the moisture, and D, Liebig's potash bulbs for absorbing the carbonic acid gas, both accurately weighed, are attached to the tube by a tightly fitting cork.

Hot charcoal is now placed in the trough at A. When the tube is here red-hot the partition, E, is gradually moved towards B, so that the whole tube is by degrees brought to a red heat. At this temperature the carbon and hydrogen of the organic body take oxygen from the cupric oxide. The water thus formed is absorbed by the calcium chloride, and the potash retains the carbonic acid. When the latter ceases to appear in the bulbs, the point F is broken, and by means of the mouth a gentle suction is applied to the open end of the potash bulbs, so that air is gradually drawn through the combustion tube, which brings with it the last traces of carbonic acid. The apparatus is now dismounted, and in about an hour the tube C and the bulbs D are weighed; $\frac{1}{9}$ of the gain C has experienced indicates the quantity of hydrogen, and $\frac{3}{11}$ of the gain of D gives the quantity of carbon, the body contained.

If the body contain nitrogen, a separate analysis is required to determine its quantity. But in this case a precaution is necessary in the process above described. When nitrogen is heated with cupric oxide, a certain quantity of some of the lower oxides of nitrogen comes off. This the chloride of calcium would retain; hence the end of the combustion tube is packed for six inches with copper turnings, and these are kept red-hot. By this means the oxides of nitrogen are decomposed, the copper combining with the oxygen, and the liberated nitrogen passing forward.

The determination of the quantity of nitrogen is based upon a fact observed by Gay Lussac, that if nitrogenous bodies be heated with an excess of potassic or sodic hydrate, all the nitrogen comes off in combination as ammonia.

To take advantage of this transformation, the body is introduced into the combustion tube as before, but not mixed with cupric oxide, but with *soda-lime*—a compound procured by slaking well-burnt lime with a solution of soda, then evaporating and igniting. The drying tube, C, is dispensed with, and bulbs somewhat similar to D are charged with pure hydrochloric acid. The heat is applied as before. The hydrochloric acid retains the ammonia. After the process is complete, and air has been drawn through the apparatus in the usual way, the bulbs are emptied, and carefully washed out, first with a mixture of alcohol and ether, and then several times with water. A solution of *platinic chloride* is now added, and a double chloride of platinum and ammonium is precipitated. This is repeatedly washed with a mixture of alcohol and ether, to remove any trace of platinic chloride. It is now brought in a weighed filter and again washed; then dried in a water bath and weighed.

220·52 parts of the salt are equivalent to 14 of nitrogen.

The result of such analyses is to give the *percentage composition* of the compound.

An example will best indicate this: 4·750 grs. of sugar were analysed—

	Grains.
Potash bulbs weighed after experiment . .	781·13
„ „ „ before „ . .	773·82
Carbonic acid =	7·31
Calcium chloride tube after experiment . .	226·05
„ „ „ before „ . .	223·30
Water . .	2·75

$$7{\cdot}31 \times \frac{3}{11} = 1{\cdot}994 = \text{Carbon.}$$

$$2{\cdot}75 \times \frac{1}{9} = {\cdot}3056 = \text{Hydrogen.}$$

Or, calculating this for 100 parts of sugar, we have—

	Grains.
Carbon	41·98
Hydrogen	6·43
Oxygen (by difference) . .	51·59
	100·00

From this, to construct the *empirical* formula, it is necessary to divide each of the quantities by the atomic weight of the element:—

$$\frac{41{\cdot}98}{12} = 3{\cdot}49;\quad \frac{6{\cdot}43}{1} = 6{\cdot}43;\quad \frac{51{\cdot}59}{16} = 3{\cdot}22.$$

That is—

349 equivalents of	. .	Carbon.
643 „ „	. .	Hydrogen.
322 „ „	. .	Oxygen.

Allowing for experimental errors, evidently the number of atoms of hydrogen double those of the oxygen; and the oxygen to the carbon bears a proportion of nearly 11 to 12; so that the empirical formula is $C_{13}H_{22}O_{11}$. The number of these elements may be only multiples of the real numbers. They cannot be less than they are, because any division of the whole three would produce fractions; and as atoms are indivisible, a fractional atom cannot exist.

To decide the true or *rational* formula, two ways suggest themselves.

1. A compound of the organic body with some inorganic element is analysed; and, knowing the atomic weight of the latter, we thus discover the combining weight of the molecule of the organic compound.

2. We know that the density of a volatile organic compound is half its molecular weight, just as the density of CO_2 is $\frac{44}{2} = 22$; that is, the molecule of CO_2 weighs 22 times the atom of hydrogen.

So is it with any other volatile organic body.

Thus, by accurately weighing a glass globe filled with the vapour, and finding the capacity of the globe, the density is ascertained; twice this gives the molecular weight, and thus the rational formula is fixed.

For the details of these processes larger works must be consulted. Liebig's "Hand-book of Organic Analysis" is recommended.

THE NATURAL HISTORY OF COMMERCE.

INTRODUCTORY.

"The addition of a new fact to a farmer's mind," it was once pithily remarked, "often increases the amount of his harvests more than the addition of acres to his estate." The principle holds good in every kind of industry and commerce. The discovery of new forms or properties of matter, or fresh applications of old ones, of new motive-power or new mechanism, is continually changing the aspect of affairs. A new tool even will sometimes add immensely to the value of an old material, promote the comfort of millions, and develop some branch of industry to an extent hitherto unthought of. Fifty years ago few workmen could accomplish the cutting of common window-glass without risk and loss; at length a thoughtful observer found out that there was one direction in which the diamond was almost incapable of abrasion or wearing by use, and he contrived the present simple tool which steadies the diamond and fastens it in the direction required.

Here was a discovery resting upon a scientific principle. It might and probably would have been made much earlier had science, or *the systematised knowledge of matter and its properties*, been more common. The complaint is now general that such knowledge is less common amongst us than it should be, than it is, in fact, elsewhere. It is remarked continually that our Continental neighbours are so sensible of the advantages of this knowledge, that they provide it liberally for every man, woman, and child. They feel that it is in itself property, and the prolific source of wealth. They see that it cannot be carried off by an enemy, or impaired by bad seasons, or paralysed by a panic. They find that it costs nothing to defend or to insure; that it is not merely a circulating commodity, yielding a single profit to its possessor, but rather fixed and constantly productive capital. Therefore, beyond primary schools, they provide industrial schools, trade schools, polytechnic schools, drawing schools, museums of art and manufacture, to all of which access is nearly free, and attendance on some of them almost compulsory.

The result is visible in our exhibitions, in the competition that displaces our trade, and drives our best workmen abroad. Our government may do something for national instruction hereafter, but hitherto they have left us pretty much to shift for ourselves. Perhaps it has been the right course. Self-help is the best. The nation is now roused. We may move slowly, but we believe that private enterprise—backed or not by parliamentary aid—will eventually bring us up to the level of the rest of Europe, and, too, of the United States of America.

It is with this object in view that, having already given to all self-teachers the opportunity of improvement in all the branches of a liberal education, we now commence a series of papers upon industrial and commercial subjects. These papers have been prepared by Dr. Yeats, who has been assisted by able men eminent in their respective departments of knowledge.

In a country like this, which is pre-eminently commercial, and in an age like the present, distinguished for the keen eagerness of its competition, it is impossible for those who are ignorant of the first principles of commercial and industrial science to compete with any hope of success with those who are largely and practically acquainted with them. Yet these are the terms upon which so many of the English industrial and commercial classes are at present engaged in carrying on a wearisome and failing competition with the manufacturing interests of other lands. As far as in our power lies, we shall in these papers place at the disposal of every artisan and *employé* the means for destroying this inequality of competition, and throwing into our side of the scale educated intellects in addition to well-trained hands. We commence, then, with what we may call the Natural History of Commerce, or a reply to the questions, Whence do we derive the raw materials which are the staple of our commerce and industry? Why do we find them in particular localities? What constitutes their true value? Are there yet no undeveloped regions or natural products?

CHAPTER I.

What is meant by Raw Produce?—The Necessity of a Knowledge of Raw Materials—The Discovery of Raw Materials, and the Effects of Discovery—How a Knowledge of Raw Materials can be gained.

The earth, with its oceans of water and of air, forms the great storehouse from which we draw the means of support and enjoyment. The animals and plants upon its surface, and the produce of its teeming waters, furnish us with food and clothing; the stone, the metals, and the coal laid up in its crust supply us with the means of shelter, with various implements, and with fuel. Several facts connected herewith are part of our earliest experience. 1st. There is in the world an indefinitely large number of substances adapted for our service in health and in sickness. 2nd. These substances are distributed so that every region has its special treasures. 3rd. The inhabitants of any one region may, by exchange, become possessed of the abundance and variety of all other regions. If, for instance, the Norwegian has plenty of timber, but a scarcity of wool, and thus finds himself well housed, but poorly clad; while the Englishman has woollen cloth to spare, but wants timber for building; each may, by interchange, be well clothed and well housed.

In speaking of the natural resources of a country, we refer to the ore in the mine, the stone unquarried, the timber unfelled, the native plants and animals—to all those latent elements of wealth only awaiting the labour of man to become of use, and therefore of value.

Raw produce has, however, an extended meaning. We do not merely gather in the indigenous materials of the country where we live, but, by intelligent industry, we increase the natural production. Tillage and cattle-rearing procure for us a greater abundance of corn and fruit, and flesh-food, and textile fibres than we should otherwise enjoy. This increase, and all the crude constituents of wealth, whatever their origin, come under the designation of *raw produce*.

Without a considerable knowledge of raw materials, and of their adaptations, we could not live; and without an unremitting application of such knowledge, we could not live in comfort. We may even measure a country's civilisation by the extent and diffusion of this important knowledge. Barbarous tribes pass their time in providing for their recurring appetites, and cannot be said to enjoy existence, in the sense of mental enjoyment. Where such tribes do not die out, their numbers, at the best, remain stationary. Among civilised nations knowledge is increased, and many things, which in some parts still remain to be discovered, have, in other parts, become the necessaries of life for populations doubling and trebling in a century.

The economic history of a nation would be a record of the discovery of new raw materials, of new sources of supply, and of additional applications. All such discoveries tend to our benefit, while their result is occasionally to enrich the discoverer, and to change the face of our social and industrial life. It has been said that he who makes two blades of grass grow where only one grew before is a benefactor to his species. The truth of this statement is easily proved. Take the single example of wheat, and imagine the blessings which a double produce of this one kind of grain would confer upon mankind.

In modern times we have had many remarkable instances of the effects of discovery. Though Corinth produced what we might call Birmingham and Sheffield wares, and Athens was the centre of the manufactures which we now find divided between Leeds, Staffordshire, and London, yet coal was not employed by the Greeks and Romans; it was not used as fuel, even at Newcastle, till the thirteenth century, and only crept into general use during the reign of Elizabeth. This one product has been the main cause of a complete revolution in our national industry. It is only a generation or two since that, by means of the raw material, coal, was evoked a new motive-power, steam, and that iron was first extensively applied to mining, to machinery, and to locomotion. Now every civilised country is scored with railroads, cities are lighted with gas, and coal and iron promise to change the characters of our ships and our mariners. Before coal was used to generate steam, the sites of manufacturing towns were determined chiefly by the convenience of mill-streams, and the woods were the seats of smelting. The forest fires are now extinguished; the fabrication of iron has travelled to the coal-fields, which have become the densest-peopled parts of the kingdom, and the scenes of the busiest industry. Wool, once the staple industry of England, is now second in magnitude and importance compared with cotton; yet, with the discovery of new sources of supply, and with increased home production, the quantity made into clothing is vastly greater than in former times. The development of the cotton industry is another example of the application of raw produce to extended uses. The introduction on the Continent of the silkworm, more than a thousand years ago, gave rise to the unrivalled manufactures of the South of France, and originated one of the chief elements of the wealth of Italy and Greece. The dyeing of textile fabrics leads us into the domain of chemistry, a subject requiring a volume merely to name its discoveries. Indigo has displaced woad as a blue dye; and the new aniline colours, outvying the Tyrian purple, elevate our taste and gratify our sense of beauty. If we take other examples, similar facts appear. The Chilian potato has provided food for many millions of people, and in 300 years has reached a perfection in Europe to which in its native soil it never approached. Maize has become an important crop round the Mediterranean; while wheat, which was given to America in exchange, has flourished there so greatly as to admit of large exports to the Old World.

Discoveries of the utmost value appear, for a time, of less moment, because their full development is not at first reached or foreseen. It is not easy for us to determine how far the industrial and social habits of posterity may be influenced by the production of the hydro-carbons and mineral oils. From the first employment of caoutchouc for rubbing out pencil-marks, its applications have been manifold. In gutta-percha we see applications of a new raw material to telegraphy, embracing the world. We need but contrast the present period of our history with any former period, or the condition of any one country with another, to perceive the effect of such knowledge upon human well-being. Every year adds to our list of useful animal, vegetable, and mineral substances; while the greater consumption of those already known calls forth, as a rule, greater production. Thus the importance of a knowledge of raw materials cannot be overrated. It is a matter of personal interest to everybody in every part of the world.

No abstract reasoning would have led us to discover the properties and uses of iron, without first seeing, handling, and examining a piece of that metal. Experiment has founded this department of knowledge. Every discovery of a new material, or a new property of an old material, has suggested new uses, and fresh necessities have led continually to fresh researches. We know that dyeing, tanning, brewing, glass-making, and weaving were known to the Egyptians in very ancient times, ranging from 1,500 to 2,500 years before Christ. These industrial operations involved an earlier discovery of the raw substances operated upon. Indigo and purple dyes; bark and other astringents that effect the change from skin to leather; barley and malt; silicious sands and alkalies that, admixed, form glass; silk, linen, and cotton—all of these must have made part of the earliest human history. Passing over a long interval, we read of quills being used for writing (A.D. 600), of the use of sugar among the Arabs (A.D. 850), and of coffee among the Persians (A.D. 875). After the lapse of several centuries, America opened to us another world of raw produce. The potato was introduced into Europe in the last decade of the sixteenth century, and its cultivation rapidly spread during the seventeenth century. Maize, cocoa, and tobacco were likewise made familiar to us.

Without extending the list, we may dwell upon the thought of how much we owe to the past, even in these few selected instances. The same methods that rewarded our ancestors with fruits of discovery, must be still followed by us in order to add to their number. Our forefathers observed, compared, tested, and applied, age by age, the gifts of nature, and bequeathed to us the accumulated store of knowledge which we inherit. To come into possession of our share of this knowledge of economic substances, our study must begin at home. Here the things are at hand, and we early become accustomed to the use of them. With imports from all parts of the earth, it has become difficult to say whether we are most interested in home or in foreign produce. In England, the facilities for study surpass those of other nations, and we may reverse the usual steps of inquiry, and endeavour, from the raw substance itself, to deduce or to arrive at the conditions of its being, wherein it differs from all other substances. What we know of the undeviating laws of nature, opens our minds to inferences and generalisations whenever a basis of facts is broad enough to support a correct induction.

In the vegetable kingdom, we see the distinction between an endogen and an exogen clearly marked from the cotyledons through the whole life-history of the plants. (See Figs. 10, 11, in Lessons in Botany, III., Vol. I., p. 81). The structure of the stem, the veining of the leaves, the number and character of the floral organs, the method of the secretions, all differ persistently in the great subkingdoms. A worker in wood will tell from the texture and grain, not merely the species, but the variety of tree, and the place of its growth. A mahogany merchant will distinguish the timber of Cuba from that of other West Indian territory, and island growths from the growths of the mainland. Again, the starches prevailing amongst so many plants are known apart by the form of their grains, so that potato-starch mixed with arrowroot can be easily detected; and flour of every kind indicates in the same way the grain from which it was prepared. The microscope shows an identity of structure between the nutmeg, or hard kernel, and the arillus, or mace, that enwraps it, and would prove that the two substances belong to each other, greatly as they differ in appearance, even though their relationship were not otherwise known. In a general way, if we see a rattan, bamboo, or palm stem, we at once know it to be an exotic or tropical production; and we infer, from the ferns and palms of the coal measures, that the beds of shale and coal originated under circumstances of climate quite different from the temperate and frozen regions where they are now found.

Examples abound equally in the animal kingdom. We do not hesitate to draw climatic inferences from the presence of the bones of fossil carnivora in cold regions, although such inferences receive no support from the existing climate. With living animals we can usually trace their geographical relation, and say, *this* is a tropical bird, fish, or insect; *that* belongs to the frigid zone.

The more minute our investigations, the more is this law of the individuality of every natural product, and of the mutual adaptation of all the conditions of being, confirmed. The structure of a bone enables our naturalists to build up the animal of which it is a part, to describe its habits, and to fix its proper position in the domain of science. Professor Owen has demonstrated that the dentile or tooth structure of every species of animal is distinct, and that, were our knowledge comprehensive enough, it would unerringly guide us to the identification of the animal.

From these illustrations it will be seen that all raw substances contain within them structural evidences of the conditions under which they were developed; and that by a scientific induction, possible only with increased knowledge, we may learn to read these evidences, and to apply our knowledge to the improvement of the substance—that is, to its increased utility. The history of discovery shows that all advance was anticipated, that new powers or properties were generally suspected, and that they revealed themselves in answer to scientific interrogation. Here we perceive the utility of museums, where economic substances from the three kingdoms of nature are classified for comparison and study. Books will not only show the knowledge already acquired, but they will direct the student in his search for more. In every civilised country there are museums; and every school should also be a repository of specimens of raw produce, in the nature and use of which direct instruction should be given. Early familiarity with the substances themselves would lay the foundation of knowledge, which would not only save the young man of business the first weary years of learning, but would send him forth into the domain of nature, perhaps as a discoverer of new materials, or of new properties or adaptations, adding to the necessaries and conveniences of life, and therefore to the health and happiness of mankind.

CORRESPONDENCE IN FRENCH.—III.

10.—Letter proposing the Opening of an Account.

Havre, March 20th, 1882

Messrs. Lewis Frisby, McHenry & Co., New Orleans.

Gentlemen,—We have to acknowledge the receipt of your favour of the 10th of February, and hasten to reply.

We willingly accept your proposals, and shall be delighted to see relations established between our two houses that may prove mutually advantageous. You may rest assured that we will do all in our power to merit the good opinion with which Mr. Rieu has inspired you, and show ourselves worthy of the confidence reposed in us.

We hasten to satisfy your wishes by sending you enclosed a *pro formâ* account sale, that may serve you as a basis for future operations. Our terms are 2 per cent. commission, and 2 per cent. *delcredere*.

We shall be ready to make advances to the extent of two-thirds of the invoice amount of goods consigned to us for sale, on receipt of invoice, bills of lading, and orders for insurance.

It is unnecessary to observe that we shall send you accounts of the state of the market by all the boats leaving for New Orleans.

We remain, Gentlemen,

Your very obedient servants,

A. J. Smith, Bros. & Co.

Le Havre, le 20 *Mars*, 1882.

Messieurs Lewis Frisby, McHenry et Cie.,

à la Nouvelle-Orléans.

Messieurs,—Nous accusons réception de votre honorée en date du 10 Février et nous nous hâtons d'y répondre.

Nous acceptons vos propositions avec empressement, et nous serons charmés de voir s'établir entre nos deux maisons des rapports suivis et réciproquement fructueux. Croyez bien que nous ferons tout ce qui dépendra de nous pour répondre dignement à l'opinion que M. Rieu vous a inspirée et à la confiance dont vous voulez nous honorer.

Nous nous empressons de satisfaire à vos désirs en vous remettant sous ce pli le compte de vente *simulé* que vous nous demandez, afin qu'il puisse vous servir de base pour vos opérations futures. Nos conditions sont: 2 pour cent de commission et 2 pour cent de *ducroire*.

Nous sommes prêts à faire des avances pour les deux tiers du montant des consignations qui nous seront adressées en recevant facture, connaissement et l'ordre de faire l'assurance.

Inutile de vous dire que nous profiterons de tous les navires en partance pour la Nouvelle-Orléans pour vous tenir au courant de l'état de notre marché.

Agréez, Messieurs,

l'assurance de notre estime,

A. J. Smith, Frères & Cie

11.—A Letter advising the Execution of an Order.

Cognac, May 10th, 1882

Messrs. J. Ellison, Wine Merchants, London.

Gentlemen,—In pursuance of the order contained in your letter of the 15th of April, and in accordance with the prices and conditions laid down, I have bought for your account 20 tierces of brandy, 27 degrees, and forwarded them to your brother in Paris. Enclosed you will find the invoice, amounting to 30,760 fr., with which I debit you. In conformity with your wishes, I have drawn this day on your account, on Messrs. J. Lafitte, of Paris, at three months, payable to my order, for the above amount.

I wrote to you on the subject of your account with me at length in my last, and have nothing more to add.

I remain, Gentlemen,

Your very obedient servant,

Francis Martin.

Cognac, le 10 *Mai*, 1882

Messieurs J. Ellison, Négociants en Vins, à Londres.

Messieurs,—En exécution de l'ordre contenu dans votre honorée du 15 Avril, j'ai acheté aux prix et conditions y fixés, pour votre compte, 20 tierçons eau-de-vie, 27 degrés, et je les ai expédiés à M. votre frère à Paris. Vous en trouverez sous ce pli la facture, s'élevant à 30,760 francs, portés à votre débit. Pour me conformer à vos désirs, je viens de disposer pour votre compte, sur MM. J. Lafitte de Paris ma traite en date de ce jour pour la dite somme, à mon ordre, payable à trois mois.

Je me suis étendu dans ma dernière au sujet de votre compte chez moi, et je n'ai rien à ajouter à mes observations.

J'ai l'honneur d'être, Messieurs,

Votre très-humble serviteur,

François Martin.

12.—Letter embodying an Offer of Services as Clerk.

Metz, March 15th, 1882

E. Merle, Esq., London.

Sir,—I take the liberty, upon recommendation of Mr. Lecouteur, with whom I have been working the last five years, of writing to offer you my services. My only motive for quitting a firm, to which I owe much, and for seeking a situation abroad, is the desire of extending my knowledge of business and of perfecting myself in a language, the rudiments of which I know already.

Having been engaged for three years in bookkeeping, I have during the last two years filled the post of English and German correspondent. At the same time I have devoted my attention to the study of the Exchange, and I venture to hope that I should satisfactorily discharge the duties of correspondent or ledger-clerk.

As regards my position in this firm, I beg to refer you to Mr. Lecouteur, who has kindly promised to write to you on my behalf.

No further assertion on my part is necessary, as to my doing my best to merit the confidence reposed in me.

Be so kind as to favour me with a reply, and should there be no vacancy in your firm, let me know what chances there are of obtaining a post among your friends,

And believe me, Sir,
Your very obedient and humble servant,
A. Wolff.

Metz, le 15 *Mars*, 1882

Monsieur E. Merle, à Londres.

Monsieur,—C'est sur la recommandation de Monsieur Lecouteur, chez qui je travaille depuis plus de cinq ans, que je prends la liberté de vous écrire pour vous offrir mes services. Le désir d'étendre mes connaissances commerciales et de me rendre plus familière une langue dont les principes me sont déjà connus, peut seul me déterminer à quitter une maison à laquelle je dois beaucoup, pour chercher une place à l'étranger.

Je me suis occupé pendant trois ans de la tenue des livres, j'ai été chargé ensuite pendant les deux dernières années de la correspondance en anglais et en allemand. J'ai donné toute mon attention à l'étude du change, et j'ose me flatter que je pourrais acquitter à votre satisfaction des fonctions qui se rattacheraient à la correspondance ou à la partie des comptes-courants.

Quant à ma position dans cette maison, je m'en réfère au témoignage de Monsieur Lecouteur, qui m'a promis de vous écrire en ma faveur.

Je ne dis mot sur le fait que je ferai de mon mieux pour justifier la confiance dont on aura bien voulu m'honorer.

Veuillez, je vous prie, m'honorer d'une réponse, et en cas où il n'y aurait pas de place chez vous, de me faire savoir s'il y aurait la chance d'en obtenir une chez un de vos amis, et agréer l'assurance de l'estime avec laquelle

J'ai l'honneur d'être, Monsieur,
Votre très-humble et très-obéissant serviteur,
A. Wolff.

13.—Letter on Transfer of Order or Commission.

Philpot Lane, London, February 10*th*, 1882

Messrs. Martin and Co., Boulogne.

Gentlemen,—We beg to forward you a letter just received from Mons. Achard, of Dieppe. You are in a better position to undertake this little matter. Will you undertake it?

We are, Gentlemen, most truly yours,
Smith Bros.

Philpot Lane, Londres, 10 *Février*, 1882

Messieurs Martin et Cie, à Boulogne.

Messieurs,—Nous avons l'honneur de vous adresser une lettre que nous recevons de Monsieur Achard, à Dieppe. Vous êtes mieux placés que nous pour traiter cette petite affaire. Vous convient-il de vous en charger?

Agréez, Messieurs, nos cordiales salutations,
Smith frères.

LESSONS IN ENGLISH LITERATURE.—III.

CHAUCER AND HIS TIMES.

From whatever point of view it be regarded, the reign of Edward III. must always be one of the most important epochs in the history of England; but to the student of literature it is especially so.

Long before this time—indeed, for centuries—a gradual fusion must have been in progress between the two races, Norman and Saxon. The bitter memories of the Conquest, and the oppression which followed it, had faded. The spirit of haughty contempt on the one side and hatred on the other, had gradually passed away. The Norman nobles and the older Saxon families had become assimilated in privileges and position; and throughout all classes the diversities of race were becoming forgotten. The English language, too, was little by little conquering in the struggle with its rival, the French, and becoming the language of the whole people. We are told by the old chroniclers, that down to the fourteenth century, and during at least a great part of it, French was the language of the grammar-schools, and even Latin was taught to English boys through the medium of the French. But we read that one John Cornwal introduced the system of teaching in English, and being followed by others who learned of him, the practice soon spread, and ultimately became universal. From some time after the Conquest, French had been the language of the courts of law; but in 1362 an Act was passed substituting English for it; and the very significant reason is given in the preamble, that the language of the courts was no longer understood by the parties to the causes. The fire necessary to complete this fusion of different elements into a single nation was supplied by the French wars of Edward III. For the first time England as a nation was called upon to measure her strength against one of the great nations of the Continent; and her success was brilliant. The enthusiasm of war and the pride of victory gave birth to a spirit of nationality, which was the one thing needed to complete the unity of the nation. And the fact that the national enemy was France, with the hatred of things French thence arising, must have decided the victory of English as the national language over its French rival.

But it was not in foreign war alone that England in that day showed that men's energies had fully awoke from the sleep of the dark ages; nor was such a revival confined to England. Everywhere in Europe old forms of faith were being sternly questioned. Old systems of philosophy were cast aside. Old institutions and social organisations were giving place to new. It was the age that saw the death of the scholastic philosophy and of the system of chivalry. It saw the revival of ancient learning, the first real efforts to throw off the corruptions of religion both in doctrine and in practice, and the commencement of modern literature. In England, the religious reformation attempted under Wickliffe, on one side; and on another side the rising spirit of the poorer classes, still burdened under the yoke of feudalism, a spirit which soon after led to the great rising of the commons under Wat Tyler, showed that England had participated in the general movement. But till the time at which we have now arrived—that is to say, the latter part of the fourteenth century—she was behind the rest of Europe in literature. In Italy, Dante had produced his great work in the beginning of the century. Petrarch and Boccaccio had written since. In other countries, too, much had been done. But, as we have seen, England was still without a literature. Now, however, everything was in her favour. Her national unity was achieved; her language was practically formed; the mental energy was present; and the desire for knowledge was so universal, that we are told, on authority which it is difficult to disbelieve, that at Oxford and Cambridge the students might then be counted by thousands where they now are by hundreds.

From comparatively early in the reign of Edward III., we find signs of the revival of a national spirit in the popular songs on subjects of national interest. Among these the most important which have been printed are a series of ten very spirited ballads by Laurence Minot, upon various battles and other achievements of Edward III.

But the first work of considerable extent and merit which demands our attention is the remarkable allegorical and satirical poem, "The Vision of Piers Ploughman." We treat this as the first because, though the year of its composition cannot be exactly fixed, it belongs in form and style so much more to the preceding age than any other great poem of the period, and shows so much less trace of the direct action of foreign influence, that it naturally takes the first place in order among the poems of the age of Chaucer. The author of "The Vision of Piers Ploughman" is said, and there is no reason to disbelieve it, to have been one Robert or William Langland, or Longland, a native of Staffordshire, who lived as a monk at Malvern: and his placing the scene of his vision in the Malvern hills confirms a part, at least, of the story.

This singular poem relates a dream, or rather a series of dreams, in which the poet sees, allegorically, the corruption and misery of the world; the remedy for those evils in the pursuit of truth; and the one guide to truth and regenerator of the world in the person of Peter the Ploughman. The world is a field full of people. Here are the poor toiling, the rich wasting; the lawyers pleading for hire; the clergy idle and corrupt; the pardoners deceiving the people for gain; yet all the while the castle of Truth stands just above them, though they see it not. At court mede (corrupt gain), and falsehood, and wrong contend with conscience, and peace, and reason; and lawyers, and confessors, and counsellors are on the side of wrong. At last Reason makes her voice heard in the world. Men are brought to confess their sins; each of the vices in turn comes to confession; and a great multitude set out upon the quest of Truth. But who shall show the way? Friars and pilgrims know it not. Peter, a ploughman, presents himself as the guide to Truth. But we very soon see that under the guise of the ploughman the poet presents to us none other than the Divine Redeemer of the world. Then we find Peter, the ploughman, employing his followers in labour upon the field which he tills (the world). We see him ploughing the soil and sowing the seed of Divine grace. While side by side with this we have another allegory of "Do Well, Do Bet, and Do Best," three degrees of moral excellence, and the guides and instructors of the soul. The poem ends somewhat abruptly —so much so that some have thought it unfinished—with the ravages of Antichrist in the kingdom of Peter the Ploughman.

We have said enough to enable the student to appreciate the general character of the religious lessons which the writer seeks to convey, and of the allegorical form in which he clothes them. But the poem is no less a satire than a religious allegory. The vices of all classes of men are painted with much vigour; but above all, the corruptions of the clergy and the monastic orders, their idleness and neglect of their flocks, their covetousness and simony, their self-indulgence, their deceptions to extract money from the people. The world as it was and the world as it might have been, the Church as it was and the Church as it ought to be, are put before us in constant contrast.

The language of Langland is decidedly more antique in cast than that of his contemporary Chaucer; though, according to Mr. Marsh ("Lectures on the English Language," p. 92), the actual number of words derived from foreign sources is at least as large in his English as in Chaucer's. But what more than anything else connects this poem with the past, rather than with the future, is its metre. It bears every mark of having been written distinctly for the people, rather than for the cultivated classes. And, perhaps, for this reason the author chose for it the old Saxon alliterative metre, which seems to have been then still habitually used, and even long afterwards sometimes occurs, in the songs of the people. The chief peculiarity of that metre is that in each couplet, or pair of verses, two or more accented—that is, emphatic—syllables in the first line, and one in the second, begin with the same letter. The character of the metre will be learned more easily from the specimen which we shall give than from any amount of description. It will be observed that it differs from our modern metres in having alliteration—that is to say, identity of initial letter in syllables—instead of rhyme; and in attending not to the number of syllables in a line, but rather to the number of accents. But it must be observed that the alliterative principle is not unfrequently departed from in individual lines. After the dreamer has described his leaving his home and falling asleep, he begins to tell his dream as follows. We merely alter the spelling in some cases where it differs from our present spelling:—

"Then gan I meeten
A marvelous sweven,*
That I was in a wilderness,
Wist I never where,
And as I beheld into the east†
On high to the sun
I saw a tower on a toft,‡
Wonderly imaked,§
A deep dale beneath,
A dungeon therein
With deep ditch and dark
And dreadful of sight.
A fair field full of folk
Found I there between
Of all manner of men,
The mean and the rich
Working and wandering
As the world asketh,‖
Some putten¶ them to the plough,
Playeden them** full seldom,
In earing†† and in sowing
Swinkin‡‡ full hard."

The great popularity which this poem attained is attested, not only by direct evidence, but by the number of imitations to which it led, the most notable of which was "The Creed of Piers Ploughman."

While, however, Langland, in his remote country home, was satirising the corruptions in practice which he saw in the Church around him, in a very different sphere had arisen one whose attack was of a far bolder kind; for it was directed, not only against the prevailing habits of life, but against the received system of doctrine as well.

John Wickliffe was born about the year 1324, in a small village near Richmond, in Yorkshire. He received his education at Oxford, having been a member first of Queen's College, and afterwards of Merton College. At Oxford he very soon made a name for himself as a man of profound learning, extreme acuteness of intellect, and fearless courage. He first acquired popularity and fame by leading the opposition to the Mendicant Friars, who at Oxford, as elsewhere, were seeking to draw all wealth and influence into their own control. His lectures on divinity were frequented by multitudes of students. Nor was his fame limited to Oxford. He was consulted by Edward III. upon the great question then pending between England and the Pope, as to the payment of tribute claimed by the Papal Court, by virtue of the cession of the kingdom in the time of King John. And he was one of those sent by the king to meet the Papal legate at Bruges, and negotiate with him upon this subject. His chief supporter at court was John of Gaunt, Duke of Lancaster. After his return from his foreign mission, he was appointed to the rectory of Lutterworth, in Leicestershire. As time went on, and his knowledge and observation were enlarged, his opposition to the existing order of things both strengthened and widened. From an opponent of practical abuses, he had gradually become an opponent of some of the most cherished doctrines of the Church—that as to transubstantiation, for example. He had drawn to himself, too, a multitude of followers, and organised a body of preachers, who spread his opinions through the whole country. He had become the head of a great movement. It was hardly to be expected that such an adversary should be left unmolested by the heads of the Church. Just before the death of Edward III., he was summoned before the Archbishop of Canterbury at St. Paul's. But the proceedings came to nothing; Wickliffe was rescued from danger by John of Gaunt. With the accession of Richard II. the power of John of Gaunt declined. Then followed the rising of the commons under Wat Tyler, in 1381, which was ascribed by his enemies to the revolutionary influence of Wickliffe's teaching. His bitterest enemy, Courtenay, had become Archbishop of Canterbury. Wickliffe was again summoned before a synod, which met at the Greyfriars, in London. He did not appear, but his doctrines were condemned as dangerous and heretical. By the Convocation at Oxford he was again condemned. No actual step was taken, however, against him, and he continued to preach and teach in his parish of Lutterworth as boldly as before; until, in the year 1384, two years after his condemnation, he died of paralysis.

Wickliffe wrote much in Latin, addressed to the learned; and much in English addressed to the people. His shorter English works consist of tracts upon subjects of temporary interest. His one great work was the translation of the Bible into English. This vast undertaking was probably not accomplished by Wickliffe unaided. No doubt a great part of it was executed by his followers and disciples under his supervision; but the design is unquestionably Wickliffe's; and there is no doubt that it was carried out in part by himself, and entirely under his direction and guidance. The first edition appears to have been completed three or four years before Wickliffe's death. A second was finished by Purvey a few years after the death of his master. This is the first really great work in English prose; and when we consider the thirst for religious knowledge at the time it was produced, and the number of its author's followers both then and afterwards, we can scarcely doubt that, quite apart from his influence in other respects, Wickliffe must have done more than almost any other man has ever done to fix the standard of the English language, and form the style of English writers.

John Gower seems to have been born before Chaucer, though he survived him by eight years; and probably some of his works, though not his great English poem, were earlier than Chaucer's most important works. Gower was sprung of a family of knightly rank in the county of Kent. He was a man of property, and is said to have been educated at Merton College, Oxford, and afterwards to have adopted the profession of the law. However this may be, it is pretty clear that he lived within the circle of the society of the court. Many short poems of his have been recovered and published in various collections, some of them in French and some in Latin. But his larger works were three in number; and of these one was written in French, one in Latin, and one in English. The "Speculum Meditantis,"

* Dream. § Wonderfully made. ** Amused themselves.
† Looked to the east. ‖ As the world requires. †† Ploughing.
‡ Field. ¶ Apply themselves. ‡‡ Laboured.

which was in French, has been lost. The "Vox Clamantis," or "Voice of One that Crieth" (so called in allusion to St. John the Baptist), is a long poem in Latin, in which, partly under the form of allegory, he sets forth the evils of the time, especially the miseries attendant upon the great rising of the commons, under Wat Tyler, in 1381; and protests against the vices and corruptions of the various classes of society. Gower, however, was no friend or follower of Wickliffe. But Gower's most important work, and his latest, is the "Confessio Amantis," or "Lover's Confession," a very long poem in English. Its form is that of a dialogue between the poet and Genius, a minister of Venus, who is assigned by her to receive his confession. The principal part in the dialogue is borne by Genius, the confessor, who lays down a number of moral precepts for the instruction of the penitent lover, and illustrates them by stories taken from all kinds of sources, ancient and modern, sacred and profane. This book thoroughly justifies the title which Chaucer gave to his friend and brother poet, and which was afterwards repeated by a long succession of writers, "Moral Gower." It shows, as all Gower's works do, much cultivation, but little poetical genius; and to us it is interesting, as showing how far the influence of Chaucer had acted upon his own contemporaries, rather than very attractive for its own sake.

Sir John Mandeville tells us that he was a native of St. Albans, and went abroad in the year 1322, on Michaelmas Day. He remained abroad some years, visiting Egypt and a very large part of Asia; and, after his return, he wrote an account of the countries he had visited. The book is full of the wildest fables; indeed, it is plain that Mandeville had the true traveller's appetite for wonders, and received and recorded whatever was told him about the countries with which he came in contact. But his accounts of what fell under his own observation are clear and interesting. What he tells about the languages in which he published the book, and his reasons, is well worth noting, as illustrating the transition which the nation was then passing through in respect of language. "Ye shall undirstande (he says in his prologue) that I have put this boke out of Latin into Frensche, and translated it agen out of Frensche into Englyssch; that every man of my nacioun may undirstande it."

The greatest genius, however, and in every respect the most strongly representative writer of this period, was Chaucer. The consideration of his life and works we must postpone to the next lesson.

LESSONS IN LATIN.—XXXIX.

DEVIATIONS IN THE THIRD CONJUGATION (*continued*).

2. *Perfect in* -UI; *Supine in* -TUM, -ĬTUM, -SUM.

i. Alo, alĕre, alui, altum, *to nourish*.

ii. Colo, colĕre, colui, cultum, *to cultivate, honour*.

iii. Consŭlo, consulĕre, consŭlui, consultum, *to consult*; with acc., *to take the advice of any one*; with dative, *to care for any one*.

iv. Occŭlo, occulĕre, occului, occultum, *to hide*.

v. Răpio, răpĕre, rapui, raptum, *to carry off by force, snatch, seize*; compounds are in ripio, as corripio, corripere, corripui, correptum, *to seize quickly*.

vi. Sero, sĕrĕre, serui, sertum, *to put in rows, set*.

vii. Depso, depsĕre, depsui, depstum, *to knead*.

viii. Texo, texĕre, texui, textum, *to weave* (E. R. *texture*).

ix. Cumbo, cumbĕre, cubui, cubĭtum, *to lie along*. The simple word is out of use; instead, employ the compounds, as discumbere, *to lie down*.

x. Elicio, elicĕre, elicui, elicitum, *to entice out* (E. R. *elicit*).

xi. Fremo, fremĕre, fremui, fremĭtum, *to rage*.

xii. Gĕmo, gemĕre, gemui, gemĭtum, *to groan*.

xiii. Gigno, gignĕre, genui, genĭtum, *to beget*.

xiv. Molo, molĕre, molui, molĭtum, *to grind*.

xv. Pinso, pinsĕre, pinsui, pinsitum (and pinsum), *to bray, pound*.

xvi. Pono, ponĕre, posui, posĭtum, *to place*.

xvii. Vomo, vomĕre, vomui, vomĭtum, *to spew*.

xviii. Frendo, frendĕre, frendui, fresum or fressum, *to grind or gnash the teeth*.

xix. Meto, metĕre, messui, messum, *to mow*.

Several verbs, having the perfect in *ui*, want the supine, as tremĕre, *to tremble*; excellere, *to be high, to surpass* (excelsus, *lofty*, is used as an adjective); and the other compounds of the obsolete cellĕre, connected with celsus, *high*; percello has perculi and perculsi, perculsum, *to shake*.

VOCABULARY.

Arripĕre, *to seize, get*.
Cærimonia, -æ, f., *sanctity, ceremony*.
Commutatio, -ōnis, f., *an exchange*.
Conserĕre, *to plant*.
Conserĕre manus, *to join battle*.
Consultum, -i, n., *consultation*.
Demĕtere, *to mow down*.
Demittere, *to send or let down*.
Depugnare, *to fight out a quarrel*.
Diripĕre, *to pillage*.
Disserĕre, *to discuss*.
Fortitudo, -ĭnis, f., *bravery*.
Ingignere, *to beget in*.
In una virtute, *in virtue alone*.
Jurare, 1, *to swear*.
Matūre, *quickly*.
Migratio, -ōnis, f., *migration, wandering*.
Mutus, -a, -um, *dumb, mute*.
Opus est, *there is need* (with ablative).
Præponĕre, *to put before, place over*.
Prætorium, -i, n., *the general's tent*.
Progredior, progrĕdi, progressus sum, 3, dep., *to advance*.
Recordatio, -ōnis, f., *remembering, recollection*.
Sepulchrum, -i, n., *a sepulchre, tomb*.
Suo, suĕre, sui, sutum, 3, *to sow*.
Suprēmus, -a, -um, *the last*.
Tegumentum, -i, n., *a covering, roof*.
Verum, -i, n., *truth*.

EXERCISE 147.—LATIN-ENGLISH.

1. In omnibus negotiis, priusquam aggrediare, consulto opus est; ubi autem consulueris, mature rem ipsam aggredĕre. 2. Socrates supremo vitæ die multa de immortalitate disseruit. 3. Manibus consertis, milites nostri fortitudine excelluerunt. 4. Animus movet id corpus cui est præpositus. 5. Zeno in unâ virtute beatam vitam posuit. 6. Natura ingenuit homini cupiditatem verum inveniendi. 7. Omnibus animalibus a naturâ ingenitus est amor sui. 8. Alexander, victor tot regum atque populorum, iræ succubuit. 9. Spero te semper maximo studio in literas incubiturum esse. 10. Cærimonias sepulchrorum homines, maximis ingeniis præditi, coluerunt; hærebat in eorum mentibus mortem non interitum esse omnia delentem, sed quandam quasi migrationem vitæ.

EXERCISE 148.—ENGLISH-LATIN.

1. Hast thou consulted thy father? 2. Take care of thy children. 3. When they have well consulted, they may approach the business (*res*). 4. The soldiers joined hands (*came to close fight*). 5. Which of the soldiers excelled in the fight? 6. God has set the mind over the body. 7. By wise men, life is placed in virtue alone. 8. I place happiness in the love of God. 9. Hast thou a desire for (*of*) finding truth? 10. Nature has produced (*ingignere*) such a desire in all minds. 11. The love of self is born in the rich and in the poor. 12. Thy brothers yielded to anger, and, coming to close quarters, fought. 13. My father will advance to besiege the city. 14. The forces have advanced, and are pillaging the houses.

The verb *colo* may serve as a subject for illustrating the natural growth and expansion of words. In Latin, as in all languages, words originally denoted material objects and their operations. Hence we learn that civilisation began at the lowest end of its scale. Colo, the root of which is found in the Greek, as in the term bu*col*ics, or songs on rural topics, has reference primarily to the operations of husbandmen. It is a word belonging to the farm, and relates generally to the care and labour bestowed on it. Accordingly, it (*cul*ture) is found in the compound term agri*cul*ture, or field-tilling. In general, then, colere has for its primitive meaning the idea of working or tilling the land—a farm, a field, a garden. But those who till the land, live on the land; and so colere came to mean *to occupy the land, to dwell in the country*; and, in a wider sense, to dwell generally. Care is another idea involved in agriculture. Consequently, colere means *to care for*. But you may care for a person as well as for a thing; and you show your care for a person by attention, by love, by respect: the highest attention rises into homage, and even worship; and thus colere, which in its birth signifies *to till a piece of ground*, in its full development signifies *to adore the Almighty*. After this verbal genealogy, let no one suppose that words have but one meaning. Every word has a root-meaning, and that root-meaning may, with care and skill, be traced in all its secondary applications. But those applications are various and numerous. I shall give instances of the several applications of the verb *colo*, leaving you to translate them with the aid of a vocabulary.

APPLICATIONS OF "COLO."

1. *To till*:—

"Villicus agri colendi causâ est constitutus."—*Varro*.
"Agri non omnes frugiferi sunt qui coluntur."—*Cicero*.

2. *To inhabit*:—

"Urbem, mi Rufe, cole et in istâ luce vive."—*Cicero*.

3. *To care for:—*

"Jupiter, qui genus colis alisque hominum."—*Plautus.*

"Ingenuus pectus coluisse per artes, cura sit."—*Ovid.*

4. *To study:—*

"Studium philosophiæ a primâ adolescentiâ coluit."—*Cicero.*

5. *To pursue:—*

"Nunc plane nec ego victum nec vitam illam colere possum."—*Cicero.*

6. *To esteem, regard, respect:—*

"Amo vos quia me colitis."—*Plautus.*

"A quibus diligenter observari videmur et coli."—*Cicero.*

7. *To honour, worship:—*

"Quid est cur deos ab hominibus colendos dicas, quum dii non modo homines non colant sed omnino nihil curent?"—*Cicero.*

"Hos deos et venerari et colere debemus."—*Cicero.*

VOCABULARY TO THE EXAMPLES OF "COLO."

Frugifer, -ĕra, -erum, *fruit-bearing.*
Observo, 1, *I pay attention to.*
Adolescentia, -æ, f., *youth.*
Ingenuus, -a, -um, *liberal.*
Victus, -ûs, m., *food, victuals.*
Villĭcus, -i, m., *a steward, bailiff.*

DEVIATIONS IN THE THIRD CONJUGATION.

3. *Perfect in* -VI; *Supine in* -TUM.

The stem of the present is strengthened by *n* or *r*.

i. Li-n-o, linere, levi, litum, *to besmear.*

ii. Si-n-o, sinere, sivi, situm, *to allow, permit.*

iii. Se-r-o, serere, sevi, satum, *to sow, plant.* The compounds have situm; as, consero, consĕrere, consevi, consitum.

In the following the *er* of the present undergoes inversion: thus, *cre* becomes *cer*:—

iv. Cer-n-o, cernere (crevi, cretum only in compounds), *to separate, determine.*

v. Sper-n-o, spernere, sprevi, spretum, *to despise.*

vi. Ster-n-o, sternere, stravi, stratum, *to spread out* (E. R. *stratum*).

Hither may be referred the following in *sco*:—

vii. Cre-s-co, crescere, crevi, cretum, *to grow;* so, accrescere, *to increase;* excrescere, *to grow out;* recrescere, *to grow again;* concrescere, *to grow together;* the other compounds want the supine.

viii. No-sc-o, noscere, novi (notus as an adjective), *to become acquainted with.* Nosco has no participle future active. After the same manner internosco, *to distinguish;* ignoscere, *to pardon;* pernoscere, *to learn thoroughly;* prænoscere, *to learn beforehand.* But agnoscere (part. fut. act. agnoturus), precognoscere, recognoscere, form the supine in -ĭtum, as recognĭtum.

ix. Pa-sc-o, pascere, pavi, pastum, *to feed.*

x. Quie-sc-o, quiescere, quievi, quietum, *to take rest.*

xi. Sci-sc-o, sciscere, scivi, scitum, *to inquire.*

xii. Sue-sc-o, suescere, suevi, suetum, *to grow accustomed to.*

VOCABULARY.

Butȳrum, -i, n., *butter.*
Comitia, -orum, n., *the public assembly of the people.*
Concionari, *to address the people.*
Consternere, *to astound.*
Corporeus, -a, -um, *corporeal, belonging to the body.*
Decernĕre, *to resolve, decree.*
Edo, edere, edi, esum, 3, *to eat.*
Importare, *to bring in, import.*
Inserĕre, *to sow in.*
Invidia, -æ, f., *envy, hatred.*
Libens, *gladly.*
Messis, -is, f., *the harvest.*
Oblinere, *to besmear, defile.*
Obtrectatio, -ōnis, f., *blame, reproach.*
Prosternere, *to cast down, prostrate.*
Secernĕre, *to separate.*
Substernere, *to lay under.*
Venustas, -ātis, f., *agreeableness, loveliness.*
Vinea, -æ, f., *a vine.*

EXERCISE 149.—LATIN-ENGLISH.

1. Insita est nobis corporis nostri caritas. 2. Ibi messis non est, ubi satum non est. 3. Omne quod erat concretum atque corporeum Deus substravit animo. 4. Vitâ tuâ malevolorum obtrectationes et invidias prostravisti. 5. Imperator Probus Aureum montem apud Mœsiam vineis consevit. 6. Prœlio commisso, omnia longe lateque telis, armis, cadaveribus constrata erant. 7. Sceleratum hominem conscientia spretæ virtutis exagitat. 8. Dic cur consilium meum sprevĕris. 9. Audi, puer, mater te rogat cur panem butȳro oblĭtum oblitus sis edere. 10. Venustas et pulchritudo corporis secreta non est a valetudine. 11. Cato concionatus est.

EXERCISE 150.—ENGLISH-LATIN.

1. The love of our children is planted in our breasts. 2. They despised my counsel. 3. My counsel was despised by them. 4. I will despise no one's counsel. 5. My boy, butter thy bread. 6. They will defile themselves with bad morals. 7. The good must be separated from the bad. 8. I have separated the boys from the girls. 9. Cicero will speak in the public assembly. 10. The power of Britain has wonderfully increased under Victoria (*Victoria reigning*, abl. absolute). 11. Our friendship will grow with our age.

KEY TO EXERCISES IN LESSONS IN LATIN.—XXXVIII.

EXERCISE 141.—LATIN-ENGLISH.

1. The temple of Janus has been closed twice since the reign of Numa. 2. If it be allowable to laugh, yet immoderate laughter is blamed. 3. If you have allowed that God is, you must confess that the world is governed by his counsel. 4. On the minds of all, God himself has impressed an idea of God. 5. The power of conscience is great, so that those who have sinned always think that punishment is before their eyes. 6. Virtues have been so coupled and joined together, that each one partakes of all. 7. Cæsar, besides ten bushels of corn, and the same number of pounds of oil, also allotted to the people three hundred sesterces to each man. 8. He who distrusts the durability of his advantages must fear lest, having lost them, he should sometimes be miserable.

EXERCISE 142.—ENGLISH-LATIN.

1. Domus mea heri clausa est. 2. Tuam domum claudam. 3. Templum clauditur. 4. Templum clausum erit. 5. Puer a schola exclusus est. 6. Concedunt esse Deum. 7. Confitendum est illis Deum esse. 8. In omnium animis ipsius notionem impressit Deus ipse. 9. Viritim dividam centum frumenti modios. 10. Nonne virtutes copulatæ sunt? 11. Qui diffidit Deo, ei timendum est, ne aliquando sit miser.

EXERCISE 143.—LATIN-ENGLISH.

1. I am greatly grieved that you have been reduced to such grief and distress. 2. Why have you thrust that person from the house? 3. I hope that my sick friend will escape from the disease. 4. If the mind has escaped from the body, then for the first time will it live and thrive. 5. The sun having risen, darkness was scattered. 6. The courage and penetration of the leader drove away all dangers which hung over the city. 7. Marius hid his aged body by plunging it into the marshes (literally, *his body plunged into the marshes*). 8. The heavenly mind, depressed from its most lofty dwelling-place, was let down, as it were, to the earth. 9. The laws, for a long time buried by the power of the enemies, at length emerged. 10. The eternal God has sown minds in human bodies. 11. All things which are now enclosed by arts were formerly scattered and spread abroad. 12. Epaminondas fell with a severe wound at the battle of Mantinea. 13. Epaminondas, when he had overcome the Lacedæmonians at the battle of Mantinea, and saw that he was dying from a severe wound, as soon as he opened his eyes, asked whether his shield was safe.

EXERCISE 144.—ENGLISH-LATIN.

1. Ubi Marius se occultabit? 2. Marius palude se occultavit. 3. Militesne corpora palude occultabunt? 4. Hominum animi e cœlo demersi sunt in terram. 5. Qui demersi sunt, emerserunt. 6. Miles eo vulnere gravi exanimatur. 7. Duo homines hastis transfixos vidi morientes in prœlio. 8. Miles moriens dispexit et rogavit hostes ne fugati essent. 9. Omnia alia caduca sunt, Deus unus permanet, et unquam permanebit, defixus in altis vitæ sui ipsius radicibus. 10. Adolescens de virtutis viâ deflexit. 11. Nebulæ dispersæ sunt, sol eluxit. 12. In omnium animis Deus virtutis semina sparsit.

Fable.—The Peacock.

The peacock complained bitterly before Juno, his mistress, because sweetness of voice had been denied him, while the nightingale, a bird with so little beauty, excels in singing. To whom Juno said, "And properly so too, for it was not proper that all advantages should be bestowed upon one."

Fable.—The Geese and the Cranes.

The geese and the cranes formerly fed in the same meadow. When the owner of the meadow came, the cranes easily flew away, but the geese, hindered by the weight of their bodies, were caught and slaughtered. Thus, when the poor are caught in the same crime with the more powerful, only those suffer punishment, while these escape uninjured.

EXERCISE 145.—LATIN-ENGLISH.

1. The just father inflicts punishment on his son. 2. The judge fined the accused citizen a very heavy fine. 3. The consul severely punished his grandfather (who was) enfeebled by years. 4. Cicero was not able to inflict the punishment due to his wickedness. 5. The conquered Carthaginians may suffer punishment from you. 6. I am severely punished for my rashness. 7. I shall be punished to-day for your bad words. 8. You will pay the penalty in your hot blood. 9. The judges inflicted very severe punishment on wicked men.

EXERCISE 146.—ENGLISH-LATIN.

1. Pœnas repetam malis pueris. 2. Mali pueri pœnas dabunt. 3. Mali pueri pœnas dignas suo scelere pendent. 4. Judex pœnas gravissimas ex sceleratis hominibus sumsit. 5. Victi vos victoribus pœnas sufferent. 6. Solvi pœnam. 7. Sumam ex illis pœnas.

RECREATIVE NATURAL HISTORY.

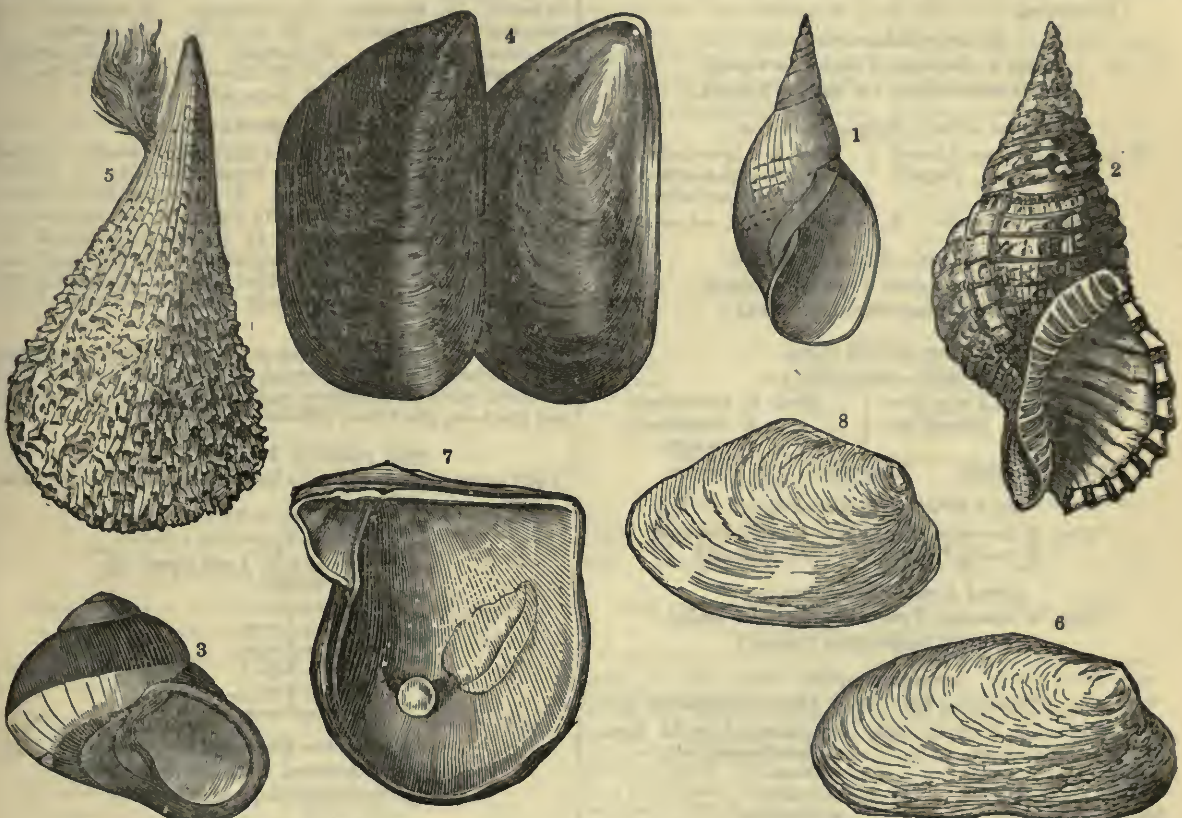
BRITISH PEARLS AND PEARLY SHELLS.

It would be difficult to find, among the multitudes of strangely-formed and deeply-interesting inhabitants of our lakes, rivers, and the sea which girds our coasts, a wider field for study and research than is presented by an examination of the habits and peculiarities of the shell-bearing Mollusca. Whether we select for investigation the tiny creature in his glass-like dwelling among the green water-weeds freshly culled from the clear brook (a familiar type of which is to be found in the *Lymnea stagnalis*, the subject of the annexed illustration, Fig. 1); or dredge up from the rock-fastnesses at the sea's bottom some stout and strong sea-castle, like that inhabited by the Triton, figured in the annexed engraving (Fig. 2); or search the grass and herbs growing in some sheltered hedge-row, where the snails and other land-shells love to dwell, we find the same admirable fitness and marvellous adaptation to the position and conditions under which each had existed: and notwithstanding that the one possesses the power of supporting and carrying out the various functions of existence in water far removed from the sea, the other beneath the salt waves of the ocean, and the third in situations far removed from water either fresh or salt, a perfect shell, exquisite in form, admirable in design, and very nearly of identical composition, is secreted in each instance. Many of these terrestrial shells are, notwithstanding the position assigned them by nature, capable of assimilating elements productive of rich, admirable, and varied colouring. The annexed sketch of *Helix hæmastoma* (Fig. 3) will serve to show this. Few of our readers will have failed to observe the beauty of tint and variety of shading to be found on the shells of the common banded and golden-yellow snails of our hedges, lanes, and thickets.

Few natural processes are more extraordinary and mysterious than that by which colour and quality of product are produced by living creatures, and even the lowest orders of plants. We take a grain of wheat, the seed of the poppy, the *nux vomica*, and the deadly nightshade; we prepare a suitable tub or other vessel for them to grow in; we furnish soil, water, heat, and shelter; and in due time, when the plants from each of these seeds have arrived at maturity, we shall find that no two will be alike either in colour of blossom, form of foliage, or shape of plant. We go a step farther, and subject them and their products to chemical analysis, and we find food suitable for man associated with a plant-stalk covered with a sheath of pure flint in the wheat; whilst the poppy, with its rich scarlet tints and soft stem, yields the useful alkaloid morphia; and the *nux vomica* furnishes to us the deadly poison, *strychnia*—all these wondrous elements and compounds being drawn from the one simple tub of earth, and the water with which it was supplied. So it is with the shells of the earth, the river, and the sea: by processes the nature of which we know nothing, results of the most extraordinary nature and magnitude are brought about. Not only the spined and gaily-painted shell of the coral reef, but the very reef itself, destined at some time to form a home for man, is slowly but surely being built up and massed together by the living labourer, who works by laws far beyond our ken. The eggs of birds, too, are marvellous in their form and colouring, and possess a crust or shell closely resembling that of the shells we have been describing, both in texture and component parts. Dealing with shells and structures allied to them, we can easily pile such beautiful works of an all-wise Creator together, apply fire and reduce them to lime; but with all our boasted skill in science and art, no human power or ingenuity could, from the materials thus formed, cause the building up of that which has been so readily torn down. Pearls, after all, are merely lime which has passed through the laboratory of that most wonderful of chemists, the shell-bearing mollusk. For the early history of English pearls, and the shells which yield them, we must go back to a period when Britain was known to other nations as a mere group of islands vaguely known as the Cassiterides. This supposed group was, no doubt, formed by the Scilly Islands and the projecting land of the coast of Cornwall. This region was probably first discovered by a band of Phœnician voyagers who were dispatched about 600 B.C., by Pharaoh-Necho, king of Egypt (the same who slew Josiah, king of Judah). These bold adventurers were directed to set sail from the Red Sea, to voyage round Africa, and enter the northern seas by the Straits of Hercules, when they were to explore and investigate such countries as they might find, and take note of all valuable productions. On the discovery of the Cassiterides by the Phœnicians, tin and probably pearls formed important objects for commercial enterprises; but the situation of the new treasure-lands was for a long time successfully concealed by the fortunate discoverers. The Romans, however, at length discovered the secret, and there appears little doubt that the glowing accounts given of the fabulous quantities of pearls possessed by the inhabitants of "Baratanac," or Britain, first led Julius Cæsar to plan his second invasion, and decide on its capture and subjugation. That pearls were the great and main attraction is proved by the fact of one of his first offerings to the shrine of Venus Genitrix as a successful conqueror being a shield or buckler covered with pearls from his new possession. Pliny, in writing of this offering, says that the pearls from Britain were of small size, devoid of lustre, and very inferior to those of Eastern origin; Tacitus also speaks of them in much the same terms. It is fair, therefore, to infer that the description of pearl known in those early days was obtained from the common edible mussel (*Mytilus edulis*, the subject of the accompanying illustration, Fig. 4), which is only met with at the mouths of tidal rivers where the water is strongly impregnated with salt, or in the sea itself. An investigation of the contents of these palatable bivalves will often lead to the discovery of small pearls of little or no commercial value. Some years since, when pearls formed an important element in the prescriptions of medical men, they were far more eagerly sought after than now. The common oyster of our coasts is also occasionally found to yield small or seed pearls, which are of value only to the curious. The great silk mussel (*Pinna nobilis*, a representation of which is shown at Fig. 5, on a reduced scale) is the largest bivalve shell found in our seas. It not only produces a tuft or tassel of silk-like material, known as the "byssus," which is at times spun into gloves and stockings, but is often found to contain coloured pearls of considerable value. Some of these are of a steel-grey tint, others are lead-coloured, reddish, and occasionally even black. It is not to this shell, however, that we have to look for the true precious pearl of Britain: that is produced by a shell much larger than the edible mussel, bearing no silk, and dwelling exclusively in running streams of fresh water. The rivers of Wales, Ireland, Germany, and Switzerland have been long celebrated for their pearl mussels. The *Unio margaritiferus*, as it is called by naturalists, represented at Fig. 6 in the accompanying illustration, is the true fresh-water pearl-shell. It has been found measuring five inches and a half in length, and two inches and a half in breadth across the valves; but it is very rarely so large, the great majority of specimens but little exceeding five inches long by about two inches broad. Some curious information relating to Irish pearls was communicated by Sir Robert Redding, through a Dr. Martin Lister, to the *Philosophical Transactions* of 1673. He states that the rivers of Derry, Donegal, Tyrone, Wexford, and Kerry contained the pearl mussels, and that the poor people in the neighbourhood of the streams fished for them during the warm weather preceding harvest, when there was little water flowing, and that they made use of either their toes, wooden tongs, or sharp-pointed sticks for dislodging them from their retreats on the bottom or among the stones. The sharp sticks were, he says, thrust between the open valves of the shells "as they lay in part opened, with the white foot protruded like a tongue out of the mouth." He then states as follows:—"Some gentlemen of the country made great advantage thereof; and I myself, whilst there, saw one pearl bought for fifty shillings that weighed thirty-six carats, and was valued at forty pounds. Everybody abounds with stories of the good pennyworths of the country, but I will add one more. A miller took out a pearl, which he sold for four pounds ten shillings to a man, who sold it for ten pounds, who sold it to the late Lady Glenealy for thirty pounds, with whom I saw it in a necklace. She refused eighty pounds from the late Duchess of Ormond for it."

Scotland, too, particularly in past times, had reason to boast of the importance of her river pearls, the Tay, from Perth to Loch Tay, being one of the richest streams. Captain Brown, in recording the particulars of the Scottish pearl-fishing, says, "The pearls sent from Scotland to London from the years 1761 to 1764 were estimated at ten thousand pounds' value." The Isle of Man, too, has had its river harvest, and a peculiar variety of the unio (*U. roissyi*) was found to produce a very noteworthy number of pearls. The river flowing near Braddon was that most successfully fished. The river Conway, in North Wales, has for ages been known to be one of the chosen homes of the pearl shell, as both the salt-water mussel at the river's mouth, and the unio high up among the brawling rills which ripple among the hazels and yellow furze blossom, bear with them ever and anon the much-coveted treasure. Bettws-y-Coed has, so tradition says, the honour of being the locality near which the bold and handsome Welsh nobleman, Sir Richard Wynne, obtained the rich and costly pearl which he presented to the queen of Charles II. The term "Cregin diluw" has been by the Welsh given to the Conway shells from an idea, which they appear to have entertained, that they were brought to the river at the time of the deluge. The formation of pearls in the tissues of this or any other mollusk can be only viewed in the light of a diseased or abnormal secretion, caused in the majority of cases by the presence of some foreign and irritating cause. Linnæus discovered by actual experiment that grains of sharp sand introduced between the valves of the shell in such a way that they rested between the body of the animal and the "mother-of-pearl," or shell-lining, caused in a short time the deposition of a coating or crust of pearl on the sand grain, which, acting as a nucleus, gathered the shielding matter around it, and so guarded the delicate tissues of the mollusk from friction and injury. It has also been found that by drilling a small hole through the outer coatings of the shell, and leaving the lining untouched by the boring instrument, that a pearl nodule was in a short time formed, as shown in the annexed illustration (Fig. 7), so as to defend the weak point, just as a skilful armourer would patch a weak place in breast or back plate. It is somewhat remarkable that the search for home pearls should be so rarely followed at the present day, as there appears no reason why they should not be found as abundantly as when Sir Robert Redding wrote: speaking of the proportion of prizes to blanks, he says, "Although, by common estimate, not above one shell in a hundred may have a pearl, and of those pearls not above one in a hundred be tolerably clear. Yet a vast number of fair merchantable pearls, and too good for the apothecary, are offered for sale by those people every summer assize."

The streams of Bavaria at the present day produce from time to time pearls well worth obtaining, and about thirty years since a most important find of them was made by mere chance in Norway. An unusually dry summer had caused the waters of the Zeddern Channel to become nearly dry. A peasant who chanced to be wandering about over the shingle and pebbles, seeing a dead and partially dried unio laying in its wide-spread shell, stopped, and picked it up, when, much to his wonder and delight, out rolled a pearl worth £50. Specimens of even greater value than this were soon after discovered by the people, who rushed from far and near to the treasure-yielding sands, which were thoroughly searched until the return of the water to its accustomed level put a stop to the search. A shell closely resembling the *Unio margaritiferus* is to be found in most of the ponds, brooks, and rivers of England; it is known as the "pond mussel," or *Adonta*. A reference to Fig. 8 will at once show the particulars of external form in which the two shells differ. The Adonta, so far as we have observed, yields no pearls, but produces an incredible number of young adontas, which are carried within the parent shell completely valved and ready to shift for themselves when cast on the world of waters. It is said that an American naturalist has succeeded in computing one Adonta family at 600,000 in number. There are many more shell-dwellers interesting in habits and curious in form, and to these we hope to refer in another paper.



1. Lymnea Stagnalis. 2. Triton. 3. Helix Hemastoma. 4. Mytilus Edulis (the Edible Mussel). 5. Pinna Nobilis (the Silk Mussel). 6. Unio Margaritiferus (the Fresh-water Pearl Shell). 7. Damaged Shell Repaired by Pearly Deposit. 8. Adonta (Pond Mussel).

LESSONS IN GREEK.—XXVII.

PARADIGM OF THE REGULAR VERB λυω, *I loose* (MIDDLE *VOICE*).

INDICATIVE MOOD.

Present.—Tense-stem λυ-.	*Imperfect.*—Tense-stem ε-λυ-.
Sing. 1. λυ-ομαι, *I loose myself,* or *am loosed, etc.*	ε-λυ-ομην, *I was loosing myself, etc.*
2. λυ-η.*	ε-λυ-ου.
3. λυ-εται.	ε-λυ-ετο.
Dual. 1. λυ-ομεθον.	ε-λυ-ομεθον.
2. λυ-εσθον.*	ε-λυ-εσθον.
3. λυ-εσθον.*	ε-λυ-εσθην.
Plur. 1. λυ-ομεθα.	ε-λυ-ομεθα.
2. λυ-εσθε.*	ε-λυ-εσθε.
3. λυ-ονται.	ε-λυ-οντο.

Future.—Tense-stem λυ-σ-.

Sing. 1. λυ-σ-ομαι, *I shall loose myself.*

(The Person-endings are like the Present.)

First Aorist.—Tense-stem ε-λυ-σ-.

Sing. 1. ε-λυ-σ-αμην, *I loosed*	*Dual.* 1. ε-λυ-σ-αμεθον.
2. ε-λυ-σ-ω. [*myself.*	2. ε-λυ-σ-ασθον.
3. ε-λυ-σ-ατο.	3. ε-λυ-σ-ασθην.

Plur. 1. ε-λυ-σ-αμεθα. 2. ε-λυ-σ-ασθε. 3. ε-λυ-σ-αντο.

Second Aorist.—Tense-stem ε-λιπ-.

Sing. 1. ε-λιπ-ομην, *I remained behind.*

(Like the Imperfect Indicative.)

SUBJUNCTIVE MOOD.

Present.—Tense-stem λυ-.

Sing. 1. λυ-ωμαι, *I may loose*	*Dual.* 1. λυ-ωμεθον.
2. λυ-η.* [*myself, etc.*	2. λυ-ησθον.
3. λυ-ηται.	3. λυ-ησθον.

Plur. 1. λυ-ωμεθα. 2. λυ-ησθε. 3. λυ-ωνται.

First Aorist.—Tense-stem λυ-σ-.

Sing. 1. λυ-σ-ωμαι, *I may have loosed myself, etc.*
2. λυ-σ-η.* (Like the Subj. Present.)

Second Aorist.—Tense-stem λιπ-.

Sing. 1. λιπ-ωμαι, *I may have remained behind.*

(Like the Subjunctive Present.)

OPTATIVE MOOD.

Imperfect.—Tense-stem λυ-.	*First Aorist.*—Tense-stem λυ-σ-.
Sing. 1. λυ-οιμην, *I might loose myself, etc.*	λυ-σ-αιμην, *I might have loosed myself, etc.*
2. λυ-οιο.	λυ-σ-αιο.
3. λυ-οιτο.	λυ-σ-αιτο.
Dual. 1. λυ-οιμεθον.	λυ-σ-αιμεθον.
2. λυ-οισθον.	λυ-σ-αισθον.
3. λυ-οισθην.	λυ-σ-αισθην.
Plur. 1. λυ-οιμεθα.	λυ-σ-αιμεθα.
2. λυ-οισθε.	λυ-σ-αισθε.
3. λυ-οιντο.	λυ-σ-αιντο.

Future.—Tense-stem λυ-σ-.

Sing. 1. λυ-σ-οιμην, *I would loose myself, etc.*

(The person-endings like the Optative Imperfect.)

Second Aorist.—Tense-stem λιπ-.

Sing. 1. λιπ-οιμην, *I might* or *would, etc.*

(Like the Optative Imperfect.)

IMPERATIVE MOOD.

Present.—Tense-stem λυ-.	*First Aorist.*—Tense-stem λυ-σ-.
Sing. 2. λυ-ου, *loose thou thyself, etc.*	λυ-σ-αι,* *loose thyself, etc.*
3. λυ-εσθω.	λυ-σ-ασθω.
Dual. 2. λυ-εσθον.*	λυ-σ-ασθον.
3. λυ-εσθων.*	λυ-σ-ασθων.*
Plur. 2. λυ-εσθε.*	λυ-σ-ασθε.
3. λυ-εσθωσαν, commonly εσθων.*	λυ-σ-ασθωσαν, commonly ασθων.*

Second Aorist.—Tense-stem λιπ-.

Sing. λιπ-ου, -εσθω, *remain behind.* (Like the Present.)

INFINITIVE MOOD.

Present,	λυ-ε-σθαι, *to loose one's self,* or *to be loosed.*
First Aorist,	λυ-σ-ασ-θαι, *to have loosed one's self.*
Second Aorist,	λιπ-εσθαι, *to have remained behind*

PARTICIPLES.

Present,	λυ-ομενος, *loosing one's self.*
First Aorist,	λυ-σ-αμενος, *having loosed.*
Second Aorist,	λιπ-ομενος, *having remained behind.*

EXERCISE 76.—GREEK-ENGLISH.

1. Λυοιμην. 2. Λυσοιμην. 3. Λυομαι. 4. Λυωμαι. 5. Ελυομην 6. Ελυσαμην. 7. Λυσομαι. 8. Ελιπομην. 9. Λυονται. 10. Ελυοντο. 11. Ελυσαντο. 12. Λυσαισθε. 13. Λιποιμην. 14. Λιπεσθαι. 15. Λιπομενος. 16. Λυσασθαι. 17. Λυεσθαι. 18. Λυομενος. 19. Λυσασθε. 20. Λιπωμαι. 21. Ελυσω. 22. Λυσηται. 23. Λυεσθων. 24. Λυοισθον. 25. Λυομενου. 26. Ελυεσθε. 27. Λυσαμενοι. 28. Λυοιντο. 29. Λυσαιμεθα.

EXERCISE 77.—ENGLISH-GREEK.

1. I might loose myself. 2. He might loose himself. 3. They might loose themselves. 4. To loose one's self. 5. Loosing one's self. 6. Loose yourselves. 7. He would loose himself. 8. Let him loose himself. 9. We may have loosed ourselves. 10. They will loose themselves. 11. He may loose himself. 12. You two might have loosed yourselves. 13. You may have loosed yourself. 14. They remained behind. 15. He may have remained behind. 16. Do ye remain behind. 17. To have loosed one's self.

Conjugate, according to the active and middle paradigms, these verbs:—παιδευω, *I instruct, educate;* βασιλευω, *I reign.* The chief parts are—παιδευω, παιδευσω, πεπαιδευκα, πεπαιδευμαι, and βασιλευω, βασιλευσω, βεβασιλευκα, βεβασιλευμαι.

THE PASSIVE VOICE OF λυω.

(The Present and Imperfect are the same as in the Middle Voice.)

INDICATIVE MOOD.

First Aorist.—Tense-stem ε-λυ-θ-.

Sing. 1. ε-λυ-θ-ην, *I was loosed, etc.*
2. ε-λυ-θ-ης.
3. ε-λυ-θ-η.
Dual. 2. ε-λυ-θ-ητον.
3. ε-λυ-θ-ητην.
Plur. 1. ε-λυ-θ-ημεν.
2. ε-λυ-θ-ητε.
3. ε-λυ-θ-ησαν.

First Future.—Tense-stem λυ-θη-σ-.

Sing. 1. λυ-θη-σ-ομαι, *I shall be loosed, etc.*

(Like the Indicative Present Middle.)

Second Aorist.—Tense-stem ε-τριβ-.

Sing. 1. ε-τριβ-ην, *I was rubbed, etc.*

(Like the Indicative First Aorist Passive.)

Second Future.—Tense-stem τριβ-η-σ-.

Sing. 1. τριβ-η-σ-ομαι, *I shall be rubbed.*

(Like the Indicative First Future Passive.)

Perfect.—Tense-stem λε-λυ-.	*Pluperfect.*—Tense-stem ε-λε-λυ.
Sing. 1. λε-λυ-μαι, *I have been loosed, etc.*	ε-λε-λυ-μην, *I had been loosed, etc.*
2. λε-λυ-σαι.	ε-λε-λυ-σο.
3. λε-λυ-ται.	ε-λε-λυ-το.
Dual. 1. λε-λυ-μεθον.	ε-λε-λυ-μεθον.
2. λε-λυ-σθον.*	ε-λε-λυ-σθον.
3. λε-λυ-σθον.*	ε-λε-λυ-σθην.
Plur. 1. λε-λυ-μεθα.	ε-λε-λυ-μεθα.
2. λε-λυ-σθε.*	ε-λε-λυ-σθε.
3. λε-λυ-νται.	ε-λε-λυ-ντο.

Note that when the tense-ending μαι of the perfect passive is preceded by a consonant the third person plural is supplied, for euphony's sake, by the perfect participle with εισι—for τετυπνται, τετυμμενοι εισι—and in the pluperfect τετυμμενοι ησαν.

Perfect Future, or Third Future.—Tense-stem λε-λυ-σ-.
Sing. 1. λε-λυ-σομαι, *I shall have been loosed.*
(Like the Indicative Present.)

SUBJUNCTIVE MOOD.

	First Aorist.—Tense-stem λυ-θ-.	*Perfect.*—Tense-stem λε-λυ-.
Sing. 1.	λυ-θ-ω, *I may have been loosed, etc.*	λε-λυ-μενος, -ω, *I may have been loosed, etc.*
2.	λυ-θ-ῃς.	λε-λυ-μενος, -ῃς.
3.	λυ-θ-ῃ.	λε-λυ-μενος, -ῃ.
Dual. 2.	λυ-θ-ητον.	λε-λυ-μενω, -ητον.
3.	λυ-θ-ητον.	λε-λυ-μενω, -ητον.
Plur. 1.	λυ-θ-ωμεν.	λε-λυ-μενοι, -ωμεν.
2.	λυ-θ-ητε.	λε-λυ-μενοι, -ητε.
3.	λυ-θ-ωσι.	λε-λυ-μενοι, -ωσι.

Second Aorist.—Tense-stem τριβ-.
Sing. 1. τριβ-ω, *I may be rubbed.*
(Like the Subjunctive First Aorist Passive.)

OPTATIVE MOOD.

	First Aorist.—Tense-stem λυ-θ-.	*Perfect.*—Tense-stem λε-λυ-.
Sing. 1.	λυ-θ-ειην, *I might have been loosed, etc.*	λε-λυ-μενος, -ειην, *I might have been loosed, etc.*
2.	λυ-θ-ειης.	λε-λυ-μενος, -ειης.
3.	λυ-θ-ειη.	λε-λυ-μενος, -ειη.
Dual. 2.	λυ-θ-ειητον.	λε-λυ-μενω, -ειητον.
3.	λυ-θ-ειητην.	λε-λυ-μενω, -ειητην.
Plur. 1.	λυ-θ-ειημεν.	λε-λυ-μενοι, -ειημεν.
2.	λυ-θ-ειητε.	λε-λυ-μενοι, -ειητε.
3.	λυ-θ-ειεν.	λε-λυ-μενοι, -ειησαν.

First Future.—Tense-stem λυ-θη-σ-.
Sing. 1. λυ-θη-σ-οιμην, *I would be loosed.*
(Like the Optative Imperfect Middle.)

Second Aorist.—Tense-stem τριβ-.
Sing. 1. τριβ-ειην, *I would be rubbed.*
(Like the Optative First Aorist Passive.)

Second Future.—Tense-stem τριβ-η-s-.
Sing. 1. τριβ-η-σ-οιμην, *I would be rubbed.*
(Like the Optative First Future Passive.)

Perfect Future, or Third Future.—Tense-stem λε-λυ-σ-.
Sing. 1. λε-λυ-σ-οιμην, *I would have been loosed.*
(Like the Optative Imperfect.)

IMPERATIVE MOOD.

	First Aorist.—Tense-stem λυ-θ-.	*Perfect.*—Tense-stem λε-λυ-.
Sing. 2.	λυ-θ-ητι, *be thou loosed, etc.*	λε-λυ-σο.
3.	λυ-θ-ητω.	λε-λυ-σθω.
Dual. 2.	λυ-θ-ητον.	λε-λυ-σθον.*
3.	λυ-θ-ητων.	λε-λυ-σθων.*
Plur. 2.	λυ-θ-ητε.	λε-λυ-σθε.*
3.	λυ-θ-ητωσαν.	λε-λυ-σθωσαν, commonly -σθων.*

Second Aorist.—Tense-stem τριβ-η.
Sing. 1. τριβ-η-θι, *be thou rubbed.*
(Like the Imperative First Aorist Passive.)

INFINITIVE MOOD.

First Aorist.	λυ-θ-ηναι, *to have been loosed.*
First Future.	λυ-θη-σ-εσθαι, *to be about to be loosed.*
Second Aorist.	τριβ-ηναι, *to have been rubbed.*
Second Future.	τριβ-η-σεσθαι, *to be about to be rubbed.*
Perfect.	λε-λυ-σθαι, *to have been loosed.*
Perfect Future, or Third Future.	λε-λυ-σ-εσθαι, *to be about to be loosed.*

PARTICIPLES.

First Aorist.	λυ-θ-εις, *having been loosed.*
First Future.	λυ-θη-σ-ομενος, *being about to be loosed.*
Second Aorist.	τριβ-εις, *having been rubbed.*
Second Future.	τριβ-η-σ-ομενος, *being about to be rubbed.*
Perfect.	λε-λυ-μενος, *having been loosed.*
Perfect Future, or Third Future.	λε-λυ-σ-ομενος, *being about to be loosed.*

VERBAL ADJECTIVES.

λυτος, *loosed.* λυτεος, *one who ought to be loosed.*

EXERCISE 78.—GREEK-ENGLISH.

1. Ετριβη. 2. Τριβῃ. 3. Τριβειης. 4. Τριβειη. 5. Λυθειητην. 6. Λυθειεν. 7. Λυθητω. 8. Λυθηναι. 9. Λυθησομενος. 10. Τριβηναι. 11. Τριβησομενος. 12. Ελυθης. 13. Ελυθητε. 14. Λυθησῃ. 15. Λυθωμεν. 16. Λυθειημεν. 17. Λυθωσι. 18. Λυθεις. 19, Λυθησεσθαι. 20. Τριβεις. 21. Τριφηθητω. 22. Λελυμαι. 23. Ελελυμην. 24. Λελυσομαι. 25. Λελυνται. 26. Ελελυντο. 27. Λελυμενος ειης.

EXERCISE 79.—ENGLISH-GREEK.

1. He was loosed. 2. He may have been loosed. 3. He might have been loosed. 4. He shall be rubbed. 5. They shall be loosed. 6. He was rubbed. 7. I have been loosed. 8. Thou mayest have been loosed. 9. They shall have been loosed.

Of the participles in the middle and passive voice, those which end in ος (μενος) are declined like αγαθος, -η, -ον. Of those which end in εις, take the following as a model :—

DECLENSION OF λυθεις, λυθεισα, λυθεν, *loosed.*

	MASC.	FEM.	NEUT.
	Singular.		
Nom.	λυθεις,	λυθεισα,	λυθεν.
Gen.	λυθεντος,	λυθεισης,	λυθεντος.
Dat.	λυθεντι,	λυθεισῃ,	λυθεντι.
Acc.	λυθεντα,	λυθεισαν,	λυθεν.
	Dual.		
Nom. and Acc.	λυθεντε,	λυθεισα,	λυθεντε.
Gen. and Dat.	λυθεντοιν,	λυθεισαιν,	λυθεντοιν.
	Plural.		
Nom.	λυθεντες,	λυθεισαι,	λυθεντα.
Gen.	λυθεντων,	λυθεισων,	λυθεντων.
Dat.	λυθεισι,	λυθεισαις,	λυθεισι.
Acc.	λυθεντας,	λυθεισας,	λυθεντα.

PERSONAL ENDINGS OF THE MIDDLE VOICE.

	PRINCIPAL TENSES.			HISTORICAL TENSES.		
	1st Pers.	*2nd Pers.*	*3rd Pers*	*1st Pers.*	*2nd Pers.*	*3rd Pers.*
Sing.	-μαι,	-σαι,	-ται.	-μην,	-σο,	-το.
Dual.	-μεθον,	-σθον,	-σθον.	-μεθον,	-σθον,	-σθην.
Plur.	-μεθα,	-σθε,	-νται.	-μεθα,	-σθε,	-ντο.

KEY TO EXERCISES IN LESSONS IN GREEK.—XXVI.

EXERCISE 74.—GREEK-ENGLISH.

1. Loosing. 2. To be about to loose. 3. He is loosing. 4. I have loosed. 5. I had loosed. 6. I shall loose. 7. Ye two would loose. 8. Thou wouldest loose. 9. Let him loose. 10. Loose ye. 11. I was loosing. 12. He shall loose. 13. We are loosing. 14. Ye two were loosing. 15. I might loose. 16. I loosed. 17. He has loosed. 18. He loosed. 19. I might have loosed. 20. Loose thou. 21. Let them two loose (aor.). 22. Having loosed. 23. I may have loosed. 24. Thou hast loosed. 25. They had loosed. 26. They loosed. 27. They have loosed. 28. Ye might have loosed. 29. Thou mayest have loosed. 30. Thou hast appeared. 31. Thou didst leave. 32. Thou mayest have left. 33. Thou mightest have left. 34. Let him leave. 35. Having left. 36. To have appeared. 37. Thou hadst appeared. 38. He might have appeared. 39. He might loose. 40. They might loose.

EXERCISE 75.—ENGLISH-GREEK.

1. Πεφηνα. 2. Ελιπετην. 3. Λειποι. 4. Λειποιτε. 5. Λυουσι. 6. Λυωσι. 7. Λυοιεν. 8. Λυσαιτε. 9. Λυε. 10. Λυοντων. 11. Λελυκα. 12. Λυσετε. 13. Λυσωσι. 14. Λυσεις. 15. Λυειν. 16. Λυσειν. 17. Λυσων. 18. Λυσας. 19. Λυῃ. 20. Ελελυκειτην. 21. Λυοιτην. 22. Λυητον. 23. Πεφηνασι. 24. Πεφηνατον. 25. Πεφηνε.

LESSONS IN ALGEBRA.—XVI.

SOLUTION OF PROBLEMS.

170. For the solution of problems in Simple Equations, we derive from the preceding principles the following general rule :—

RULE.—1. *Translate the statement of the question from the ordinary language into algebraic language, in such a manner as to form an equation ; that is, put the question into the form of an equation.*

2. *Clear the equation of fractions by multiplying every term in both members by all the denominators successively, or by their least common multiple.*

3. *Transpose all the terms containing the unknown quantity to*

the one side of the equation, and all the known quantities to the other, taking care to change the signs of the terms transposed, and incorporate the terms that are alike.

4. *Remove the co-efficient of the unknown quantity, by dividing all the terms in the equation by it; the result will be the solution required.*

PROOF.—*Substitute the value of the unknown quantity for the letter which stands for it in the equation; and if the number satisfies the conditions of the question, it is the answer sought.*

PROBLEM 1.—A man being asked how much he gave for his watch, replied: If you multiply the price by 4, to the product add 70, and from this sum subtract 50, the remainder will be equal to 220 pounds.

In order to solve this question, we must first translate the conditions of the problem into such an algebraic expression as will form an *equation.*

Let x be the price of the watch.

This price is to be multiplied by 4, which makes $4x$; to the product 70 is to be added, making $4x + 70$; from this, 50 is to be subtracted, making $4x + 70 - 50$.

Here we have a number of the conditions, expressed in algebraic terms; but we have as yet no *equation.* We must observe, then, that by the last condition of the problem, the preceding terms are said to be *equal* to 220.

We have, therefore, this equation, $4x + 70 - 50 = 220$; which reduced, gives $x = 50$. *Ans.*

Here the value of x is found to be 50 pounds, which is the price of the watch.

PROOF.—The original equation is $4x + 70 - 50 = 220$; substituting 50 for x, it becomes $4 \times 50 + 70 - 50 = 220$; that is, $220 = 220$.

PROBLEM 2.—What number is that to which, if its half be added, and from the sum 20 be subtracted, the remainder will be a fourth of the number itself?

In stating questions of this kind, where fractions are concerned, it should be recollected that $\frac{1}{3}x$ is the same as $\frac{x}{3}$; that $\frac{2}{5}x = \frac{2x}{5}$, etc.

Let x be the number required.

Then by the conditions, we have $x + \frac{x}{2} - 20 = \frac{x}{4}$, and reducing the equation, we have $x = 16$. *Ans.*

PROOF.—Thus $16 + \frac{16}{2} - 20 = \frac{16}{4}$.

PROBLEM 3.—A father divides his estate among his three sons in such a manner, that the first has £1,000 less than the whole; the second has £800 less than one-third of the whole; the third has £600 less than one-fourth of the whole. What is the value of the estate? *Ans.* £$4{,}114\frac{2}{7}$.

PROBLEM 4.—Divide 48 into two such parts, that if the less be divided by 4, and the greater by 6, the sum of the quotients will be 9.

Let x be the smaller part; then $48 - x$ is the greater part; and, by the conditions of the problem, we have $\frac{x}{4} + \frac{48 - x}{6} = 9$. Whence $x = 12$; therefore, 12 is the less part, and 36 the greater part.

171. Letters may be employed to express the *known* quantities in an equation, as well as the unknown. A particular value is assigned to the letters, when they are introduced into the calculation; and at its close, the numbers are restored.

EXAMPLE.—If to a certain number 720 be added, and the sum be divided by 125, the quotient will be equal to 7392 divided by 462. What is the number?

Let x be the number required; and let $a = 720$, $b = 125$, $d = 7392$, and $h = 462$.

Then, by the conditions of the problem, we have $\frac{x + a}{b} = \frac{d}{h}$; and reducing, we have $x = \frac{bd - ah}{h}$.

Restoring the numbers, we have $x = \frac{(125 \times 7392) - (720 \times 462)}{462} = 1280$.

EXERCISE 29.—MISCELLANEOUS PROBLEMS IN SIMPLE EQUATIONS.

1. Divide 11 into two parts, such that the sum of twice the first and half the second may be 16.

2. Divide 39 into four parts, such that if the first be increased by 1, the second diminished by 2, the third multiplied by 3, and the fourth divided by 4, the results may be all equal.

3. If a certain number is divided by 12, the quotient, dividend, and divisor, added together, will amount to 64. What is the number?

4. An estate is divided among four children, in such a manner that the first has £200 more than $\frac{1}{4}$ of the whole, the second has £340 more than $\frac{1}{5}$ of the whole, the third has £300 more than $\frac{1}{6}$ of the whole, the fourth has £400 more than $\frac{1}{8}$ of the whole. What is the value of the estate?

5. What is that number which is as much less than 500, as a fifth part of it is greater than 40?

6. There are two numbers whose difference is 40, and which are to each other as 6 to 5. What are the numbers?

7. Suppose two coaches to start at the same hour, one from London for Glasgow, and the other from Glasgow for London, the former travelling $10\frac{1}{2}$ and the latter $9\frac{1}{2}$ miles per hour. Where will they meet, the distance between the two cities being 400 miles?

8. Suppose everything to be as in the last qnestion, except that the coach from Glasgow starts two hours earlier than the other. Where will they meet?

9. A dealer purchases 60 yards of cloth for £30; and by selling one part of it at 12s., another, twice as great, at 14s., and the rest at 10s. per yard, he gains £8. How many yards were in the several lots?

10. Suppose two dealers each annually to double his capital, except an expenditure of £100; and that at the end of three years the capital of one is found to be doubled, while the other has only half what he had at first. How much had each to commence with?

11. If a person each year double his capital, except an expenditure of £300 the first year, £400 the next year, and £500 the third, and at the end of three years be found to be worth £5,500, what was his original capital?

12. A father's age is now treble of his son's, while five years ago it was quadruple. What are their present ages?

13. Divide £1,000 between A, B, and C, giving A £100 more, and B £50 less, than C.

14. A spirit merchant finds that if he add 10 gallons to a cask of brandy, the mixture will be worth 21s. per gallon; but that if he had ten gallons more, the value will be reduced to 18s. How many gallons were in the cask?

15. Find a number, such that if it be divided successively by 2, 3, 4, 5, 6, 7, 8, 9, and 10, half the sum of the first four quotients increased by 20 shall be equal to the sum of the remaining five.

16. Find two numbers differing by 6, and such that three times the less may exceed twice the greater by 7.

17. Find a number, such that if it be increased successively by 1, 2, and 3, the sum of one-half of the first result and one-third of the second shall exceed one-fourth of the third by 8.

LESSONS IN ITALIAN.—XIV.

EXERCISES FOR PRACTICE.

WE resume in this lesson our series of exercises which will afford the student sufficient practice in translating simple sentences in Italian into English, and turning English into Italian. The copious vocabularies will afford the learner a useful opportunity of storing his mind and memory with Italian words.

VOCABULARY.

***Anche*, also.**	*E's-so*, m., *ès-sa*, f., he, she, it (of persons and things).	*L' o-ro-lô-gio*, the watch or clock.
Che, who, whom, that, which.	*Il cap-pêl-lo*, the hat.	*Ma*, but.
Dó-ve, where.	*Il ca-vál-lo*, the horse.	*Mól-to*, very.
E-gli, he.	*Il fan-ciúl-lo*, the child.	*Per*, for.
E'l-la, she, it (in reference to a feminine noun).	*Il tem-pe-rí-no*, the penknife.	*Per-dú-to*, lost.
		Tro-vá-to, found.

EXERCISE 8.—COLLOQUIAL.

1. Mí-o pá-dre è buô-no; é-gli ha án-che un buôn fra-têl-lo. 2. Mí-a má-dre è buô-na; él-la ha án-che ú-na buô-na so-rêl-la. 3. Ab-biá-mo ve-dú-to vô-stro zí-o; é-gli ha com-prá-to un gran lí-bro. 4. A-vé-te vôi ve-dú-to il nô-stro giar-dí-no? és-so è mól-to grán-de. 5. Hô com-prá-to ú-na pén-na; és-sa è mól-to

buô-na. 6. Il tú-o lí-bro ò píc-co-lo, ma és-so ò buô-no. 7. Ab-biá-mo un pá-dre che ò buô-no. 8. A-vé-te ú-na má-dre che ò buô-na. 9. Hô un lí-bro che ò mól-to píc-co-lo. 10. Mí-a so-rêl-la ha ú-na pén-na che ò mól-to grán-de. 11. Il lí-bro che a-vé-te com-prá-to ò buô-no. 12. Il giar-dí-no che ab-biá-mo ve-dú-to ò mól-to grán-de. 13. Hai tu ve-dú-to il lí-bro che mí-o zí-o ha com-prá-to? 14. Il lí-bro che vô-stro zí-o ha com-prá-to ò mól-to píc-co-lo, ma és-so ò buô-no. 15. Hô án-che com-prá-to un lí-bro, ma és-so ò grán-de.

Vocabulary.

April, *A-prí-le.*
Asks for, *do-mán-da.*
Ball, *bál-lo.*
Bread, *pá-ne*, m.
Button, *bot-tó-ne.*
By, *per.*
Changeable, *va-riá-bi-le.*
City, *cit-tá.*
Cloth, *pán-no*, m.
Coffee, *caf-fè*, m.
December, *De-cêm-bre.*
Dozen, *doz-zí-na* (ds), f.
Dress, *á-bi-to.*
Eat, *man-giá-te.*
Find me, *cer-cá-te-mi.*
Finish drinking, *fi-ní-te di bé-re.*
Glass, *bic-chié-re*, m.
Half an ounce, *méz-za ón-cia*, f.
He had given him, *gli fú-ro-no as-se gná-te.*
Hour, *ó-ra*, f.
I come, *vên-go.*
I shall return, *ri-tor-ne-rò* (pron. *ri-tor-ne-ró*)
January, *Gen-ná-jo.*
Loaf, *pá-ne*, m.
London, *Lón-dra.*
Map, *cár-ta geo-grá-fi-ca*, f.
Master, *pa-dró-ne*, m.
May, *Mág-gio.*
Month, *mé-se*, m.
Nine, *nó-ve.*
On the contrary, *all' in-cón-tro.*
Order, *ór-di-ne*, m.
Paris, *Pa-rí-gi.*
Performance (*i.e.*, comedy), *com-mé-dia*, f.
Pleasant, *a-mé-no.*
Pound, *líb-bra*, f.
Preparation, *pre-pa-ra-zi-óne*, f.
Quarter, *quár-to.*
Room, *cá-me-ra*, f., *sót-to*, below, underneath.
Roughest, *il più rí-gi-do.*
Send for, *man-dá-te a prén-de-re.*
Silk, *sé-ta*, f.
Small crust, *cro-stí-no*, m.
Sugar, *zúc-che-ro* (ts), m.
Tailor, *sar-tó-re*, m.
Take, *pren-dé-te.*
That are to be made, *che si fác-cia-no.*
To-morrow, *giór-no di do-má-ni.*
To-morrow, *do-má-ni.*
To tell you, *a dír-vi.*
Two, *dú-e.*
Very, *mól-to.*
Were you, *sié-te stá-ti.*
What, *che.*
Will you put on, *met-te-ré-te.*
Wine, *ví-no*, m.
Yard, *brác-cio*, m. (pl. *le brác-cia*, f.)
Year, *án-no* (with the genitive.)
Yesterday, *jé-ri.*

Exercise 9.

1. The tailor asks for nine yards of cloth, two dozen of buttons, and half an ounce of silk. 2. Send for a loaf of sugar and two pounds of coffee. 3. I shall return in a quarter of an hour. 4. Finish this glass of wine, and eat this small crust of bread. 5. Take the map and find me the city of Paris and the city of London. 6. I come by order of the master to tell you that the preparations for to-morrow are to be made. 7. The month of April is changeable; the month of May, on the contrary, is very pleasant. 8. The months of December and January are the roughest in the year. 9. What dress will you put on for the ball of to-morrow? 10. Were you at the performance of yesterday? 11. He had given him the lower rooms.

Vocabulary.

Abbigliamento, ornament, dress, fitting out, equipment.
Abilità, ability.
Acciajo, steel.
Acqua, water.
Affare, affair, business; station of life, condition, rank (*uomo di grand' affare*, a man of consequence or importance; a very able or clever man; a man of superior genius or talents).
Altrettanto, as much again.
Anno, year.
Argento, silver.
Arte, art.
Barca, barge, boat (*ponte di barche*, pontoon).
Basso, m., *bassa*, f., low.
Bello, beautiful, fine.
Briccone, rogue, scoundrel.
Campo, camp.
Cannone, cannon.*
Cappello, hat.
Carattere, character; handwriting, hand (*caratteri*, pl., types, letters).
Cattivo, m., *cattiva*, f., bad, wicked.
Certificato, certificate.
Chiaro, light, brightness, shining.
Colpo, blow, stroke.
Commedia, a comedy, play.
Condotta, f., conduct, behaviour.
Confine, *confino*, confines, frontier.
Corte, court (*uomo di corte*, courtier, formerly the court's fool).
Cosa, f., thing, matter.
Cotone, cotton (*filatojo di cotone*, cotton-mill or manufactory).
Cuore, heart.
Decreto, decree.
Diavolo, devil.
Dolce, sweet, gentle, soft.
Domani, to-morrow.
Drittaccio (for *dirittaccio*), arrant knave or sly fox.
Duro, m., *dura*, f., hard, obstinate.
È, is.
Entro, within.
Estrazione, f., extraction, descent.
Fa, it is, there is.
Fede, faith, fidelity.
Femmina, female.
Ferro, iron.
Festa, feast, festival, festivity.
Fiera, fair (for merchants).
Filatojo, spinning-wheel, spinning-mill or manufactory.
Filo, thread, wire.
Fino, m., *fina*, f., fine, thin, delicate.
Fiore, flower, bloom, prime; the most excellent or valuable part of anything; model, standard.
Fonderia, foundry.
Francoforte, Frankfort.
Galante, polite, civil; obliging, kind; gentleman-like; love-making, amorous, gallant (*gallant' uomo*, an upright, honest man; a man of honour, a perfect gentleman).
Garbo, pleasing address, gentility, politeness, (*uomo di garbo*, a polite man; also an honest man).
Giona, Jonas.
Giorno, day.
Giuda, Judas.
Grande, great.
Grido, cry, reputation, report (*uomo*, *medico di grido*, celebrated man, physician).
Guanto, glove.
Guerra, f., war.
Guglielmo, William.
Imperatore, emperor.
Importanza, importance.
Inghilterra, England.
Inspettore, inspector.
Italia, Italy.
Jeri, yesterday.
Legge, law.*
Lettera, letter (*uomo di lettere*, learned man, scholar).
Luna, moon.
Macigno, sandstone, mill-stone, stone.
Malattia, disease, illness, malady.
Male, ill, badly.
Medico, physician.
Mese, month.
Mezzo, m., *mezza*, f., (ds),† middle.
Miniera, mine.
Mondo, world.
Nome, name.
Nomina, designation to office, appointment, nomination (*decreto di nomina*, diploma, commission).
Occhio, eye (*colpo d' occhio*, sight, view, prospect, instead of *ve-dú-ta*).
Oggi, to-day.
Oggi giorno, now-a-days.
Origine, origin, descent, birth.
Oro, gold.
Otto, eight.
Paglia, straw.
Pelle, f., skin, hide, pelt, leather.
Permesso, *congedo*, permission, leave (of absence), discharge.
Persona, person.
Piacere, pleasure (*campo di piacere*, military encampment for the diversion of the prince).
Poco, m., *poca*, f., little, small, few.
Ponte, bridge.
Poverino, poor, unfortunate.
Prodigio, prodigy, miracle.
Progetto, project, plan.
Quattro, four.
Quello, that.
Questo, this.
Reputazione, reputation, fame.
Russia, Russia.
Salute, f., health.
Sassonia, Saxony.
Sciocco, fool, blockhead.
Servo, servant.
Sette, seven.
Settimana, week.
Sì, so.
Soldato, soldier.
Soprannome, surname, family name.
Sopranominato, surnamed.
Spada, sword.
Squillo, sound.
Stato, state.
Stiria, Styria.
Tabacchiera, snuff-box.
Taddeo, Thaddeus.
Taglia, size, stature, shape, figure, waist.
Talento, talent, inclination, propensity, bent, bias, will (*mal talento*, malignity, maliciousness, malice, malevolence; *uomo di mal talento*, ill-natured man).
Tanto, so much.
Teatro, theatre.
Tempra, temper.
Termine, space or point of time, period, term.
Testa, f., head.
Tintore, dyer.
Tocco, piece.‡
Torniajo, turner.
Tre, three.
Trenta, thirty.
Tromba, trumpet.
Unito, united.
Uno, one.
Uomo, man.
Vaso, vessel, vase.
Velluto, velvet.
Venti, twenty.
Vestito, dress.
Vino, wine.
Vostro, your.

Exercise 10.

1. Ta-bac-chiê-ra d' ô-ro. 2. Un vá-so d' ar-gên-to. 3. Ve-stí-to di vel-lú-to. 4. Ví-no d' I-tá-lia. 5. Un cuôr di ma-cí-gno. 6. Il fí-lo di fèr-ro. 7. Guán-ti di pêl-le fí-na. 8. Cap-pêl-lo di pá-glia. 9. U'-na mi-niê-ra d' ô-ro, d' ar-gên-to. 10. Ac-ciá-jo d' In-ghil-têr-ra. 11. Fèr-ro di Stí-ria. 12. Fiê-ra di Fran-co-fôr-te. 13. La fê-sta di do-má-ni. 14. Il giór-no d' ôg-gi. 15. La com-mê-dia di jê-ri. 16. Il teá-tro d' ôg-gi giór-no. 17. U'-na ma-lat-tí-a di quát-tro set-ti-má-ne. 18. Il ví-no di ôt-to, di vén-ti án-ni. 19. La guêr-ra di sêt-te án-ni. 20. Un bêl cól-po d' ôc-chio. 21. Lo squíl-lo dél-la tróm-ba. 22. U'-na per-só-na di fé-de. 23. E'-gli è di tê-sta dú-ra. 24. Uô-mo di cór-te, di món-do. 25. Uô-mo di lêt-te-re, di dól-ce têm-pra. 26. Uô-mo di grand' af-fá-re, di gár-bo. 27. Uô-mo di cat-tí-va con-dót-ta. 28. Uô-mo di grán-de a-bi-li-tà, di gran re-pu-ta-zió-ne. 29. Uô-mo di mêz-za tá-glia. 30. Uô-mo di mal ta-lên-to, di spá-da, di guêr-ra. 31. Uô-mo di bás-sa e-stra-zió-ne. 32. Uô-mo di pô-ca sa-lú-te. 33. La cô-sa è di grán-de im-por-tán-za. 34. Un mê-di-co di grí-do. 35. L' ár-te del tor-ni-á-jo, del tin-tó-re. 36. La fon-de-rí-a de' ca-rát-te-ri. 37. Cám-po di pia-cé-re. 38. Fi-la-tó-jo di co-tó-ne. 39. Pón-te di bár-che. 40. In-spet-tó-re dél-la fon-de-rí-a de' can-nó-ni. 41. L' ab-bi-glia-mén-to dei sol-dá-ti. 42. Pro-gêt-to di lég-ge. 43. Il de-cré-to di nô-mi-na. 44. Cer-ti-fi-cá-to d' o-rí-gi-ne. 45. Sta-ti u-ní-ti d' A-mê-ri-ca. 46. L' Im-pe-ra-tó-re dél-le Rús-sie. 47. I

* *Can-nó-ne*, cannon, piece of ordnance, and *cá-no-ne*, rule, precept; canon (in ecclesiastical affairs and in music).

* *Lég-ge*, law, and *lég-ge*, he reads.

† The student must bear in mind the difference of pronunciation and meaning between these two words: *méz-zo* (ts), dough-like, over-ripe, shrivelled (of fruit), and *méz-zo* (ds) middle, half, the centre, the middle, means, mediation.

‡ *Tóc-co*, touch; blow with a hammer, stroke of a clock; and *tóc-co*, toque, a kind of bonnet; piece, bit.

con-fí-ni dél-la Sas-sô-nia. 48. E'n-tro il têr-mi-ne di tre mé-si. 49. Un pro-dí-gio di uô-mo. 50. Un uô-mo di trén-ta. 51. Il fiór di ga-lánt' uô-mi-ni. 52. Quél-lo sciôc-co di vô-stro sêr-vo. 53. Qué-sto diá-vo-lo di fém-mi-na. 54. Quel drit-tác-cio di Gu-gli-êl-mo. 55. Tôc-co di bric-cô-ne! 56. Quel po-ve-rí-no di mí-o fra-têl-lo! 57. Tán-to di ví-no ed al-tret-tán-to d' á-cqua. 58. Fa un sì bêl chiá-ro di lú-na. 59. U'-no di nó-me Giô-na. 60. Giú-da di so-pran-nó-me (so-pran-no-mi-ná-to) Tad-dê-o. 61. Per-més-so (con-gê-do) di tre mé-si.

VOCABULARY.

Bêl-lo, m., *bêl-la*, f., beautiful, handsome.	*La car-rôz-za* (ts), coach, carriage.	*L' o-ste-rí-a*, inn, hotel, tavern, public-house.
Gran-dís-si-mo, m., *gran-dís-si-ma*, f., very great.	*La cúf-fia*, cap, coif, hood (particularly for women).	*Qué-sto*, m., *qué-sta*, f., this.
Il fí-glio, the son.	*La fí-glia*, the daughter.	*Ri-ce-vú-to*, received, got.
Il man-têl-lo, the cloak.	*La lêt-te-ra*, the letter.	*Scrít-to*, written.
Il re-gá-lo, the present, gift.	*La ta-bac-chiê-ra*, snuff-box.	*Sú-o*, m., *sú-a*, f., his, her, its.
L' a-nêl-lo, ring.	*L' om-brêl-la*, umbrella.	*Ven-dú-to*, sold.

EXERCISE 11.—COLLOQUIAL.

1. Qué-sto ca-vál-lo è bêl-lo. 2. Qué-sta ta-bac-chiê-ra è mól-to píc-co-la. 3. Quest' o-ste-rí-a è grán-de. 4. Qué-sto fan-ciúl-lo è mí-o fra-têl-lo. 5. Qué-sto lí-bro è per mí-o pá-dre. 6. Qué-sto tem-pe-rí-no è per mí-o fra-têl-lo. 7. Hô tro-vá-to un' a-nêl-lo. 8. Dó-ve a-vé-te vói tro-vá-to quést' a-nêl-lo? 9. La vô-stra píc-co-la so-rêl-la ha un bêl lí-bro. 10. Mí-a má-dre ha com-prá-to qué-sto cap-pêl-lo. 11. Tú-o fra-têl-lo ha ve-dú-to qué-sta bêl-la car-rôz-za. 12. Il vô-stro píc-co-lo fra-têl-lo è un buôn fan-ciúl-lo. 13. Dó-ve hai tu com-prá-to qué-sta ta-bac-chiê-ra? 14. Quést' o-ro-lô-gio è mól-to buô-no. 15. Qué-sto bêll' a-nêl-lo è per qué-sto fan-ciúl-lo. 16. Mí-o zí-o ha un fí-glio ed ú-na fí-glia. 17. Hô ve-dú-to tú-o fra-têl-lo e tú-a so-rêl-la. 18. Ab-biá-mo ri-ce-vú-to un re-gá-lo. 19. A-vé-te vói scrít-to ú-na lêt-te-ra? 20. Mí-a so-rêl-la ha ri-ce-vú-to ú-na bêl-la cúf-fia. 21. Hô ven-dú-to la mí-a car-rôz-za. 22. Hai tu án-che ven-dú-to la tú-a car-rôz-za? 23. Qué-sto re-gá-lo è per vô-stra zí-a. 24. Vô-stro fí-glio è mól-to píc-co-lo, ma é-gli è buô-no. 25. Mí-a fí-glia è gran-dís-si-ma. 26. Qué-sto pá-dre ha ú-na bêl-la fí-glia. 27. Qué-sto fan-ciúl-lo è mí-o fí-glio. 28. Il giar-dí-no che hô ve-dú-to è gran-dís-si-mo. 29. Mí-o pá-dre ha per-dú-to il sú-o cap-pêl-lo e la sú-a om-brêl-la. 30. Nô-stro zí-o ha vend-dú-to la sú-a bêl-la car-rôz-za. 31. Mí-a so-rêl-la ha tro-vá-to il sú-o a-nêl-lo. 32. Qué-sto pá-dre ha per-dú-to sú-a fí-glia. 33. Qué-sta má-dre ha per-dú-to sú-o fí-glio. 34. Mí-o zí-o ha com-prá-to ú-na cúf-fia per la sú-a píc-co-la fí-glia. 35. Qué-sto re-gá-lo è per mí-a so-rêl-la. 36. Qué-sto fan-ciúl-lo ha scrít-to ú-na gran-dís-si-ma lêt-tera per sú-a má-dre. 37. Nô-stra zí-a ha com-prá-to un bel-lís-simo man-têl-lo per sú-o fí-glio. 38. A-vé-te vói tro-vá-to un' a-nêl-lo? 39. Mí-o zí-o ha per-dú-to il sú-o man-têl-lo.

KEY TO EXERCISES IN LESSONS IN ITALIAN—XIII.

EXERCISE 4.

1. The memory. 2. Of the face. 3. To the hill. 4. From the esplanade. 5. The slaughter-houses. 6. Of the inns. 7. To the doors. 8. From the streets. 9. To one's face. 10. In the vineyard. 11. In the forests. 12. With straw. 13. With the vine. 14. With the pens. 15. Through misfortune. 16. By the valley. 17. For the follies. 18. Upon the carriage. 19. On the rocks. 20. The dawn. 21. Of the joy. 22. To the opinion. 23. From the tavern. 24. The ideas. 25. Of the herbs. 26. To the arts. 27. From the city. 28. In sledges. 29. In the imagination. 30. In the minds. 31. With water. 32. With the nail. 33. With the standards. 34. For friendship. 35. For security. 36. By the actions. 37. On the salad. 38. Upon the iron bars. 39. A child. 40. A fool. 41. An animal. 42. A week. 43. Of a river. 44. To a fusileer. 45. From a dancer. 46. In a church. 47. With a stick. 48. For a scholar. 49. On a rock; upon a stone.

EXERCISE 5.

1. I have a book and a pen. 2. Thou hast a good book and a good pen. 3. I have a good brother. 4. Thou hast a good sister. 5. I have a large book; my sister has also a large book. 6. My brother has a little pen. 7. Hast thou a sister? 8. I have a sister and a brother. 9. Hast thou my pen? 10. I have thy book and thy pen. 11. We have a good father and a good mother. 12. We have also a good brother and a good sister. 13. The garden is large. 14. I have a little book. 15. Hast thou also a book? 16. We have a large garden. 17. My little brother has a good book. 18. My little sister has also a good book. 19. We have a large book and a small pen. 20. You have a good father and a good mother. 21. Have you also a brother? 22. I have a book. 23. I have bought a good book. 24. We have seen a large garden. 25. My brother has also seen a large garden. 26. I have bought a pen. 27. Hast thou bought a good pen? 28. Hast thou seen my book? 29. I have seen thy book and thy pen. 30. Have you seen my little sister? 31. My father has bought a garden. 32. Thy sister has bought a little book.

EXERCISE 6.

1. L' ipocrosia è un omaggio che il vizio rende alla virtu. 2. La natura non domanda che il necessario. 3. La ragione vuole l' utile, l' amor proprio cerca il dilettevole, la passione esige il superfluo. 4. Gli alberi grandi danno più ombra che frutto. 5. Iddio è il Padre degli uomini e il Conservatore delle creature. 6. Le stelle del cielo, gli uccelli dell' aria, i pesci del mare, le piante, gli animali sono le opere del Signore. 7. Lo scopo della creazione è infinito, l' ingegno dell' uomo è debile. 8. La sapienza di Dio è come la luce del cielo. 9. L'ordine, la bellezza e la giocondità del mondo sono le prove manifeste d' un Essere supremo. 10. L' eccesso delle passioni è ordinariamente la cagione dell' infelicità degli uomini. 11. Le agitazioni dell' ira, dell' invidia e dell' orgoglio sconcertano violentemente l' equilibrio de' fluidi, il sistema de' nervi, e per fine danneggiano anche spesso il mecanismo del corpo. 12. Il piacere dell' intemperanza e dell' incontinenza è il nemico che reca all' uomo il più gran danno; esso indebolisce la sua forza, lo priva delle ricchezze e guasta il suo miglior bene, la salute.

EXERCISE 7.

1. The uncle's cloak. 2. John's coat. 3. My sister's house. 4. The rising, the setting of the sun. 5. The name of Just, of Great. 6. Sheep's wool. 7. Point of view. 8. The house of correction. 9. One hears a pistol-shot. 10. Stone and marble quarries. 11. His masterpiece. 12. The body-guard. 13. With a single stroke of a pen. 14. A bell stroke. 15. Window-pane. 16. Cream. 17. A garland of flowers. 18. What a blockhead thou art! 19. The knife's point. 20. A silver vein. 21. To-morrow is post-day. 22. A master of drawing, of fencing. 23. Court of Appeal. 24. Lottery ticket, pawnbroker's ticket. 25. The post-horses. 26. Office certificate. 27. Austrian empire. 28. Kingdom of England, of Scotland, of Ireland. 29. The city of London, of Edinburgh, of Dublin, of Manchester, of Liverpool, of Birmingham, of Glasgow. 30. The month of January, of May. 31. The name of Joseph, of Francis. 32. The island of Sicily, of Sardinia. 33. A quarter of an hour. 34. A kind of dogs. 35. A horse-race. 36. Garrison troops. 37. The road of Trieste. 38. Tonnage duty. 39. Stamp tax. 40. A game at cards. 41. An ostrich feather. 42. The head-dress. 43. The order of the day. 44. Ten yards of linen, of cloth. 45. A barrel of oil, of vinegar. 46. A pound of meat, of cheese. 47. A hundredweight of sugar, of coffee. 48. A bushel of corn. 49. A piece of bread, a piece of roast meat. 50. A quarter of a pound of butter. 51. A glass of wine, of beer. 52. I have bought ten bottles of Burgundy and six of champagne. 53. A box of pipes. 54. A great number of wolves. 55. A quantity of sheep, of oxen. 56. An innumerable multitude of people. 57. A pair of old shoes. 58. Two pairs of boots, of trousers, of stockings. 59. A score of sequins. 60. Five miles of road. 61. A cup of coffee. 62. A cup of tea. 63. A pinch of snuff. 64. Measure me for a cloak and a pair of trousers. 65. A team of horses.

LESSONS IN ASTRONOMY.—III.

HISTORY OF THE SCIENCE (*continued*)—KEPLER'S SECOND AND THIRD LAWS—GALILEO—INVENTION OF THE TELESCOPE—NEWTON—LAW OF UNIVERSAL GRAVITATION.

BEFORE proceeding to consider the other laws discovered by Kepler which govern the motions of the planets, we must just pause to explain one or two astronomical terms which we shall frequently meet with. The sun, as we have seen, is situated in one of the foci of the ellipse in which any planet revolves; it is clear, therefore, that the distance between them cannot always be the same.

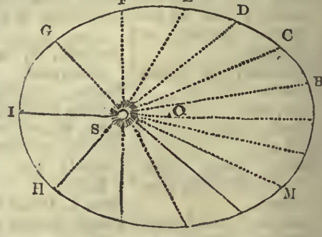


Fig. 2.

Let S (Fig. 2) represent the position of the sun, and A B C I the orbit in which the planet moves; it evidently is much nearer to the sun when at I than when it has moved on in its course to M. From this cause we find that Mercury and Venus sometimes recede to a much greater distance from the sun before they begin to retrace their steps than they do at other times.

Now when any planet is in that part of its orbit which is nearest to the sun, it is said to be in *perihelion*, a term composed of two Greek words signifying "near the sun;" and when at the other extremity of its course, it is said to be in *aphelion*, or away from the sun.

The distance O A, or half the major axis, is called the *mean distance*, and this it is which is given in all tables of the solar system as the distance of the planets.

Now it had long been noticed that the apparent daily motion of the sun was greater at some times than at others; and the planets, too, were found not to move exactly at a uniform rate, their motion being more rapid when in perihelion than when in other parts of their orbits. Kepler accordingly determined to try and discover the law which established the relation between their distances and their speeds. This link was manifestly wanting to enable him to foretell the exact place the sun or a planet would occupy at any given moment, for though he had mapped out their paths, yet, as their speeds varied, he could not tell in what part of those paths they would be unless he knew the amount of this variation.

This work he accomplished with far less difficulty than he had experienced in the discovery of his first great law, and he soon announced his second law, which teaches that—

The velocity of any planet at every point of its orbit is such that the line drawn from it to the sun always describes equal spaces in equal times. This imaginary line, joining the centres of the sun and planet, is called the *radius vector*.

This law may be easily understood by reference to Fig. 2, where S may be taken to represent the position of the sun, and A B C D E F G the successive positions occupied by the planet at equal intervals, so that it passes from A to B in the same period as from B to C or from C to D.

Now join these points with S, and we shall find that the space A S B passed over by the radius vector in one period is exactly equal to the space B S C passed over in the next, and to each of the other spaces C S D, D S E, etc. We see thus that the rate of the planet's motion when near C is greater than as it approaches A. The same would be found to hold good if we had divided the orbit into spaces passed over in one day, or in any other period. This law, then, together with the former one, enables us exactly to calculate the place of any planet at any time. Kepler, however, was not content with this: as he gazed on the different members of our system, he found so many points of resemblance in their movements that he conceived there must be some general law connecting the whole into one grand unity. They all had the sun as one focus of their orbits, they all moved in elliptical orbits around that body and in the same direction, and all obeyed the same law as to rate of motion; he fancied, therefore, that some intimate bond of union must exist between them, and set himself to discover it.

This was a more difficult task than either of the former had been, for there he had certain facts given, and had merely to form a theory that would explain them all; now he had to grope about for some law the very existence of which he only suspected, nor could he tell whether it connected their distances, their sizes, their periods, or their densities. He conjectured, however, that if there was any such relationship, it would probably be between their distances and their periods of revolution, more especially as his second law showed that in the case of each individual planet these quantities varied in a definite proportion. Accordingly, he commenced to compare their distances with their periods, but not the faintest clue could he find in this way to guide him; he then tried various multiples of these quantities, but with no better success. So firmly, however, was he convinced that some such law did exist, that he tried fresh combinations and multiples; yet could find no relation whatever. He then compared the squares and the cubes, but, though trifling approximations were at times found, they were far from complete, and he had still to try again. It now occurred to him to compare the squares of the periods with the cubes of the distances, and these calculations he accordingly worked out, but failed to detect any resemblance, owing, as afterwards appeared, to an error in some of his figures. The question now began to appear hopeless, and was for a time laid aside, many anxious years having been spent in vain attempts to solve it; but still at times Kepler would almost instinctively look back over his old calculations, and in doing so one day he detected the error above referred to. He accordingly went again over the whole work, and with intense joy found the result agree in the most marked way. The same calculations were then made for the other planets, and still found to hold good, and thus the remaining law which governs our universe was at last discovered. Only those who have themselves toiled on year after year in a search which often appeared hopeless, can realise the triumph of the philosopher as he thus discovered the laws of the heavens, and reduced all the apparently irregular motions of the heavenly orbs to three great but simple laws.

The third law may be stated thus:—*The squares of the periodic times of any two planets bear the same proportion to each other as the cubes of their mean distances.*

Thus, if we know the distance of a planet, we can calculate approximately its time of revolution round the sun; and, on the other hand, if we know its time we can ascertain its distance. When the distances and periods of the different members of our system have been given, the student will be able to check this rule for himself, and will find that the proportion holds true to within a comparatively small amount. As an illustration, however, he may take the distances and periods of Venus and the Earth, which may be set down in round numbers as follows:—

	Period.	*Distance.*
Venus . .	224 days	68,000,000 miles.
Earth . . .	365 ,,	95,000,000 ,,

The proportion between the periods here is $\frac{224}{365}$, and that between the distances $\frac{68}{95}$. If now we take the square of the former quantity, we shall find that it is nearly equal to the cube of the latter. It must, however, be remembered that the numbers above given are mere approximations; the exact figures will be given in a subsequent lesson.

Almost contemporary with Kepler there lived another great philosopher and astronomer, Galileo by name, chiefly memorable now as having been the first to construct the astronomical telescope, though his powers were such as would have ensured his renown, even had this great discovery not been made by him. He was born in 1564, and became a philosophical teacher at Pisa. Here he soon rendered himself remarkable by his violent opposition to some of the teachings of Aristotle, which he proved by experiment to be incorrect. This brought upon him much odium, and even persecution; but though he thus opposed the received views on mechanical subjects, he continued for some time a firm believer in the Ptolemaic system, and even refused to hear any explanation of the views and theories of Copernicus. After a time, however, he saw the folly of this, and commenced a careful inquiry, the result of which was that he became an ardent upholder of the new system.

In the early part of the seventeenth century, Galileo heard of a discovery which had been made by an instrument-maker in Holland, by which distant objects could be made distinctly visible. He therefore made every inquiry, and, after several trials, at last succeeded in manufacturing a telescope which possessed a magnifying power of 30.

This he first directed towards the moon, and here he at once detected many points of resemblance to the earth: there were rugged mountainous parts and lofty elevations; level plains likewise, which were at first called seas, were observed. A greater discovery was, however, made when on the 7th of January, 1610, he directed his magic tube towards the planet Jupiter. Not only did it present to him a brilliant disc streaked across with dark bands, but close to it were three small stars almost in a straight line. These were at first supposed to be merely fixed stars; on the following evening, however, when the telescope was again directed to the planet, it was observed that they had moved along with it, and had also changed their positions with respect to each other. Here, then, was evidently some new discovery, and most anxiously did Galileo await the recurrence of a clear evening to enable him to decide the matter. The next view satisfied him that they were in reality moons accompanying the planet, and further, he found that there were four of them.

Intense excitement was created among astronomers by this discovery, some urging the absurdity of increasing the number of the heavenly bodies beyond the sacred number seven, and others angry at the man who attempted to depose the earth from its position of dignity, by asserting that Jupiter had four satellites while the earth had only one. Some even refused to look through the instrument which made such unheard-of revelations. The followers of Copernicus, on the other hand, welcomed the discovery as presenting a miniature model of the solar system, and thus upholding their theory.

The telescope soon made other discoveries. By its aid Galileo found that Venus presented the same phases as the moon, appearing at times as a narrow crescent, and then gradually becoming more and more illuminated, till at last it shone with an almost circular disc. It could not, however, be seen with a complete disc, as at such a time the earth must be in the part of its orbit exactly opposite to Venus, which would therefore appear in conjunction with the sun and be lost in its brightness.

This discovery was a very important one, as it afforded a strong confirmation of the truth of the Copernican system. In fact, an objection had been raised to this system on the ground that these phases were not seen, as they ought to be if the theory were true. The telescope, however, soon settled this difficulty and silenced these objections.

Another discovery was made when the planet Saturn was examined. Instead of appearing with a circular disc, like the other heavenly bodies, it was found to be elongated, as if ears were affixed to each side of it. Owing to imperfections in the construction of his telescope, Galileo failed to discover that this appearance was caused by a large ring which completely encircled it, and imagined that the planet was in reality composed of three smaller ones. Both these discoveries were, according to the practice of scientific men in those days, made known in anagrams only intelligible to those who possessed the key.

We see even thus early what an important instrument the telescope proved, and we shall shortly find that almost all discoveries since this time have been made by its use, and that now nearly all our astronomical instruments consist, wholly or in part, of a telescope. We see thus to what important results the accident of a child playing with two spectacle-glasses has led.

The whole career of Galileo was a splendid one; it was, however, somewhat marred near its close. The prominent position he had taken as an upholder and defender of the new doctrines had attracted the attention of the papal authorities, who regarded his views as heretical, and demanded of him a public recantation of his belief in the motion of the earth. This he reluctantly gave, though he is related to have said immediately afterwards, "It moves for all that." It seems probable, however, that he considered this act as one which he was called upon to perform by the Church, and that therefore it was his duty to obey; still, it was, in several ways, a sad scene. Not very long after this, in 1642, he died. In the same year there was born Newton, a man even more celebrated than Galileo or Kepler.

From this time onward we come across the names of so many great astronomers that we can but refer to a few of the more distinguished. Huyghens discovered that the appendage to Saturn was in reality a ring surrounding it, and further, he found one of the satellites of that planet. Napier had some forty years before this invented logarithms, and thus reduced the work of weeks to days or even hours; and a little later, reflecting telescopes were introduced by Gregory.

The name of Newton, however, stands foremost amidst all these names as the discoverer of the one great law on which all those of Kepler depend. Kepler seems to have suspected that some such general law did exist, but failed to discover it; he seems likewise to have been aware of the fact that the tides were in some way influenced by the moon, and that the other heavenly bodies were in some way connected so as to influence one another; but he could not find what this mysterious bond of union was, and therefore with him it was a mere conjecture.

Newton, however, applied himself to clear up this difficulty. It is said that his attention was first directed to the subject by observing an apple fall one day while he was sitting in a summer-house in his garden. There was nothing remarkable in the circumstance in itself, for it was an event that might be seen any day; it set him thinking, however, and he began to inquire why the apple should fall downwards or towards the ground, instead of upwards or to one side. To most men such a question would have appeared utterly vain and frivolous; to him, however, it appeared an important step towards great and vast results, and such in reality it became. After careful inquiry, he found that all bodies were attracted towards the centre of the earth, and this attraction he called gravitation. The question then arose, whether this action was confined to the surface of the earth, or whether distant bodies were attracted in a similar way. The intensity of this force was also believed to diminish with the square of the distance; but the difficulty arose, how was this to be tested. Even if a body could have been raised several miles from the earth's surface, this amount would have been so slight, when compared with the radius of the earth, that no appreciable difference would have been manifested.

No way, therefore, appeared practicable of putting this theory to the test, till at last the thought occurred to him, why not use the moon as the falling body, and ascertain the distance through which it falls in any given space of time—say, for instance, in one minute. This idea at first sight appears absurd, but the annexed figure will enable us to understand it.

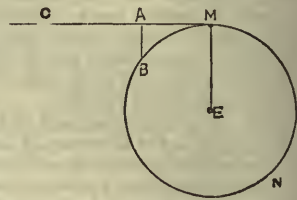


Fig. 3.

We know that the moon revolves around the earth in an orbit almost circular, as M B N. Now, suppose the moon to be at M, its tendency at that moment is to move along in the direction of the tangent M C, and in this direction it would certainly move did not some other force bend it out of its course. This force Newton supposed to be the attraction of the earth, and determined to calculate whether or not the amount it deviated from a straight line was that which would arise from the earth's attraction. We can easily see that when the moon has moved into the position B, the distance which it has deviated from its true path is equal to A B. He accordingly calculated how great this distance would become after the lapse of one minute—that is, how far the moon would fall towards the earth in that time; he next computed the space through which a body removed to the distance of the moon ought to fall in the same period under the action of the earth's gravitation, and compared these results together.

Though this calculation seems to be simple enough, it was in reality the work of many years; and when at length it was completed, he found a considerable resemblance between the amounts, but not a sufficiently close one to satisfy him, and his work was therefore, for a time, laid aside. After some time, however, he heard that a more accurate determination of the earth's diameter had been effected, and he accordingly repeated his calculations, substituting the new figures, and when at length the bewildering task was completed, the results were found to agree most accurately.

In order to fully satisfy himself of the accuracy of his theory, the same calculations were gone through with reference to other planets, and with the same results, and Newton then announced this general law:—

Every particle of matter in the universe attracts every other particle with a force proportional to the quantity of matter in each, and decreasing inversely as the squares of their distances.

The motion of the planets is thus seen to be compounded of two—the one, the original motion or impetus given them by the Creator, and remaining unchecked by any counteracting force; the other, the attraction of the body round which they rotate.

Having attained this result, Newton set himself one more task, and that was to ascertain on mathematical principles the curve in which the planets ought under these conditions to move. This was a calculation requiring the utmost amount of mathematical skill. Newton, however, possessed this, and set about the work, fully expecting to find that the curve must be an ellipse. He found, however, when the result was complete, one which represented not only this, but any of the "conic sections," that is, of the curves which may be obtained by cutting a cone. These are—the *circle*, which is the curve obtained when it is cut parallel to the base; the *ellipse*, when it is cut a little inclined to this; the *parabola*, when the line passes parallel to one side of the cone; and the *hyperbola*, when it is parallel to the axis. In any one of these curves, then, a planet may move under the influence of these general laws; and, as we shall find, the satellites of Saturn move in the first, the planets generally in the second, while the comets career onwards in parabolas or hyperbolas.

RECREATIVE SCIENCE.—I.

THE SOURCES OF LIGHT.

Apropos of shining lights, intellectual as well as material, and by way of inaugurating the series of papers on "Recreative Science," useless to the reader unless accompanied with ample descriptions of the mode of conducting scientific experiments, speak we first of the late prince of manipulators, the much-beloved and regretted Faraday, to whom a "memorial" is now in course of promotion in the shape of a monument in St. Paul's Cathedral. It may be said, without exaggeration, that if London had not contained a single philosophical instrument maker, this ingenious, original, and skilful philosopher would have made himself understood by experiments and manipulations, all conducted with what might be called the barest necessaries. Tyndall states, in his lecture "On Faraday as a Discoverer," that years ago, when Faraday assisted Mr. Brande in his lectures, he did this so quietly, skilfully, and modestly, that his master's vocation was pronounced to be "lecturing on velvet." Had Faraday been a clumsy, slovenly, and careless manipulator, his position in life might have been quite different from that which he justly held; but Faraday was industrious and painstaking to the last degree, and has left a bright example for all would-be philosophers to imitate.

Beginning with the artificial means of procuring light, there is no substance that can surpass phosphorus in this respect; as its name implies, it is a "light-bearer" (φως, *light*, and φερειν, *to bear*), and, at a cost of a few pence, may afford hours of amusement and instruction to those who will experiment carefully with it. Phosphorus is always kept under water, and thus viewed in its containing phial, gives no sign of light when examined in a darkened room.

A stick of phosphorus may be cut up into small pieces under water in a saucer, and still no light is apparent. With the sharp point of a knife or a pointed wire a little bit is taken out of the water and gently squeezed in the folds of a cotton duster, to remove the moisture which adheres to it. The phosphorus now gradually combines with the oxygen of the air. A spontaneous though slow combustion is set up, and it emits a faint, pale-green coloured light; a white smoke, called phosphorous acid, is at the same time produced, and this, by exposure to air containing moisture, changes to phosphoric acid. To show that acid is produced whilst the phosphorus is shining, place a small portion in a short length of glass tube, narrowed at one end to prevent the bit of phosphorus tumbling out, after it is reduced in size by oxidation. Put the tube in a little glass funnel, supported in a wine-glass to receive the dense acid liquor which will gradually form and drop into it. The first acid generated is termed phosphorous acid, and as this attracts moisture from the air, and is what is called deliquescent, it gradually takes up more oxygen, and is converted into phosphoric acid.

The fluid obtained by the above process diluted with a little water is found to be strongly acid to the taste; it will redden a piece of paper coloured blue with tincture of litmus; and if a few grains of carbonate of soda are dropped carefully into the glass, they effervesce, in consequence of the escape of carbonic acid produced by the combination of the acid with the alkaline base. These experiments, conducted on the smallest scale, indicate to the operator the cause of the production of the light from the phosphorus; and the principle being once understood, it is easy to modify the manner of oxidation.

To show the oxidation of phosphorus under water, and the evolution of light under these apparently contradictory and exceptional circumstances, a few grains of chlorate of potash and some little bits of phosphorus are placed with water in a deeper vessel, such as an ale or, better still, a champagne glass. When oil of vitriol is poured slowly down one side of the glass, or conveyed to the materials by a glass or pewter tube with a funnel-like opening at the top, beautiful flashes of green light are observed, and the energy of the change is shown by a peculiar crackling sound produced by the explosion under water of the little bubbles of peroxide of chlorine, which are resolved into oxygen and chlorine, and cause the submerged phosphorus to burn when it comes in contact with them. Tiny particles of phosphorus are sometimes enclosed in the bubbles of the mixed gases, and they burn as they ascend.

A few pieces of phosphorus thrown into a clean Florence oil-flask half full of water, will exhibit a display of miniature bombs and rockets in the space above the water when the latter is boiled. A lambent flame makes its appearance at the mouth of the flask, consisting of finely divided and sublimed phosphorus, mixed with steam, which slowly unites with the oxygen of the air, as the vapour is condensed into water.

Phosphorus quickly dissolves in bisulphide of carbon; and if the solution is dropped upon a sheet of blotting paper the solvent—viz., the bisulphide of carbon—evaporates, and the finely divided phosphorus left in the pores of the paper unites rapidly with the oxygen of the air, and, being in large quantity, first shines with a green light, and then burns most brilliantly, and contrasts in a very marked degree with the feeble light obtained when phosphorus is boiled in water and allowed to escape with the steam from the mouth of a flask.

Of course the proper apparatus, a ring-stand for holding a flask with its contents, and a convenient heat-giving flame, such as that from a spirit-lamp, or a mixed air and coal-gas burner, are most desirable; but as these experiments are often ventured on at a moment's notice in some far away country house, it is quite as well to be able to imitate Faraday, and make apparatus out of *nothing*, as it is termed—the nothing being such glass, or other vessels, pots and pans, which the house may afford.

For the time-honoured ring-stand, a common red garden flower-pot, with a triangular wire resting on the top to carry the flask, and containing a spirit-lamp improvised from part of an ink-bottle filled with methylated spirit, and fitted with a perforated cork through which some shreds of cotton are passed, will answer the purpose required; and to prevent the cork burning, a bit of thin sheet-lead may be perforated and laid upon it. The flower-pot protects the flame, and prevents its being blown about, and thereby economises heat, *i.e.*, spirit. The changes thus described denote that chemical action is one of the most important means of obtaining artificial light; at the same time it will be understood that the light-giving power is not confined to experiments with phosphorus. A block of Wenham Lake ice becomes a beautiful source of light if a globule of potassium is placed upon it; and at an American popular lecture we hear of pounds of the metal potassium thrown upon hundred-weights of ice, producing a blaze of light worthy of the palmy days of Vauxhall. Ice, as everybody is supposed to know, is only a solidified compound of oxygen and hydrogen; the former unites with the metal, and generating an enormous amount of heat, becomes red hot, and sets fire to the hydrogen, which escapes around the potassium. A piece of wetted blotting-paper laid in a common dinner-plate will always set fire to sodium, and this metal burns with its peculiar monochromatic or yellow light: the experiment fails if the sodium is thrown on water. Young people should take care of their eyes in all experiments with potassium and sodium, by standing at a respectful distance from the burning metals, which usually burst at the last moment when the red-hot globule of fused alkali (potash or soda) comes in contact with the cold ice or water. The red-hot globule of alkali is repelled and supported on a cushion of vapour, and when the temperature falls it touches the water, steam is generated with explosive violence, the globule bursts, and is blown about in all directions.

The combustion of tallow, oil, wax, and gas affords a practical illustration of the production of light by chemical action. It does not, however, always follow that the body giving out light burns; it has, therefore, been necessary to give a different term to this effect, viz., ignition; and the *ignition of solids* becomes a source of light that will next be considered. The difference between combustion and ignition is easily demonstrated, by placing a pill-box containing a little gun-cotton in a deep glass filled with carbonic acid. On attempting to explode the gun-cotton with a lighted taper, the latter is of course extinguished, because it will not burn in carbonic acid; but if a wire is made red-hot, and passed through the gas until it touches the gun-cotton, a flash of light is seen as the cotton is exploded, the ignition of the solid iron being wholly unaffected by circumstances that prevent combustion. Carbonic acid gas is easily procured by placing a few lumps of chalk, whitening, or marble in a small jug, and pouring vinegar, or dilute sulphuric, hydrochloric, or nitric acid slowly upon it. Whilst the operation is proceeding a piece of paper should be laid upon the top of the jug to prevent any motion in the carbonic acid thus generated; and by applying a lighted taper occasionally it may soon be discovered when the jug is full of carbonic acid; and as this gas is half as heavy again as common air, it may be poured from the jug into the deep ale-glass in which the pill-box and gun-cotton have already been placed: by this simple arrangement the trouble of perforating a cork, and fitting it with a bent tube to a bottle containing the materials for generating carbonic acid, is saved.

The current of burnt gas and heated air that escapes from the top of an argand burner is usually very hot, but does not evolve light, as it is estimated that a current of gaseous matter may have a temperature of 2,000°, and yet not become luminous.

If, however, a spiral of fine iron or platinum wire, or a bit of asbestos, is held in the hottest part of the current of air, ignition of the solid thus employed takes place, and light is evolved. The increase of heat in the solid is seen better when the glass chimney of the argand burner is covered with tin-foil to within two or three inches of the top, as the glare from the lamp frequently overpowers the light from the incandescent wire.

In all cases where artificial light is obtained, the ignition or incandescence of some kind of solid matter takes place; with gas or oil it is the carbon. The oxy-hydrogen or lime light is a remarkable illnstration of the same fact, the mixed gases, oxygen and hydrogen, hardly giving out any light when bnrnt alone; but if directed on to a piece of lime, the latter becomes gradnally so hot that it emits the most dazzling rays of light. Even the electric light as first known to ns, which may be considered the most intense and brilliant of all artificial lights, is prodnced by the ignition of two points of charcoal, throngh which the current of electricity from a powerful battery is passed. The ignition of the carbon is wholly independent of the air; no combustion is necessary. A transfer of solid particles of charcoal takes place from one pole to the other, which goes on quite as well, if not better, in the vacnum of an air-pnmp.

Directly after the ball of lime has been used for the production of the oxy-hydrogen light it sometimes continues to emit a very faint light. This is due to phosphorescence, another and most curious source of light. Phosphorescence occurs with certain living organisms; there are lnminous animalculæ in the ocean, luminous insects, such as the fire-fly, and a luminous worm, called the glow-worm, from which Matteucci extracted a yellowish phosphorescent substance. The decay of organic matter is usually the result of an oxidising process, but the phosphorescence of certain fish, such as whitings and herrings, does not appear to be due to oxidation, because the light is not reduced when the fish is placed in nitrogen or hydrogen. At the moment of crystallisation, flashes of faint light are sometimes seen, and especially when the saline substance, such as sulphate of soda, has been fused at a red heat, cooled, dissolved in water, and crystallised. Fusion or vitrefaction, followed by subsequent solution in water, and crystallisation appears to be accompanied most frequently with these appearances of light. A brass button fitted on a cork, and rubbed violently against a small piece of wood, soon affords enough heat to set fire to a piece of phosphorus. The attrition of a flint against a hard metal, such as steel, is said to "strike fire;" and in this case friction becomes a direct source of light. On the Underground Railway sparks of fire generally accompany the application of the brake, as the train is brought to a standstill at the various stations. The sparks from the wheels, or the flint and steel, are derived from minute particles of metal which are rubbed off by friction, and being very hot burn in the air.

When electricity of high intensity—lightning—darts through the air in the discharging of electrified clouds, the flash of light is most overpowering, and in some cases has caused blindness. The nearest imitation of Jove's lightnings is that obtainable from a great inductorium coil and some Leyden jars: the noise of the discharge, the intensity of the light, its peculiar colonr, the rapidity with which it comes and goes, remind one of Juliet's pretty speech:—

> "I have no joy of this contract to-night:
> It is too rash, too unadvised, too sudden;
> Too like the lightning, which doth cease to be,
> Ere one can say 'It lightens.'"

All terrestrial modes of obtaining light, such as friction, chemical action, ignition of solids, phosphorescence, crystallisation, and electricity, sink into insignificance before the great natural source of light, the sun, the centre of our planetary system, and the great source of heat and light to the world.

Sir John Herschel has estimated that "the sun gives out as much light as 146 lime-lights would do, if each ball of lime were as large as the sun, and gave out light from all parts of its surface;" and that "the heat evolved from every square yard of the sun's surface is as great as that which would be produced by burning six tons of coal on it each hour."

The heat and the light of the sun come from an envelope, called the photosphere, and this is supposed by eminent astronomers to be neither solid or liquid, but cloud-like and gaseous; of this they are almost certain, although the actual source of the heat and light of the sun is unknown.

READINGS IN GREEK.—III.

DEMOSTHENES.

Of all the brilliant array of orators that Greece produced, Demosthenes has always enjoyed the highest reputation. Living as he did at a critical and eventually disastrous period of the history of Athens, he took an active interest from a comparatively early age in political affairs, and throughout his life was constant in his endeavours to stir up and keep alive the fire of patriotism and courage which had well nigh become extinct in the bosoms of his countrymen. The whole of Greece was gradually falling under the sway of Philip of Macedon, whose schemes of aggrandisement were afterwards carried out so extensively by his son, Alexander the Great; and it was chiefly against the policy of the Macedonian king that the efforts of Demosthenes were directed. But bribery and craft soon did their work; the Athenians offered but a half-hearted resistance to the invader, and the year B.C. 338 witnessed the downfall of the liberties of Greece at the disastrous battle of Chæronea. The news of the defeat filled the Athenians with the utmost consternation, and at this terrible crisis, Demosthenes, in whom the people placed unbounded confidence, exerted all his energies for the defence of Athens. The crisis passed, owing in a great measure to the prudent forbearance of Philip—partly, also, no doubt, to the energetic exertions of Demosthenes; and some seven months later an Athenian citizen named Ktesiphon got a decree passed that a gold crown should be given to Demosthenes in recognition of his services to the state. For this action Ktesiphon was impeached by the Macedonian party in Athens, and the indictment was entrusted to Æschines, the rival and determined opponent of Demosthenes. Though directed nominally against Ktesiphon, the prosecution was, in fact, an impeachment of the whole political career of Demosthenes, and Æschines endeavoured to prove that his rival's policy was not only undeserving of commendation, but even positively censurable. The reply of Demosthenes is contained in the magnificent oration "De Corona" (On the Crown), in which the great orator unflinchingly accepts the challenge held out to him, and shows triumphantly that Æschines and his party were the real traitors to their country and the abettors of her ruin. The first extract is taken from an early portion of the speech:—

DEMOSTHENES.—"DE CORONA," §§ 12, 13.

Τὰ μὲν οὖν κατηγορημένα[1] πολλά, καὶ περὶ ὧν[2] ἐνίων μεγάλας καὶ τὰς ἐσχάτας οἱ νόμοι διδόασι τιμωρίας· τοῦ δὲ παρόντος ἀγῶνος ἡ προαίρεσις[3] αὕτη· ἐχθροῦ μὲν ἐπήρειαν[4] ἔχει καὶ ὕβριν καὶ λοιδορίαν καὶ προπηλακισμὸν ὁμοῦ καὶ πάντα τὰ τοιαῦτα, τῶν μέντοι κατηγοριῶν καὶ τῶν αἰτιῶν τῶν εἰρημένων, εἴ περ ἦσαν ἀληθεῖς, οὐκ ἔνι[5] τῇ πόλει δίκην ἀξίαν λαβεῖν, οὐδ' ἐγγύς· οὐ γὰρ[6] ἀφαιρεῖσθαι δεῖ τὸ προσελθεῖν[7] τῷ δήμῳ καὶ λόγου τυχεῖν, οὐδ' ἐν ἐπηρείας τάξει[8] καὶ φθόνου τοῦτο ποιεῖν· οὔτε μὰ τοὺς θεοὺς ὀρθῶς ἔχον οὔτε πολιτικὸν οὔτε δίκαιόν ἐστιν ὦ ἄνδρες Ἀθηναῖοι· ἀλλ' ἐφ' οἷς ἀδικοῦντά με ἑώρα τὴν πόλιν, οὖσί γε τηλικούτοις ἡλίκα νῦν ἐτραγῴδει[9] καὶ διεξῄει, ταῖς ἐκ τῶν νόμων τιμωρίαις παρ' αὐτὰ τἀδικήματα[10] χρῆσθαι,[11] εἰ μὲν εἰσαγγελίας[12] ἄξια πράττοντά με ἑώρα, εἰσαγγέλλοντα καὶ τοῦτον τὸν τρόπον εἰς κρίσιν καθιστάντα παρ' ὑμῖν, εἰ δὲ γράφοντα παράνομα, παρανόμων γραφόμενον.

NOTES.

1. Κατηγ., *the counts of the indictment are many.* Supply ἐστί.

2. Καὶ περὶ ὧν. A contracted form of expression for τοιαῦτα or ἐκεῖνα περὶ ὧν. *And of such a nature that for some of them.*

3. Προαίρεσις means originally *deliberate choice*, and thus *intention*. *This is the intention of the present suit.*

4. Ἐπήρεια, *wanton spite; ἔχει, it is full of.*

5. Ἔνι, for ἔνεστι. *It is not in the power of the state to exact a sufficient penalty, nor anything like one.* Δίκην λαβεῖν, *to exact a penalty, to punish.* Δίκην δοῦναι, *to be punished.*

6. Γάρ. Supply *it is simply spiteful,—for.*

7. Τὸ προσελθεῖν—λόγου τυχεῖν are treated as substantives in the accusative case after ἀφαιρεῖσθαι. In other words, they are the objects to ἀφαιρεῖσθαι. Λόγου τυχεῖν, *to obtain a hearing.*

8. Οὐδ' ἐν ἐπηρείας τάξει, *still less is it right to do so on the ground of spite.* Ἐν τάξει is a military term. So ἐν ἐχθροῦ τάξει, *in a hostile manner.*

9. Ἐτραγῴδει καὶ διεξῄει, *which he (Æschines) detailed in such a bombastic style.* The first of the many allusions in this speech to Æschines' former profession as an actor. The phrase is equivalent to τραγῳδῶν διεξῄει.

10. Παρ' αὐτὰ τἀδικήματα. *At the actual time when the offences were committed.* The present trial did not come off until seven years after the decree had been passed by Ktesiphon.

11. Χρῆσθαι. Supply ἔδει from δεῖ in the previous sentence, *he ought to have used.*

12. Εἰσαγγελίος. Two forms of procedure are mentioned in this sentence, of which Æschines might have availed himself to punish Demosthenes: (1) εἰσαγγελία, a proceeding against offences not specifically provided for in the statutes, *an impeachment;* (2) γραφὴ παρανόμων, *an indictment for proposing illegal or unconstitutional measures.* Γράφειν τινα παρανόμων is to institute such a proceeding. For a full account of the forms of procedure in both cases the reader is referred to Smith's "Dictionary of Antiquities." *If he saw me proposing any illegal measures, he should have indicted me accordingly.*

The next extract is a brilliant piece of invective, in which Demosthenes draws a comparison between his rival's antecedents and his own :—

DEMOSTHENES.—"DE CORONA," 258—261.

Σὺ δ' ὁ σεμνυνόμενος ἀνὴρ καὶ διαπτύων τοὺς ἄλλους σκόπει πρὸς ταύτην ποίᾳ τινὶ κέχρησαι τύχῃ, δι' ἣν παῖς μὲν ὢν μετὰ πολλῆς ἐνδείας ἐτράφης, ἅμα τῷ πατρὶ[1] πρὸς τῷ διδασκαλείῳ, προσεδρεύων, τὸ μέλαν τρίβων,[2] καὶ τὰ βάθρα[3] σπογγίζων καὶ τὸ παιδαγωγεῖον κορῶν, οἰκέτου τάξιν, οὐκ ἐλευθέρου παιδὸς ἔχων,[4] ἀνὴρ δὲ γενόμενος τῇ μητρὶ τελούσῃ[5] τὰς βίβλους[6] ἀνεγίγνωσκες καὶ τἄλλα συνεσκευωροῦ,[7] τὴν μὲν νύκτα[8] νεβρίζων[9] καὶ κρατηρίζων καὶ καθαίρων τοὺς τελουμένους καὶ ἀπομάττων[10] τῷ πηλῷ καὶ τοῖς πιτύροις καὶ ἀνιστὰς ἀπὸ τοῦ καθαρμοῦ κελεύων λέγειν, "ἔφυγον κακόν, εὗρον ἄμεινον," ἐπι τῷ μηδένα πώποτε τηλικοῦτ' ὀλολύξαι σεμνυνόμενος[11] (καὶ ἔγωγε[12] νομίζω· μὴ γὰρ οἴεσθ' αὐτὸν φθέγγεσθαι μὲν οὕτω μέγα, ὀλολύζειν δ' οὐχ ὑπέρλαμπρον), ἐν δὲ ταῖς ἡμέραις τοὺς καλοὺς θιάσους ἄγων διὰ τῶν ὁδῶν τοὺς ἐστεφανωμένους τῷ μαράθῳ[13] καὶ τῇ λευκῇ, τοὺς ὄφεις[14] τοὺς παρείας θλίβων, καὶ ὑπὲρ τῆς κεφαλῆς αἰωρῶν, καὶ βοῶν εὐοῖ σαβοῖ[15] καὶ ἐπορχούμενος[16] ὕης ἄττης ἄττης ὕης, ἔξαρχος καὶ προηγεμὼν καὶ κιττοφόρος καὶ λικνοφόρος καὶ τοιαῦτα ὑπὸ τῶν γραδίων[17] προσαγορευόμενος, μισθὸν λαμβάνων τούτων ἔνθρυπτα καὶ στρεπτοὺς καὶ νεήλατα, ἐφ' οἷς[18] τίς οὐκ ἂν ὡς ἀληθῶς αὐτὸν εὐδαιμονίσειε καὶ τὴν αὐτοῦ τύχην;

NOTES.

1. Ἅμα τῷ πατρί. Atromêtus, the father of Æschines, was a teacher in a small school; his mother, Glaukothea, made a living by presiding over certain religious rites chiefly attended by the poor; and Æschines served under both in a menial capacity.

2. Τρίβων, *pounding* and so *preparing the ink.*

3. Βάθρα, *the benches* on which the scholars sat.

4. Τάξιν ἔχων, *holding the position of a menial, not that of a freedman's son.*

5. Τελούσῃ, *as she performed the initiatory ceremonies.* The allusions in this whole passage are to the Phrygian rites as practised at Athens.

6. Βίβλους, the sacred books containing the mystic formulæ.

7. Συνεσκευωροῦ, *bore a part in all the rest of her knavish impostures* (imp. from συσκευωρέομαι).

8. Τὴν μὲν νύκτα. Accusative of duration of time; opposed to ἐν δὲ ταῖς ἡμέραις below.

9. Νεβρίζων, clothing those undergoing initiation *in fawn skins* (νέβρις). Κρατηρίζων, *pouring them out drink from the goblet* (κρατήρ). Both parts of the ceremony.

10. Ἀπομάττων, etc., *cleansing them with loam and bran.*

11. Σεμνυνόμενος—ἐπὶ τῷ, *priding yourself on the fact that no one ever shouted out so loudly.* Ὀλολύξαι, generally used of a cry of grief, is here to be taken in its more original meaning of a jubilant religious cry.

12. Καὶ ἔγωγε. Here Demosthenes turns from Æschines to the audience. "He must have had a splendid voice, judging from the exhibition we have had to-day."

13. Μαράθῳ, *fennel;* λευκῇ, *white poplar.*

14. Τοὺς ὄφεις, etc., *now pressing the coppered serpents* is the translation of one annotator, and παρείας is said to be the same word as παρώας, from πάρωος, copper-coloured. Aristophanes mentions snakes of this colour as being sacred to Æsculapius.

15. Εὐοῖ σαβοῖ—ὕης ἄττης. Mystic cries in the ceremonial of initiation.

16. Ἐπορχούμενος, *beginning a dance to the cry of "Attes Hyes!"*

17. Γραδίων, a diminutive of γραῦς, implying contempt, *the miserable old crones.*

18. Ἐφ' οἷς, etc., *for which things who would not congratulate himself and his good fortune?*

The following eloquent appeal is one of many that occur in the speech :—

DEMOSTHENES.—"DE CORONA," 180.

Καλῶ δ' ἐναντίον ὑμῶν, ὦ ἄνδρες Ἀθηναῖοι, τοὺς θεοὺς[1] ἅπαντας καὶ πάσας, ὅσοι τὴν χώραν ἔχουσι τὴν Ἀττικήν, καὶ τὸν Ἀπόλλω τὸν Πύθιον,[2] ὃς πατρῷός[3] ἐστι τῇ πόλει, καὶ ἐπεύχομαι πᾶσι τούτοις, εἰ μὲν ἀληθῆ πρὸς ὑμᾶς εἴποιμι, καὶ εἶπον[4] τότ' εὐθὺς ἐν τῷ δήμῳ, ὅτε πρῶτον εἶδον τουτονὶ[5] τὸν μιαρὸν τούτου τοῦ πράγματος ἁπτόμενον (ἔγνων γάρ, εὐθέως ἔγνων), εὐτυχίαν μοὶ δοῦναι καὶ σωτηρίαν· εἰ δὲ πρὸς ἔχθραν[6] ἢ φιλονεικίας ἰδίας ἕνεκ' αἰτίαν ἐπάγω τούτῳ ψευδῆ, πάντων τῶν ἀγαθῶν ἀνόνητον[7] με ποιῆσαι.

NOTES.

1. Θεούς is used as of two genders—*all the gods and goddesses.*

2. Πύθιον, *of Pytho,* the old name of Delphi, where Apollo's most famous temple stood.

3. Πατρῷος. Apollo was regarded as one of the tutelary deities of Athens. A more especial relationship was found in the legend that he was the father of Ion, the reputed founder of the Ionic race.

4. Καὶ εἶπον, *and I did speak out at once in the public assembly on that occasion.*

5. Τουτονί. The ι emphasises the word, and was probably accompanied with a significant gesture towards Æschines.

6. Πρὸς ἔχθραν, *with a view to, by way of, hatred.*

7. Ἀνόνητον, *deriving no benefit from, unblest by.* Generally the word is used in an active sense; as in Sophocles, ἀνόνητα σώματα ("Ajax," 758) means *useless bodies.*

For a specimen of Demosthenes' powers in a somewhat different style, we will take a short extract from the Olynthiac orations, the object of which was to stir up the Athenians to take decided measures against Philip, who had begun to encroach upon a small group of Athenian cities in the immediate neighbourhood of Macedonia, of which the town of Olynthus was the chief. In the following passage Demosthenes insists on the necessity of sending aid to the Olynthians :—

DEMOSTHENES.—"OLYNTHIACS," III. 4.

Τί οὖν ὑπόλοιπον ὦ ἄνδρες Ἀθηναῖοι, πλὴν βοηθεῖν ἐρρωμένως καὶ προθύμως; ἐγὼ μὲν οὐχ ὁρῶ.[1] Χωρὶς γὰρ τῆς περιστάσης ἂν[2] ἡμᾶς αἰσχύνης, εἰ καθυφείμεθά τι τῶν πραγμάτων οὐδὲ τὸν φόβον[3] ὦ ἄνδρες Ἀθηναῖοι μικρὸν ὁρῶ τὸν τῶν μετὰ ταῦτα, ἐχόντων μὲν ὡς ἔχουσι[4] Θηβαίων ἡμῖν, ἀπειρηκότων δὲ χρήμασι Φωκέων, μηδενὸς δ' ἐμποδὼν ὄντος Φιλίππῳ τὰ παρόντα καταστρεψαμένῳ, πρὸς ταῦτα ἐπικλῖναι τὰ πράγματα.[5] Ἀλλὰ μὴν εἴ τις ὑμῶν εἰς τοῦτο ἀναβάλλεται ποιήσειν τὰ δέοντα, ἰδεῖν ἐγγύθεν βούλεται τὰ δεινά, ἐξὸν[6] ἀκούειν ἄλλοθι γιγνόμενα, καὶ βοηθοὺς ἑαυτῷ ζητεῖν, ἐξὸν νῦν ἑτέροις αὐτὸν βοηθεῖν.

NOTES.

1. Οὐχ ὁρῶ, sc. τὸ ὑπόλοιπον, *what remains for us?*

2. Τῆς περιστάσης ἄν, etc., *the disgrace that would accrue to us.*

3. Τὸν φόβον, *and the danger which I foresee will ensue is no slight one.*

4. Ἐχόντων ὡς ἔχουσι, *while the Thebans occupy their present attitude,* a euphemism to express their hostility. Ἔχειν is in this phrase really equivalent to εἶναι.

5. Πρὸς ταῦτα—τὰ πράγματα, sc. to the affairs of Athens.

6. Ἐξόν, *while it is in his power,* nom. absolute. This construction is very frequently found in the case of several neut. sing. participles, especially of compounded forms of εἰμί. So also δέον.

TRANSLATION OF EXTRACT 3 IN READINGS IN GREEK.—II.

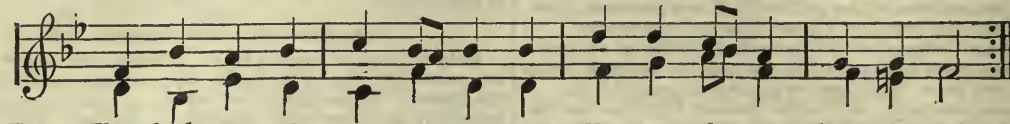
EURIPIDES.—"MEDEA," 820—841.

The sons of Erecthens of old time have been prosperous, and the children of the blessed gods, feeding on the glorious wisdom of a land sacred, untrodden by the spoiler's foot; moving ever with dainty tread through the bright pure air, where erst, so goes the tale, golden-haired Harmonia gave birth to the nine Pierian Muses. And 'tis said that the Cyprian goddess, when she had drunk a draught from the bright, sparkling Cephissus, sent the sweet gentle breezes breathing over the land; and, ever wreathing her hair with the fragrant garland of the roses' bloom, she sends the loves that attend on wisdom the helpers in every kind of virtue.

LESSONS IN MUSIC.—XXIII.

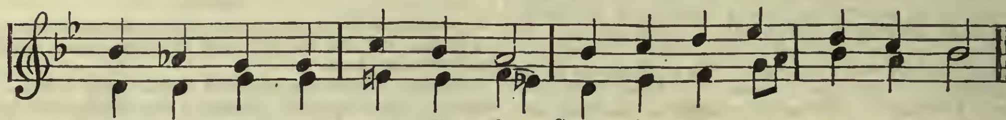
In the following tune our pupils will find an exquisite example of the sub-dominant transition. Notice the beautiful effect of TA in the third line. [Learners of the staff notation should put a square note, to represent the place of DOH, on the middle line of the staff. Observe the dots, which indicate the repetition of music and the corresponding repetition of words.]

EXERCISE 39.—OBERLIN. KEY B FLAT. M. 58.



Verse 1. *Through the day thy love hath spared us, Now we lay us down to rest;*
Rep. Through the si - lent watch-es guard us, Let no foe our peace mo - lest.

2. *Pil - grims here on earth and stran - gers, Dwell - ing in the midst of foes;*
Rep. Us and ours pre - serve from dan - gers: In thine arms may we re - pose:



1. *Je - sus, thou our guar - dian be;* Sweet it is to trust in thee.
2. And when life's short day is past, REST WITH THEE IN HEAV'N AT LAST.

In the next exercise our readers will find in the new or sol-fa notation the exercise which has just been placed before them in the old notation. From this may be gathered the advantages the former possesses over the latter.

EXERCISE 40.—OBERLIN. (IN THE NEW NOTATION.) KEY B FLAT. M. 58.

s_1 :d	t_1 :d	r :$d.t_1$	d :d	m :m	r.d :t_1
Through the	day thy	love has	spar'd us,	Now we	lay us
m_1 :d_1	f_1 :m_1	r_1 :s_1	m_1 :m_1	s_1 :l_1	$t_1.d$:s_1

l_1 :l_1	s_1 :—	s_1 :d	t_1 :d	r :$d.t_1$	d :d
down to	rest.	Through the	si - lent	watch - es	guard us -
s_1 fe_1	s_1 :—	m_1 :d_1	f_1 :m_1	r_1 :s_1	m_1 :m_1

m :m	r.d :t_1	l_1 :l_1	s_1 :—	d :ta_1	l_1 :l_1
Let no	foe our	peace mo -	lest;	Je - sus	thou our
s_1 :l_1	$t_1.d$:s_1	s_1 :fe_1	s_1 :—	m_1 :m_1	f_1 :f_1

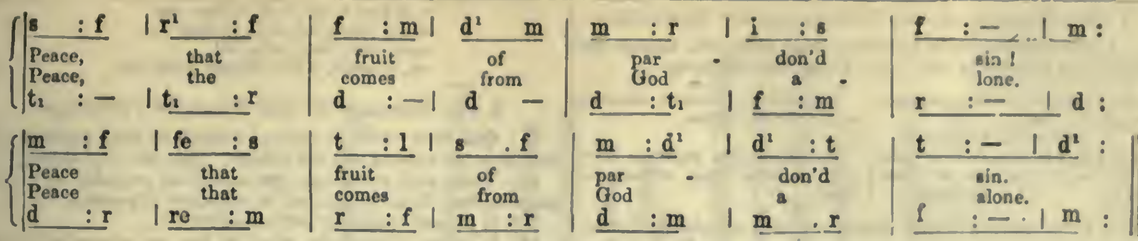
r :d	t_1 :—	d :r	m :f	m :r	d :—
guar - dian	be;	Sweet it	is to	trust in	Thee!
fe_1 :fe_1	s_1 :f_1	m_1 :f_1	s_1 :$l_1.t_1$	d :t_1	d :—

EXERCISE 41.—DELABORE. (TO ILLUSTRATE CHROMATIC NOTES.) KEY E. M. 66.

m :f	f :s	l :s	s :m	s :f	f :m	m :—	r :
Peace	be	to	this	ha -	bi -	ta -	tion;
Peace	that	speaks	the	heaven -	ly	giv -	er;
d :r	r :m	f :t_1	t_1 :d	m :r	r :d	d :—	t_1 :

m :f	f :s	l :s	s :d^1	t :d^1	l :d^1	l :—	s :
Peace	to	all	that	dwell	there -	in!	
Peace	to	world -	ly	minds	un -	known.	
d :r	r :m	f :s	m :d	r :m	f :—	fe :—	s :

f :m	r :l	s :f	m :d^1	l :t	d^1 :r^1	d^1 :—	t
Peace,	the	ear -	nest	of	sal -	va -	tion!
Peace	di -	vine,	that	lasts	for	e -	ver;
r :d	t_1 :f	m :r	d :m	f :r	m :f	m :—	r



The tune "Melcombe," which was brought under the reader's notice in our last lesson, and "Edgeware" in this, will illustrate to our pupils the effect of transition into the key of the dominant. We have given them in the new notation only, in order that our pupils may have an exercise in copying these tunes as well as others into the old notation. It would be excellent practice for such of our pupils who desire to read and write the old notation, as well as the new notation, with facility, to do this with every exercise that has been and may be brought under their notice—namely, to write out in the old notation exercises given in the new notation only, and *vice versa.*

Music from HANDEL.] EXERCISE 42.—**EDGWARE.** KEY E. M. 66. [Words by BARRY CORNWALL.

2. *Song from baser thoughts should win us;*
Song should charm us out of woe:
SONG SHOULD STIR THE HEART WITHIN US,
LIKE A PATRIOT'S FRIENDLY BLOW.

3. *Song should spur the mind to duty,*
Nerve the weak, and stir the strong:
EVERY DEED OF TRUTH AND BEAUTY
SHOULD BE CROWNED WITH STARRY SONG!

LESSONS IN FRENCH.—LVII.

§ 36.—REMARKS ON THE POSSESSIVE PRONOUN.

(1.) IT may be seen from the table given in the last lesson that the termination of the possessive pronoun agrees in gender and number with the object possessed:—

Votre canif et *le mien.* *Your penknife and mine.*	Votre plume et *la mienne.* *Your pen and mine.*
Vos frères et *les miens.* *Your brothers and mine.*	Vos sœurs et *les miennes.* *Your sisters and mine.*

(2.) The article is an inseparable part of these pronouns, and undergoes with them the same change as when it is joined to a noun:—

of mine	**du** mien,	**de la** mienne,	**des** miens,	**des** miennes, etc.
to ours	**au** nôtre,	**à la** nôtre,	**aux** nôtres,	**aux** nôtres, etc.

Je parle de ses parents, et il parle **des** leurs.	*I speak of his relatives, and he speaks of theirs.*

(3.) These pronouns should relate to a noun* previously expressed, with which they *must* agree in gender, although they may differ in number:—

Votre maison est plus haute que *la leur.*	*Your house is higher than theirs is.*
Son frère est plus âgé que **les vôtres.**	*His brother is older than yours are.*

(4.) These pronouns may, however, be used absolutely when we mean thereby our family, near relatives, friends, partisans, soldiers, countrymen, etc.:—

Moi, j'ai les *miens*, la cour, le peuple à contenter. LA FONTAINE.	*I have my family or friends, the court, the people to please.*
Malheureux . . . . qui porte chez les *siens* le glaive et les flambeaux. COLARDEAU.	*Wretched is he who carries among his fellow-citizens the sword and the torch.*
C'est à nous à payer pour les crimes des *nôtres.* RACINE.	*We must bear the penalty of the crimes of our family or people.*

(5.) **Le mien** and **le tien** are also used absolutely as the words *mine* and *thine* in English, in the sense of possession, property:—

Et *le mien* et *le tien*, deux frères pointilleux. BOILEAU.	*And mine and thine (meum and tuum), two punctilious brothers.*
Le tien et *le mien*, sont les sources de toutes les divisions et de toutes les querelles. GIRAULT-DUVIVIER.	*Mine and thine (meum and tuum) are the sources of all divisions and quarrels.*

§ 37.—DEMONSTRATIVE PRONOUNS.

Singular.			*Plural.*		
Masculine.	*Feminine.*		*Masculine.*	*Feminine.*	
celui,	celle,	*this. that.*	ceux,	celles,	*these, those.*
celui-ci,	celle-ci,	*this.*	ceux-ci,	celles-ci,	*these.*
celui-là,	celle-là,	*that.*	ceux-là,	celles-là,	*those.*

ce, *it, they.*

Absolute Demonstrative Pronouns.

ceci, *this,* } not used in the
cela, *that,* } plural.

* This rule is not always observed in mercantile correspondence, in which is often found: **J'ai reçu** *la vôtre* **en date du** . . . instead of **J'ai reçu votre lettre en date du** . . . *I received your letter dated* . . . a form which is not to be imitated.

§ 38.—REMARKS ON THE DEMONSTRATIVE PRONOUNS.

(1.) The demonstrative pronouns **celui, celle,** etc., assume the gender and number of the nouns which they represent:—

Je ne connais d'avarice permise que *celle* du temps. STANISLAS LECZINSKY.	*Methinks no avarice is allowable unless it be that of time.*
Les seules louanges que le cœur donne, sont *celles* que la bonté s'attire. MASSILLON.	*The only praises which the heart gives are those which goodness deserves.*

(2.) These pronouns are sometimes used absolutely before **qui, que, dont,** etc., in the same manner as the English personal pronouns, *he, they,* etc., before *who, whom,* etc.:—

Celui qui rend un service doit l'oublier, **celui qui** le reçoit, s'en souvenir. BARTHÉLEMY.	*He who renders a service should forget it; he who receives it should remember it.*
Aimer **ceux qui** vous haïssent, **ceux qui** vous persécutent, c'est la charité du chrétien, c'est l'esprit de la religion. BOURDALOUE.	*To love those who hate you, those who persecute you, is the charity of the Christian; it is the spirit of religion.*

(3.) **Celui-ci, celle-ci,** etc., **celui-là, celle-là,** are used when it is desirable to denote the comparative proximity or remoteness expressed in English by the words *this* and *that*:—

celui-ci, *this one.* celui-là, *that one.*

(4.) **Celui-ci, celui-là,** etc., are often used to express contrast or comparison. They are then equivalent to the English expressions, *the former, the latter; this one, that one*:—

Un magistrat intègre et un brave officier sont également estimables: **celui-là** fait la guerre aux ennemis domestiques, **celui-ci** nous protége contre les ennemis extérieurs. GIRAULT-DUVIVIER.	*An upright magistrate and a brave officer are equally estimable: the former makes war against domestic enemies, the latter protects us against foreign enemies.*
Tel est l'avantage ordinaire Qu'ont sur la beauté les talents: **Ceux-ci** plaisent dans tous les temps; **Celle-là** n'a qu'un temps pour plaire. VOLTAIRE.	*Such is the ordinary advantage which talents possess over beauty: the former please at all times; the latter has but one time to please.*

(5.) **Ceci, cela,** have no plural, and are used only of things. They do not refer to a word expressed before, but serve to point out objects:—

prenez *ceci, take this.*	donnez-moi *cela, give me that.*
J'ai déjà dit ce qu'il faut faire, quand un enfant veut avoir *ceci* et *cela.* J. J. ROUSSEAU.	*I have already said what should be done when a child will have this and that.*

(6.) **Ce,** a pronoun, must not be confounded with the demonstrative adjective *ce.* The pronoun *ce* is often used without an antecedent, as the nominative of the verb *être,* in the same manner as the English pronoun *it*:—

c'est moi, *it is I.*	c'est vous, *it is you.*
Ce n'est plus le jouet d'une flamme servile.	*It is no longer the sport of an unworthy love.*
C'est Pyrrhus, **c'**est le fils et le rival d'Achille. RACINE.	*It is Pyrrhus; it is the son and the rival of Achilles.*

For particular rules on this pronoun, see § 104.

§ 39.—RELATIVE PRONOUNS.

(1.) The relative pronouns are so named on account of the intimate relation which they have to a noun or pronoun which precedes, and of which they recall the idea. The noun or pronoun so preceding the relative pronoun is called the antecedent.

(2.) TABLE OF THE RELATIVE PRONOUNS.

qui, *who, which, that* (subject) — de qui, *of, from whom;* — dont, *of, from whom; which;* } Régime indirect, genitive and ablative.
que, *whom, which, that* (direct object)

à qui, *to whom* (indirect object, dative).
lequel, *who, which;* composed of the article and *quel.*

Singular.		*Plural.*		
Masculine.	*Feminine.*	*Masculine.*	*Feminine.*	
lequel,	laquelle,	lesquels,	lesquelles,	*who, which;*
duquel,	de laquelle,	desquels,	desquelles,	*of, from which;*
auquel,	à laquelle,	auxquels,	auxquelles,	*to which.*

y, *to him, to her, to it, to them,* etc.
en, *of him, of her, of it, of them,* etc.
quoi, *what, which, why,* etc.
où, *in which, therein, through which,* etc.

§ 40.—REMARKS ON THE RELATIVE PRONOUNS.

(1.) **Qui,** *who, which,* is used as subject for both genders and numbers, for persons and for things. (See No. 6 of this §.)

(2.) When used for things, **qui** cannot be preceded by a preposition, but it can be so used in reference to persons.

(3.) It is used relatively and absolutely.

(4.) It is used relatively when it has an antecedent from which it must not be separated by a noun:—

Le premier *qui* fut roi, fut un père adoré. AUBERT.	*The first who became king, was an adored father.*
L'amour avidement croit tout ce *qui* le flatte. RACINE.	*Love believes eagerly all that flatters it.*
L'homme **en qui** vous mettez votre confiance.	*The man in whom you place your confidence.*

(5.) It may be used absolutely, *i.e.,* without antecedent, in affirmative, negative, or interrogative sentences, and in this case as subject, and as direct or indirect object, *but only in reference to persons.* It is then rendered in English by: *he who, he whom, him who, him whom, whoever, whomsoever, who, whom*:—

Qui veut parler sur tout, souvent parle au hasard. ANDRIEUX.	*Who (he who) wishes to speak on every subject, speaks often at random.*
Je sais **de qui** elle veut parler.	*I know of whom she wishes to speak.*
Elle épousera **qui** elle voudra.	*She shall marry whomsoever she likes.*
À qui écrivez-vous?	*To whom are you writing?*
Il sait **à qui** vous écrivez.	*He knows to whom you write.*
Qui parle? *who speaks?*	*Qui* voyez-vous? *whom do you see?*

(6.) **Que,** *whom, what, which,* stands generally as direct object. This pronoun is used for persons and things. It is of both genders and numbers:—

les lettres **que** j'ai,	*the letters which I have.*
les hommes **que** j'ai vus,	*the men whom I have seen.*

(7.) It is relative when it has an antecedent, from which it must not be separated:—

La gloire prête un charme aux horreurs **qu'**on affronte. DELAVIGNE.	*Glory lends a charm to the horrors which we face.*
Des lois **que** nous suivons, la première est l'honneur. VOLTAIRE.	*Of the laws which we follow, the first is honour.*

(8.) It is absolute when it has no antecedent. In this sense it is only used in reference to inanimate objects, and means *what thing? what?*

que voulez-vous?	*what will you (have)?*
que dit-on?	*what do people say?*

(9.) **Quoi,** *what,* is invariable, and said only of things. It may be used absolutely and relatively, with or without preposition:—

j'ignore **ce à quoi** il pense, *I am ignorant of what he thinks.*

In the above sentence it is relative, being preceded by its antecedent ce.

il ne sait **quoi** dire, *he does not know what to say.*

(10.) **Quoi,** when absolute, means *what thing?* and is used mostly in interrogative and doubtful sentences:—

Il y a dans cette affaire je ne sais **quoi**, que je n'entends pas. L'ACADÉMIE.	*There is in that affair I know not what, which I do not understand.*
Il y avait je ne *sais* **quoi** dans ses yeux perçants, qui me faisait peur. FÉNELON.	*There was I know not what in his piercing eyes, which inspired me with fear.*

(11.) **Dont,** *of whom, of which, whose,* is used for both genders and numbers, for persons and for things. It is always employed relatively, and, therefore, always refers to an antecedent:—

Un plaisir **dont** on est assuré de se repentir ne peut jamais être tranquille. MME. DE LA VALLIÈRE.	*A pleasure of which we are sure to repent, can never be a peaceful one.*

Il faut plaindre le sort du prince infortuné, **dont** le cœur endurci n'a jamais pardonné. CHÉNIER.	*We must pity the fate of that unfortunate prince, whose hardened heart has never forgiven.*

(12.) **Dont** is used instead of **de qui**, *of whom*; **par lequel**, *through which*; **duquel**, *of which*; **de quoi**, *of what*, etc., and may be separated from its antecedent :—

La dame à qui vous parliez, et **dont** vous avez vu le mari hier . . .	*The lady to whom you were speaking, and whose husband you saw yesterday . . .*

(13.) An interrogative sentence cannot be introduced by dont. When *whose* introduces an interrogative sentence, it is expressed in French by **de qui**, and when absolute possession is meant, by **à qui** :—

Whose son is he?	**De qui** est-il fils?
Whose house is that?	**À qui** est cette maison?

(14.) **Lequel, lesquels, laquelle, lesquelles**, *who, which*, should be used instead of **qui** or **que**, when the latter should be separated from their antecedent by a noun, in order to avoid ambiguity. They may relate to persons or things :—

C'est un effet de la divine Providence, **lequel** attire l'admiration de tout le monde. BUSSI-RABUTIN.	*It is a provision of divine Providence, which (provision) attracts the admiration of every one.*

(15.) **Lequel**, preceded by a preposition—that is, **duquel, auquel, dans lequel**, etc., must always be used in reference to inanimate objects, and never **qui**, as has been mentioned above :—

Un livre curieux serait celui **dans lequel** on ne trouverait pas un mensonge. NAPOLÉON.	*That would be a curious book in which not a falsehood were found.*
La Seine, dans le lit **de laquelle** viennent se jeter l'Yonne, la Marne et l'Oise.	*The Seine, into the bed of which the Yonne, the Marne, and the Oise empty themselves.*

(16.) **Lequel**, in all its modifications, may be used in reference to persons and things :—

lequel? *which one?*	duquel? *of which one?*
lequel voyez-vous?	*which one do you see?*
C'est une de ses sœurs, mais je ne sais pas **laquelle**.	*It is one of his sisters, but I do not know which.*
Voici deux romans, choisis **lequel** tu voudras.	*Here are two novels, choose which you please.*

(17.) **En**, *of him, of her, of it, of them*. This pronoun is of both genders and numbers. It is often used for the English words *some, any*, when employed absolutely, or even when understood; as indirect object in relation to things, and sometimes, but not often, in relation to persons [§ 89 (2)], instead of the personal pronouns **de lui, d'elle, d'eux, d'elles**. This pronoun must be placed before the verb when the latter is followed by a numeral adjective, an adverb of quantity, or a noun of quantity, whenever those words are not followed by a noun. [§ 100, Rule 1.]

A-t-il de l'argent sur lui?	*Has he any money about him?*
Oui, il **en** a.	*Yes, he has some.*
Il n'**en** a pas.	*He has none.*
Avez-vous des amis? Oui, j'**en** ai.	*Have you friends? Yes, I have.*
Vous **en** parlez, *you speak of it.*	**J'en** ai, *I have some.*
La fortune a son prix: l'imprudent **en** abuse,	*Fortune has its worth: the imprudent abuse it, the hypocrite speaks evil of it, and the worthy man uses it.*
L'hypocrite **en** médit, et l'honnête homme **en** use. DELILLE.	
Les limites des sciences sont comme l'horizon; plus on **en** approche, plus elles reculent. MME. NECKER.	*The limits of science are like the horizon, the more we approach (them), the more they recede.*
La vie est un dépôt confié par le ciel;	*Life is a trust confided by heaven; to dare to dispose of it is a crime.*
Oser **en** disposer, c'est être criminel. GRESSET.	
Il a deux frères, moi j'**en** ai trois.	*He has two brothers, I have three.*
Il a de l'argent, mais il n'**en** a pas beaucoup.	*He has money, but he has not much.*
Combien de bouteilles de vin voulez-vous?	*How many bottles of wine will you have?*
J'en veux une douzaine.	*I want a dozen.*

(18.) **Y**, *to him, to her, to it, to them, thereto*, etc. This relative pronoun, of both genders and numbers, is used instead of *à lui, à elle, en lui*, etc., in reference to things, sometimes but rarely in reference to persons, and also adverbially in the sense of *there*.

J'y pense, *I think of it.*	**J'y** donne mes soins, *I devote my care to it.*
J'ai connu le malheur, et **j'y** sais compatir. GUICHARD.	*I have known misfortune, and I can sympathise with it.*
N'**y** songeons plus, cher Paulin; plus **j'y** pense,	*Let us think no more of this, dear Paulin; the longer I think of it, the more I feel my cruel constancy waver.*
Plus je sens chanceler ma cruelle constance. RACINE.	
Vous avez peu de biens; joignez-**y** ma fortune. DORAT.	*You have but little property; join my fortune to it.*
En quelque pays que j'aie été, **j'y** ai vécu comme si j'eusse dû **y** passer ma vie. MONTESQUIEU.	*In whatever country I have been, I lived (there) as if I was to spend my life in it.*
Je connais cet homme, je ne m'**y** fie pas.	*I know that man, I do not trust him.*

(19.) The pronouns **en** and **y*** may be used to avoid the repetition of *any* personal pronoun :—

Je parle souvent de toi, mais **j'y** pense encore plus.	*I often speak, and still more often think of you.*
Elle ne pense guère à moi, et elle **en** parle rarement.	*She thinks and speaks but rarely of me.*

(20.) **Où**, *in which, through which, during which*, etc. This pronoun is used in reference to place and time, and never applied to persons. It is common gender and number, and may be replaced by **lequel, laquelle**, etc., and a preposition :—

La ville **où** (or dans laquelle) il demeure.	*The town in which he lives.*
Les rues **où** (or par lesquelles) il a passé.	*The streets through which he passed.*
Le jour **où** (or pendant lequel) je suis arrivé.	*The day on which I arrived.*

§ 41.—INDEFINITE PRONOUNS.

The indefinite pronouns indicate persons and things without particularising them; they are :—

autrui,	*others.*	l'un l'autre,	*one another.*
chacun,	*every one.*	l'un et l'autre,	*both.*
on,	*one, people, they.*	rien,	*nothing, anything.*
personne,	*no one, nobody.*		
quelqu'un,	*some, somebody.*	tel,	*such.*
quiconque,	*whoever.*	tout,	*everything, whole.*

§ 42.—REMARKS ON THE INDEFINITE PRONOUNS.

(1.) **Autrui**, *others*. This pronoun is applied only to persons. It has no change of form for gender or number, and is used generally after a preposition :—

L'honnête homme est discret; il remarque les défauts d'**autrui**, mais il n'en parle jamais. ST. ÉVREMOND.	*The gentleman is discreet; he observes the defects of others, but never alludes to them.*
Ne fais point **à autrui** ce que tu ne voudrais pas qu'on te fît.	*Do not unto others that which thou wouldest not like to be done unto thee.*

(2.) **Chacun**, *every one, each one*. When this pronoun is absolute, and means *every one, everybody*, it is invariable :—

Le sens commun n'est pas chose commune,	*Common sense is no common thing, though every one believes he has enough of it.*
Chacun pourtant, croit en avoir assez. VALAINCOURT.	
Chacun est prosterné devant les gens heureux. DESTOUCHES.	*Every one bows before the fortunate.*

(3.) When **chacun** is used relatively it may take the form of the feminine :—

Chacune de nous (des femmes) se prétendait supérieure aux autres en beauté. MONTESQUIEU.	*Every one of us (women) thought herself superior in beauty to the others.*

(4.) **On** (*one, people, they*) is only used as subject; and though it always governs its verb in the third person singular, yet it

* The use of these two pronouns is subordinate to the preposition required by the verb: **en** can only be used with verbs which require **de**, and **y** with verbs which require **à**.

conveys most generally the idea of plurality. It is commonly used in indefinite sentences :—

On dit, *people say, they say, it is said.*	**On** parle, *somebody speaks, etc.*
On garde sans remords ce qu'**on** acquiert sans crime. CORNEILLE.	*We (one, people) keep without remorse that which we (one, people) acquire without crime.*
On relit tout Racine; **on** choisit dans Voltaire. DELILLE.	*We (people, they) read again and again all Racine; we (etc.) select in Voltaire.*
On ne surmonte le vice qu'en le fuyant. FÉNELON.	*We conquer vice only by avoiding it.*

(5.) **On**, coming immediately after the words **et, où, si, que,** and **qui**, may be preceded by the article l', used for euphony; this should not be done, however, when **on** precedes a word beginning with l :—

Ce que **l'on** conçoit bien, s'exprime clairement. BOILEAU.	*That which one understands well he clearly expresses.*
C'est d'un roi que **l'on** tient cette maxime auguste, Que jamais **on** n'est grand, qu'autant que **l'on** est juste. BOILEAU.	*It is from a king that we derive this august maxim, that one is only great in proportion as he is just.*

NOTE.—**L'on** may be used *before*, but *never after*, a verb. When **on** follows a verb ending with a vowel, *t* is inserted between them for the sake of euphony :—

Vous croira-**t-on**?	*Will they believe you?*
L'aime-**t-on**?	*Is he loved?*

(6.) **Personne**, *no one, nobody*, as an indefinite pronoun, is always masculine and singular, and may be used as subject or as object. Like all negative expressions, it requires **ne** before the verb :—

Il n'est **personne** qui ne cherche à se rendre heureux.—*Chinese thought.*	*There is no one who does not seek to render himself happy.*
Personne ne veut être plaint de ses erreurs. VAUVENARGUES.	*No one wishes to be pitied on account of his mistakes.*
Je n'ai vu et n'ai entendu **personne.**	*I have seen and heard nobody.*

LESSONS IN GEOGRAPHY.—XXXVII.

NORTH AMERICA (*continued*).

THE *rivers* in North America are even on a grander scale than the mountains, as compared with those of the Old World. The largest river in this continent is the Mississippi, which brings to the Atlantic the waters drained from a surface of more than a million of square miles. This river, which rises in Lake Itasca, in Minnesota, at the elevation of about 1,500 feet, flows in a southerly direction to its embouchure, in the Gulf of Mexico, a distance of about 2,400 miles, reckoning its windings. The longer branch of this river, called the Missouri, rises in the Rocky Mountains, and has a course of about 2,500 miles before it joins the Mississippi; so that the whole length of the River Mississippi by this great branch is upwards of 4,000 miles. This river is navigable from the sea to the Falls of St. Anthony, a distance of about 400 miles from its source; and the Missouri is navigable from its junction with the Mississippi to the great falls at the base of the Rocky Mountains. Thus the navigation of the Mississippi exceeds a distance of 2,000 miles, and that of the Missouri, with the lower Mississippi, a distance of 3,000 miles. The Ohio, another tributary to the Mississippi, has a course of nearly 1,000 miles before it reaches the latter, and receives a considerable number of tributary rivers, of which the Tennessee is the largest, being nearly equal to the Ohio itself. The delta of the Mississippi, owing to the floods which occur among the tributaries and the principal branches, is annually inundated to a great extent from its banks, and is frequently the cause of very serious changes and loss to the neighbouring country.

The next river of importance and magnitude is the St. Lawrence. The source of this river is the St. Louis, which flows into Lake Superior. This lake is connected, like a chain, with Lakes Huron, Erie, and Ontario, through all of which the river runs, and, escaping from the latter, receives the name of the St. Lawrence: it then flows in a channel of about 700 miles in length, forming between Quebec and the sea a broad estuary, which increases from 25 miles to upwards of 100 miles at its embouchure. The whole length of the St. Lawrence is consequently about 2,000 miles. This river is navigable to the rapids, near Montreal. On the channel between Lakes Erie and Ontario, a distance of about 40 miles, occur the Falls of Niagara, about 150 feet in depth, one of the most remarkable cataracts in the world for extent and sublimity. In the northern regions of the North American continent occur several rivers of considerable extent: the Nelson, about 1,400 miles; the Churchill, about 900 miles; the Mackenzie, upwards of 2,000 miles; the Coppermine River, and others, whose lengths are not yet determined. On the eastern coast of this continent are a number of rivers, whose average length is about 400 miles, such as the Connecticut, the Hudson, the Delaware, the Susquehanna, the Potomac, the Savannah, etc., all of which flow into the Atlantic. On the western side of the continent, and flowing into the Pacific, are the following, with their estimated lengths :—The Columbia, 750 miles; the Sacramento, 420 miles; and the Colorado, 840 miles. The Rio Grande del Norte, about 1,400 miles long, falls into the Gulf of Mexico.

Of the *lakes* in North America, the largest are those in the line of the St. Lawrence, namely, Superior, Huron, Michigan, Erie, and Ontario, which, taken together, are estimated to cover a surface of nearly 100,000 square miles. These lakes are situated upon a succession of terraces, rising one above another. Ontario, at a height of 234 feet above the level of the sea, covers about 13,000 square miles; Erie, at a height of 565 feet, about 11,000 square miles; Huron, at a height of 595 feet, about 17,000 square miles; Michigan, about the same height, nearly 14,000 square miles; and Superior, at the height of 627 feet, about 43,000 square miles.

The other lakes of North America are very considerably smaller, those in the northern part of this continent being Lakes Winnipeg, Winnipegoos, and Athabasca, the Great Slave and Great Bear Lakes, the Deer Lake, Lake Wollaston, etc., covering altogether a surface of about 30,000 square miles. To the west of the Rocky Mountains are the Great Salt Lake and Lake Utah; in Mexico and Central America, Lake Chapala, Lake Nicaragua, and Lake Managua, covering a space of about 4,600 square miles.

The *islands* of North America are numerous. Greenland may be regarded as an immense island, in the north-west; Grinnell Land, North Devon, Cornwallis, Melville Island, Banks Land, Prince Albert Island, Prince of Wales Island, North Somerset, Cockburn Island, and some others to the north of the mainland, form what is sometimes called the Arctic Archipelago. Going southwards along the Atlantic seaboard we find Newfoundland, Anticosti, Prince Edward Island, and Cape Breton, on the British coast, and Long Island and some smaller ones on the United States Coast. Far out in the Atlantic are the Bermudas, and stretching in an arc from Florida to the north coast of South America are the West India Islands, which will be mentioned in detail in our next lesson. On the Pacific seaboard are Vancouver Island and Queen Charlotte Islands. On the coast of British Columbia and on the coast of Alaska are Prince of Wales Archipelago, Sitka, Kodiak, and some others; and the Aleutian Isles trending westward in a long chain from the headland which terminates the peninsula of Alaska. This peninsula, it may be said, gives its name to the whole of the new territory purchased by the United States from Russia, and formerly known as Russian America.

SUMMARY OF RIVERS.

St. Lawrence, Canada.
Hudson, E. United States.
Delaware, E. United States.
Chesapeake, E. United States.
Mississippi (with the Missouri, Ohio, and other great tributaries), Central and S. United States.
Rio Grande del Norte, Mexico.
Colorado, E. United States.
Sacramento, E. United States.
Columbia, E. United States.
Frazer River, British Columbia.
Youkon, Alaska.
Mackenzie River, British North America.
Back River, British North America.
Great Fish River, British North America.
Nelson (and its tributary, the Saskatchewan), British North America.

SUMMARY OF LAKES.

Ontario, Erie, Huron, Michigan, Superior — For boundary line between the United States and Dominion of Canada.
Itasca, Minnesota, U.S.
Nicaragua, Central America.
Chapala, Mexico.
Great Salt Lake, Utah.


NORTH AMERICA
Scale of Miles
200 400 600 800
Lon. West from Greenwich
ARCTIC OCEAN
POLAR SEA
GREENLAND
BAFFIN'S BAY
BRITISH AMERICA
HUDSON'S BAY
LABRADOR
UNITED STATES
MEXICO
GULF OF MEXICO
WEST INDIES
CARIBBEAN SEA
PACIFIC OCEAN
ATLANTIC OCEAN
SOUTH AMERICA
TEXAS
CALIFORNIA
OREGON
UTAH
MISSOURI TERRITORY
INDIAN TERRITORY
ALASKA
QUEBEC
ONTARIO
NOVA SCOTIA
NEW FOUNDLAND
Arctic Circle
Tropic of Cancer
Gulf Stream
Lat. of Pekin
Lat. of Jedo
Lat. of Canton
Lat. of the Sandwich Is.
Lat. of Morocco
Lat. of the Canary Is.
Bermudas Is.
Sitka
Chicago
St. Louis
Nashville
Memphis
Little Rock
Natchez
Mobile
Pensacola
Columbus
Savannah
Charleston
Wilmington
Augusta
Richmond
Cincinnati
Washington
Philadelphia
New York
Albany
Hartford
Boston
Pittsburg
Toronto
Detroit
Kingston
Montreal
Quebec
Halifax
St. Johns
Astoria
Oregon City
San Francisco
Monterey
St. Diego
Santa Fe
Austin
Houston
New Orleans
Chihuahua
Durango
Monterey
Matamoras
Zacatecas
Guanaxuato
Guadalaxara
San Blas
Mexico
La Puebla
Vera Cruz
Campeche
Merida
Acapulco
Belize
Havanna
Kingston
New Guatemala
Bay of Campeche
Bay of Honduras
Chesapeake Bay
Delaware Bay
L. Superior
L. Michigan
L. Erie
L. Ontario
L. Winnipeg
Great Slave L.
Athabasca L.
L. of the Woods
Lon. West from Washington
Lon. East

Great Bear Lake, British North America.
Great Slave Lake, British North America.
Athabasca, British North America.
Winnipeg, British North America.
Winnipegoos, British North America.

Summary of Islands.

Greenland, N.W. America.
Arctic Archipelago, comprising—
Grinnell Land.
North Devon.
Cornwallis.
Melville Island.
Banks Land.
Prince Albert Land.
Prince of Wales Island.
North Somerset.
Cockburn Island.
Newfoundland.
Anticosti.
Prince Edward Island.
Cape Breton.
Long Island.
West India Islands.
Bermudas.
Vancouver Island.
Queen Charlotte Islands.
Prince of Wales Archipelago.
Sitka.
Kodiak.
Aleutian Isles.

CIVIL SERVICE PAPERS.—III.

GROUP III.

Group III. will be treated in this and one or two subsequent papers. It is the largest of the groups, and comprises the British Museum, the Charity Commission, the Civil Service Commission, the House of Lords Office, the House of Commons Office, the Copyhold and Tithe Commission, Ecclesiastical Commission, Emigration Office, Lunacy Commission, Mint, National Debt Office, Patent Office, Paymaster-General's, Record Office, and General Registry Office.

1.—British Museum, Great Russell Street. (*Nomination.*)

This office is charged with carrying out the administrative detail of the duties of the trustees for the Museum. Patronage in the three principal trustees, who are the Primate, the Lord Chancellor, and the Speaker of the House of Commons. Limits of age of candidates—assistants, 18 and 30; attendants, 18 and 30; messengers, 18 and 40. The attendants are examined in—

1. Writing from Dictation.
2. Elementary Arithmetic.

Assistants are examined in—

1. Writing from Dictation.
2. Arithmetic (elementary).
3. English Composition.
4. Précis.
5. Geography.
6. British History.
7. Translation from one Ancient and one Modern Language.
8. Orthography.

[Persons possessing a special knowledge, whose services are particularly needed, will be examined with regard to the knowledge in which special proficiency is required rather than with regard to the general subjects of the qualifications for assistants. In such an establishment as the British Museum, where special scientific or antiquarian knowledge is required, such a regulation is obviously necessary.]

Besides the heads of departments and other chief officers, there are 25 first-class assistants, £250 to £450; 44 second-class assistants, £120 to £240; clerk, lower division, £95 to £250; 56 first-class attendants, £105 to £120; 83 second-class attendants, £60 to £100; and 3 messengers, £100 to £150.

2.—The Charity Commission, York Street, St. James's Square. (*Open Competition.*)

This office is charged with the detail of the duties thrown upon the Commissioners by the Act of Parliament which, in 1853, empowered them to deal with lands and money left for charitable purposes in such a way as would most thoroughly promote the objects of charity without reference to the special objects named in the bequests. Salaries:—4 principal clerks, £650 to £800; 3 first-class clerks, £400 to £550; 4 second-class clerks, senior division, £300 to £400; 6 second-class clerks, junior division, £200 to £300; 21 lower division men clerks, £95 to £250; and 5 messengers, £70 to £100.

3.—Civil Service Commission, Cannon Row, Westminster. (*Open Competition.*)

Instituted in 1855, for the purpose of testing educational acquirements of candidates for the Civil Service. Clerical staff small. Salaries:—10 supplementary clerks, £95 to £250; 6 junior clerks, £100 to £350; 5 senior clerks, £400 to £600.

4.—House of Lords (Clerk of Parliaments). (*Nomination.*)

Establishment as follows:—Five senior clerks, various salaries, from £850 to £1,000; 15 clerks, £100 to £600; 1 receiver of fees and accountant, partly paid by poundage on sums received, £250; 1 assistant accountant ditto, £350; 7 messengers, £80 to £170.

5.—House of Commons. (*Nomination.*)

There are three departments—the patronage resting with the Speaker, the Treasury (Department of the Sergeant-at-Arms), and the Clerk of the House. The limits of age for clerks are 19 and 25, but for candidates who have previously been in the public service as temporary clerks, or otherwise, the maximum limit shall be extended to 30, provided the candidate was under 25 when he entered the service, and has served continuously; messengers must be between the ages of 25 and 40 to be appointed.

I. Clerks and Supernumerary Clerks.

1. Handwriting and Orthography.
2. The Power of Accurate Comparison of Copies with Originals.
3. Arithmetic (including Vulgar and Decimal Fractions).
4. English Composition.
5. History of England, and of the Constitution.
6. Latin or French (Translation).
7. Bookkeeping by single entry.

Salaries:—Junior clerks, £100 to £250, by £10 a year; assistant clerks, £300 to £600, by £15 a year; senior clerks, £650 to £800, by £15 a year. The prizes are the principal clerkships, with salaries ranging from £850 to £1,000, by annual increments of £25.

6.—Copyhold, Enclosure, and Tithe Commission, St. James's Square. (*Nomination.*)

Commissioners assist in the enclosure and utilisation of waste lands; in the commutation of tithes, and in arranging for payment of fines to lords of manors. Their work is a purely artificial one, created by Acts of Parliament to meet exigencies arising out of a change in English home policy. There is a great deal of strictly professional work for surveyors, architects, and lawyers. Office patronage in the Commissioners. Ages: clerks and assistant record keepers, 18 to 25. Salaries: Chief clerk, £600; senior first-class clerk, £550; 4 first-class clerks, £300 to £500; 6 second-class clerks, £100 to £300; 2 building clerks, £100 to £300; 4 lower division clerks, £80 to £200; surveyor, £250 to £350; 5 assistant surveyors, £150 to £250; record keeper, £80 to £200; assistant record keeper, £80 to £150; 2 messengers, £60 to £80.

LESSONS IN ALGEBRA.—XVII.

SIMPLE EQUATIONS (*continued*).

NUMERICAL SUBSTITUTION.

172. In the reduction of an equation, as well as in other parts of algebra, a *complicated* process can often be rendered *more simple*, by using letters for the given numbers, and also by introducing a *new letter* which shall be made to represent a *whole algebraic expression. This process is called* SUBSTITUTION. After the algebraic operation is completed, the *numbers*, or the *compound quantity* for which a *single* letter has been *substituted*, must be restored, in order to obtain the numerical value.

Example.—Reduce $\frac{x}{750}+\frac{3}{375}=1$.

Here, by substituting a for 750, b for 3, and c for 375, the equation becomes $\frac{x}{a}+\frac{b}{c}=1$. Now, clearing of fractions, we have $cx+ab=ac$; and $x=a-\frac{ab}{c}$. On restoring the numbers, we have $x=750-\frac{3\times750}{375}=744$. *Ans.*

Exercise 28.

1. Reduce $\frac{3x}{4} + 6 = 84$.

2. Reduce $\frac{x}{350} + \frac{4500}{7000} = 10$.

3. Reduce $\frac{x}{m+n} + \frac{a}{c} = b$.

4. Reduce $\frac{x}{l-m-n} + \frac{d}{c} = ab$.

5. Reduce $\frac{x}{m} - \frac{a}{b+c+d} = cd$.

6. Reduce $\frac{3x}{4} + 6 = \frac{5x}{8} + 7$.

7. Reduce $\frac{x}{a} + h = \frac{x}{b} - \frac{x}{c} + d$.

8. Reduce $40 - 6x - 16 = 120 - 14x$.

9. Reduce $\frac{x-3}{2} + \frac{x}{3} = 20 - \frac{x-19}{2}$.

10. Reduce $\frac{x}{3} + \frac{x}{5} = 20 - \frac{x}{4}$.

11. Reduce $\frac{1-a}{x} - 4 = 5$.

12. Reduce $\frac{3}{x+4} - 2 = 8$.

13. Reduce $\frac{6x}{x+4} = 1$.

14. Reduce $x + \frac{x}{2} + \frac{x}{3} = 11$.

15. Reduce $\frac{x}{2} + \frac{x}{3} - \frac{x}{4} = \frac{7}{10}$.

16. Reduce $\frac{x-5}{4} + 6x = \frac{284-x}{5}$.

17. Reduce $3x + \frac{2x+6}{5} = 5 + \frac{11x-37}{2}$.

18. Reduce $\frac{6x-4}{3} - 2 = \frac{18-4x}{3} + x$.

19. Reduce $21 + \frac{3x-11}{16} = \frac{5x-5}{8} + \frac{97-7x}{2}$.

20. Reduce $3x - \frac{x-4}{4} - 4 = \frac{5x+14}{3} - \frac{1}{12}$.

21. Reduce $\frac{7x+5}{3} - \frac{16+4x}{5} + 6 = \frac{3x+9}{2}$.

22. Reduce $\frac{17-3x}{5} - \frac{4x+2}{3} = 5 - 6x + \frac{7x+14}{3}$.

23. Reduce $x - \frac{3x-3}{5} + 4 = \frac{20-x}{2} - \frac{6x-8}{7} + \frac{4x-4}{5}$.

24. Reduce $\frac{6x+7}{9} + \frac{7x-13}{6x+3} = \frac{2x+4}{3}$

25. Reduce $\frac{5x+4}{2} : \frac{18-x}{4} :: 7 : 4$.

26. Reduce $2x - 9 = 72 + \frac{x}{5}$.

27. Reduce $x - 11 = \frac{x+2}{5} + 7$.

28. Reduce $\frac{x}{2} - 1 = \frac{x}{3} + 1$.

29. Reduce $11 - \frac{x}{5} = 13 - \frac{x}{4}$.

30. Reduce $\frac{x+1}{4} + \frac{x-1}{6} = 8$.

31. Reduce $\frac{x-3}{8} + \frac{x+9}{12} = \frac{3x+7}{20} + 3$.

32. Reduce $\frac{2x}{3} + \frac{4x}{5} - \frac{6x}{7} = \frac{x}{2} + \frac{3x}{4} - \frac{5x}{6} + 81$.

33. Reduce $\frac{x-1}{2} + \frac{x-2}{3} - \frac{x-3}{4} = 6$.

GEOMETRICAL PERSPECTIVE.—XV.

We will commence this lesson by giving a practical illustration of the remarks made in the last lesson upon Fig. 71.

Problem XLII. (Fig. 72).—*A folding screen of four leaves,* A, B, C, D. *Two of the leaves,* A *and* B, *form an angle of* 100°; C *is at an angle of* 80° *with* B; *and* D *at an angle of* 70° *with* C. *The screen is* 6 *feet high, and each leaf is* 3 *feet broad. Height of the eye,* 5 *feet; and distance from the picture plane,* 9 *feet. The eye opposite the centre of the leaf* B.

In drawing the ground plan, make the plans of the leaves A, B, C, D each 3 feet long, and unite them according to the angles stated in the question. The PP may be drawn at any distance from it, and in any position the draughtsman may consider to be most convenient, with reference to any particular view of the subject he wishes to represent, bearing in mind that the *direction of sight from the selected station point of view must be perpendicular to the* PP. Therefore the line drawn from the centre of the leaf B (opposite to which the eye is directed according to the conditions in the question) must be drawn perpendicularly to the PP; and upon it place the SP 9 feet from the PP. The HL and base of the picture may be drawn anywhere below the PP. From the SP draw vanishing lines to the PP, to produce the vanishing points; and mark each VP with the letter of the leaf to which it belongs, to ensure the right direction of the extremities of each leaf respectively. Draw visual rays from each angle of the plan to the PP, in the direction of the SP, afterwards to be drawn perpendicularly from the PP. Produce the plan of one of the leaves, say A, to the PP, for a point of contact; *e f* will then be the line of contact upon which to mark the height of the screen *f h*.

We must remind our pupils here that they are *to follow the course of the ground plan* when drawing the perspective positions of the ends of the leaves, viz., the tops and bases; change the directions at the visual rays, and be guided by their respective vanishing points; whilst the perpendicular continuations of the visual rays from the PP will determine their widths. Thus *i n o g* represent the leaf A; *o p k g* the leaf B; *p r l k* the leaf C; and *r l m s* the leaf D.

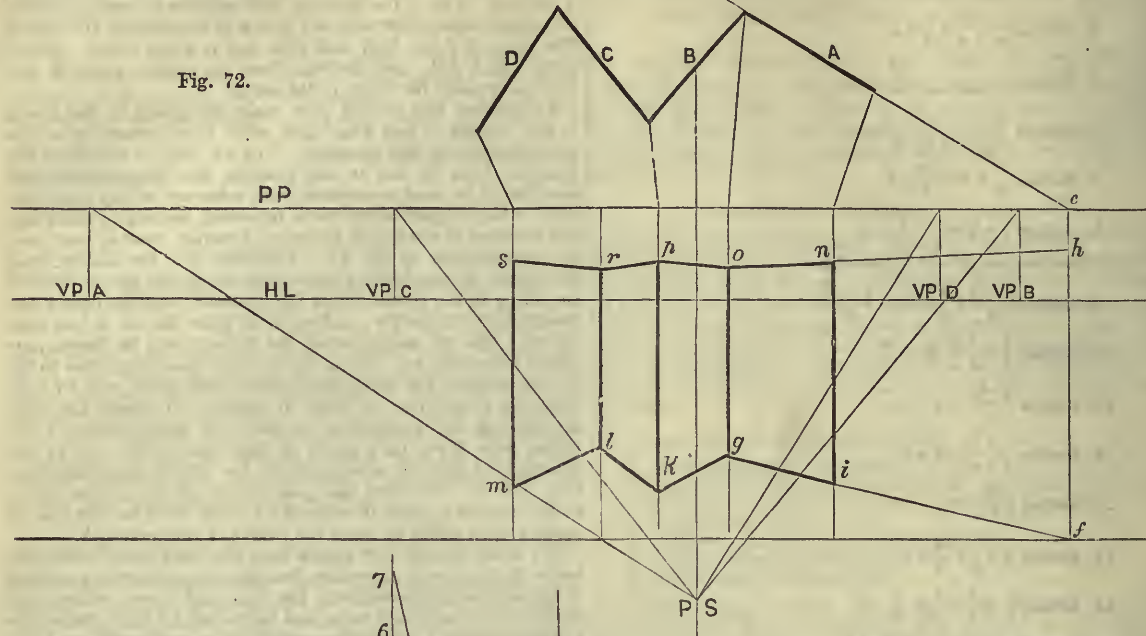
In drawing buildings where there are many projections the regulation of *following the course of the ground plan, directed by the vanishing points*, is important. It saves the trouble of additional lines of contact, when the vanishing points for the various projections are obtained.

Our next subject will be steps or staircases.

Problem XLIII. (Fig. 73).—*A flight of eight descending steps. Length of steps,* 12 *feet; width of each,* 1 *foot* 2 *inches; depth of each,* 6 *inches. Height of eye,* 7 *feet. Distance of the eye from the* PP, 9 *feet. Scale,* ¼ *inch to the foot.*

Draw the horizontal line, and the plane of the picture 7 feet below it. Place the PS and DE^1 and DE^2 at 9 feet from PS. The first thing to be considered is the inclination of the steps, found by constructing a profile or section of them from DE^1. Make the distance from DE^1 to *a* equal to the width of the steps, 1 ft. 2 in.; also the spaces *a b*, *b c*, and *c d*, the same. Draw perpendiculars from each of these points to *e*, *f*, *g*, and *h*; making *a e* equal to 6 inches; *b f* twice that distance; *c g* three times; and *d h* four times. Rule a line from DE^1, through the points *e*, *f*, *g*, *h*, to the VP on the perpendicular line drawn through PS. This last line, *e*, *f*, *g*, *h*, will represent the downward inclination of the steps. The tread of each step may be drawn through the points *e*, *f*, *g*, *h*, parallel to the HL. From VP, with the radius to DE^1, draw the arc from DE^1 to DVP, for the distance point of the vanishing point of the inclination. Set off the length of the first step, *i k*, equal to 12 feet. Draw a perpendicular line through *i* for a line of contact or measuring line. Draw from *i* and *k* to VP. Upon these last lines will be found the angles of the steps, thus:—Set off from *i* upwards the spaces 1, 2, 3, 4, etc., each equal to the *inclined* spaces from DE^1 to *e*; from *e* to *f*; from *f* to *g*, etc. Rule from each of these points to DVP. Where these lines cut the one from *i* to VP will be found the angles of the steps. The top of each step must be drawn from these intersections directed from PS, because the tops or treads of the steps are horizontal; and as they retire at right angles from the picture plane, they have the PS for their vanishing point. The other ends of the steps upon *k* must be treated in the same way. The balustrade at the right may be drawn at pleasure, observing that the top of the descending portion vanishes at VP; whilst the horizontal portion from the bottom vanishes at the PS. The points m and n, from which to draw the retiring edge of the pavement, are found thus:—Draw a perpendicular line from k downwards, continue the top of the lowest step at each end, lines to meet one drawn from r to s in w, w, w, etc. From each of these points w, draw lines to PS. Where they appear beyond the line $m\,n$, will be represented the retiring edges of the slabs. A diagonal line from n to t will enable us to find the parallel edges

Fig. 72.



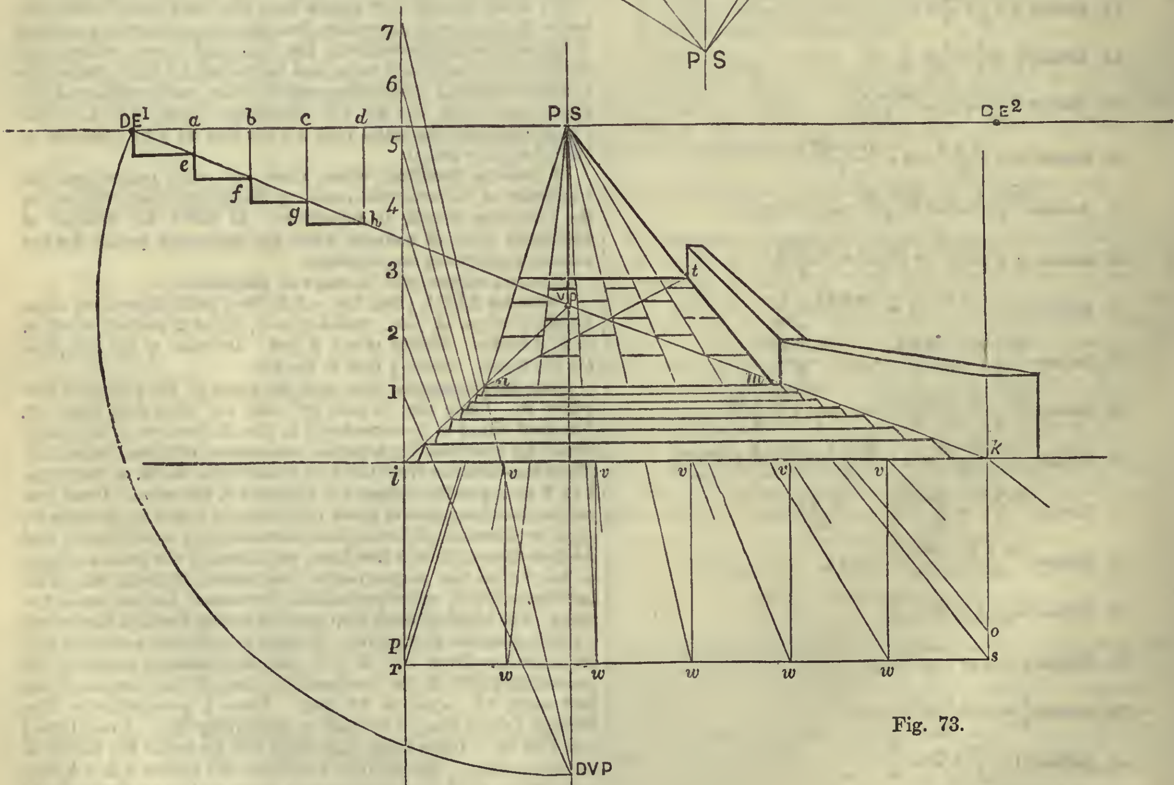


Fig. 73.

directed from the PS, until the lines meet the perpendiculars in p and o; make $p\,r$ and $o\,s$ each equal to the depth of the step, 6 inches; rule back again from p and s to PS. These last lines, appearing beyond the edge of the lowest step, will be the perspective of the sides of the horizontal pavement. To draw the widths of the slabs which compose the pavement, first divide $i\,k$ into the same number of parts as there are slabs to be represented in v, v, v, etc. From these points draw perpendicular of the slabs, because their angles meet the retiring lines which represent the retiring edges, and the diagonal which cuts them.

PROBLEM XLIV. (Fig. 74).—*A flight of ascending steps. Angle of ascent,* 25°. *Seven steps to the first landing, each* 8 *feet long; tread, or horizontal surface of each step,* 1 *foot* 2 *inches; length of first landing, exclusive of the top step,* 8 *feet. Afterwards, four other steps, the same proportions as the lower. Balustrade,* 2 *feet wide, and* 3 *feet high. Angle of the ends of the steps with the* *picture plane, 43°. Height of the eye, 7 feet; nearest angle, 1 foot 6 inches to the right of the eye, and touching the picture plane. Distance of the eye from the picture plane, 11 feet 6 inches. A doorway to be constructed upon the uppermost landing, its proportions at pleasure. Scale,* $\frac{1}{48}$.

Most of the rules applicable to this problem, in the introductory stages of its construction, have been already given in former lessons. We will merely refer to the details previously explained in their order, and pass on to those which especially belong to the subject. The nearest angle touching the picture plane is at *a*; the ground line of the ends of the steps is directed to VP¹; the fronts to VP². The angle of inclination of the ascent is constructed from DVP¹, meeting the perpendicular from VP¹ at VP³ (see Problem XXXI., Fig. 53). Upon this inclined line construct the profiles of a few steps, for a purpose to be explained presently. The simplest way will be to mark the width of each step, 1 foot 2 inches, on the HL, commencing at DVP¹, viz., 1, 2, 3, etc. From these points draw perpendicular lines to cut and pass beyond the inclined line. The remainder of this portion of the problem will be understood from the figure. Draw from *a* on the PP a line of contact, and take the distances *a*, *b*, *c*, *d*, from the *inclined* line, commencing at DVP¹, and transfer them to *a*, *b*, *c*, *d* on the line of contact, making seven divisions, because there are to be seven steps. Draw lines from the points thus marked on the line of contact to DVP³, and where they cut the inclined line from *a* to VP³ will be produced the positions of the angles of the steps. The ends of their horizontal surface or tread must be drawn towards VP¹. The fronts of the same must be drawn to VP², and the rise will be represented by perpendicular lines meeting the horizontal edges of the steps. For the lengths, the distance of 8 feet must be set off from *a* to *e*. A line drawn from *e* to DVP² will determine *af*, the perspective width. From *f* a line must be drawn to VP³, and upon it draw the ends of the steps in contact with the face of the balustrade, in the same way as those were on the incline from *a*.

We are now about to use the half distance point (see Lesson XIII.). From *g* commences the retiring edge of the landing, *g n*, which is a retiring line of 8 feet; *o* is the half distance point. Directed by this point, draw a line from *h* to *i*, and make *i k* equal to 4 feet. Rule from *k* back again to *m*; draw the perpendicular *m n*; *g n* will then be the retiring edge of the landing, directed to VP¹. From *n* draw an inclined line to VP³. Through *n*, from DVP³, draw a line to meet the line of contact in *p*. Make *p*, *q*, *r*, *s*, and *t* equal to the distances *a*, *b*, *c*, *d*, etc., below. Draw from *q*, *r*, *s*, *t* to DVP³, cutting the inclined line from *n* to VP³, for the purpose of constructing the four remaining steps above the landing. These must be done in the same way as those between *a* and *g*. To draw the balustrade, produce a line from *f* to meet the picture plane in the point of contact 4: 4 *z* will be the line of contact. Draw a line through *f* from DVP¹ to *v*; make *v w* equal to 2 feet; rule back again to produce *x*. The width of 2 feet is cut off by drawing a line from *f*, directed by DVP², to *e*; make *e* 5 equal to 2 feet; rule from 5 back again to 6. The horizontal parts of the balustrade must be drawn towards VP¹, and the remaining portions up the incline must be directed towards VP³.

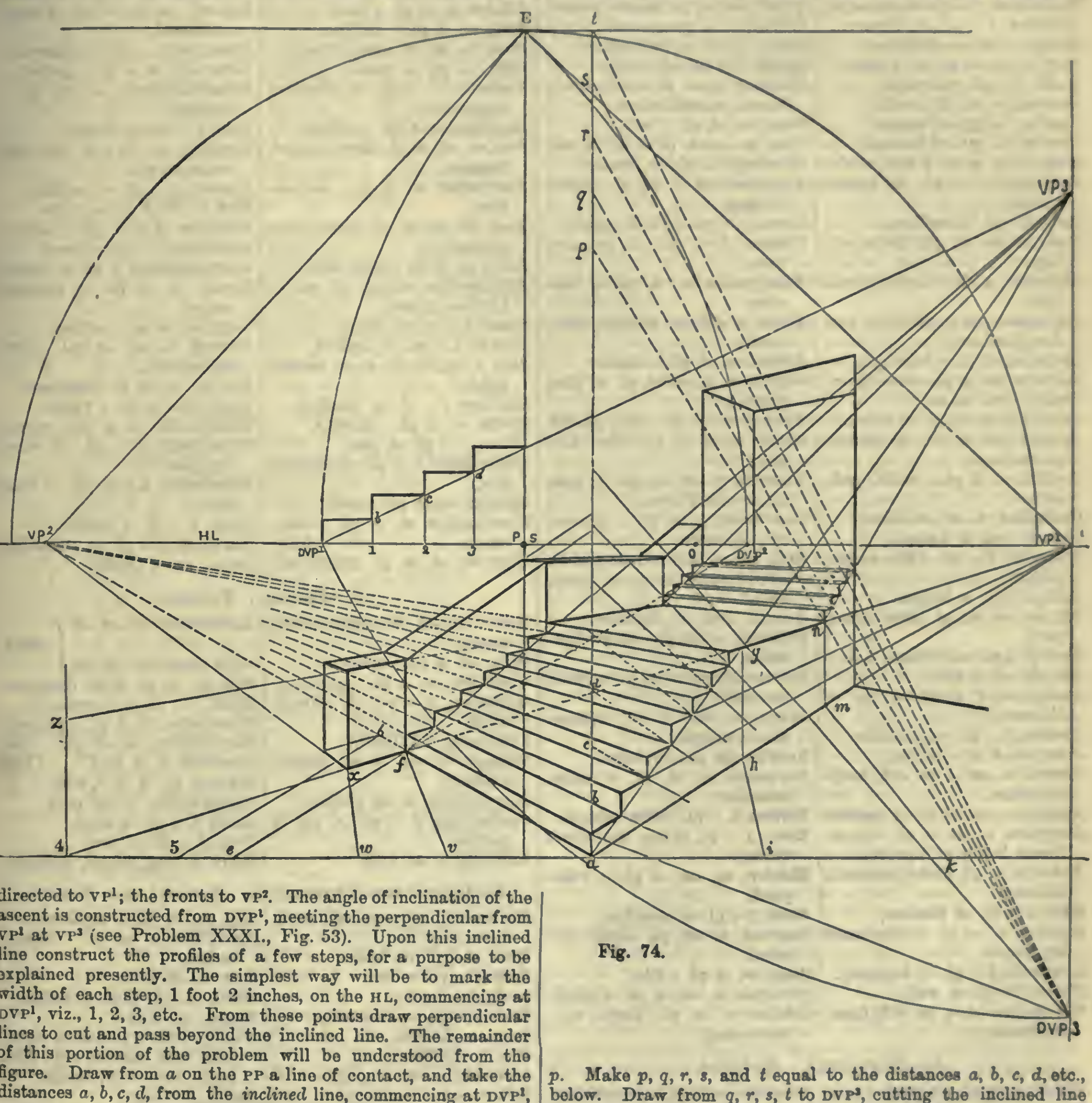


Fig. 74.

LESSONS IN GERMAN.—XLIX.

SECTION C. (*continued*).—EXERCISES IN SPEAKING AND WRITING GERMAN.

VOCABULARY (*continued*).

4.—TOWN AND HOUSE. Die Stadt und das Haus.

Balken, *m.* -s, pl. -, beam.
Bank, *f.* -, pl. -en, bank.
Baum'garten, *m.* -s, pl. -gärten, orchard.
Baum'schule, *f.* -, pl. -n, nursery.
Bibliothek', *f.* -, pl. -en, library.
Börse, *f.* -, pl. -n, exchange.
Brett, *n.* -es, -s, pl. -er, plank.
Brücke, *f.* -, pl. -n, bridge.
Brunnen, *m.* -s, pl. -, well.
Capel'le, *f.* -, pl. -n, chapel.
Caser'ne, *f.* -, pl. -n, barrack.
Dach, *n.* -es, -s, pl. Dächer, roof.
Dach'rinne, *f.* -, pl. -n, gutter, spout.
Decke, *f.* -, pl. -n, ceiling.
Dorf, *n.* -es, -s, pl. Dörfer, village.
Erd'geschoß, *n.* -sses, pl. -sse, ground-floor.
Fen'sterladen, *m.* -s, pl. -läden, window-shutters.
Flecken, *m.* -s, pl. -, borough.
Fuß'boden, *m.* -s, pl. -böden, floor.
Gasse, *f.* -, pl. -n, lane.
Gefäng'niß, *n.* -es, pl. -e, prison.
Gewächs'haus, *n.* -es, pl. -häuser, green-house.
Gewöl'be, *n.* -s, pl. -, vault, arch, cellar.
Glock'enspiel, *n.* -es, -s, chime.
Gosse, *f.* -, pl. -n, kennel.
Hauptstadt, *f.* -, pl. -städte, metropolis.
Hecke, *f.* -, pl. -n, hedge.
Hof, *m.* -es, -s, pl. Höfe, court, yard.
Hütte, *f.* -, pl. -n, cottage, hut.
Kalk, *m.* -es, -s, lime.
Kamin', *m.* & *n.* -es, -s, pl. -e, chimney.
Kammer, *f.* -, pl. -n, chamber.
Keller, *m.* -s, pl. -, cellar.
Kirchhof, *m.* -es, -s, pl. -höfe, burying-place.
Kirchspiel, *n.* -es, -s, pl. -e, parish.
Kirchthurm, *m.* -es, -s, pl. -thürme, tower, belfry of a church.
Kloster, *n.* -s, pl. Klöster, convent, cloister.
Küche, *f.* -, pl. -n, kitchen.
Landhaus, *n.* -es, pl. -häuser, country-house.
Land'straße, *f.* -, pl. -n, highway.
Mauer, *f.* -, pl. -n, wall.
Mei'erhof, *m.* -es, -s, pl. -höfe, farm, tenement.

Möbel, pl. furniture.
Mörtel, *m.* -s, mortar.
Münze, *f.* -, pl. -n, mint, coin.
Ofen, *m.* -s, pl. Oefen, stove.
Palast', *m.* es, pl. Paläste, palace.
Pflaster, *n.* -s, pavement.
Post, *f.* -, pl. -en, post-office.
Pumpe, *f.* -, pl. -en, pump.
Rathhaus, *n.* -es, pl. -häuser, town-house, council-house.
Riegel, *m.* -s, pl. -, bolt.
Saal, *m.* -es, -s, pl. Säle, saloon.
Sacristei', *f.* -, pl. -en, vestry.
Schau'spielhaus, *n.* -es, pl. -häuser, theatre.
Schelle, *f.* -, pl. -n, bell (small).
Scheune, *f.* -, pl. -n, granary, barn.
Schlaf'zimmer, *n.* -s, pl. -, bedroom.
Schloß, *n.* -sses, pl. Schlösser, lock, castle.
Schiefer, *m.* -s, pl. -, slate.
Schornstein, *m.* -es, -s, pl. -e. (See Kamin.)
Speicher, *m.* -s, pl. -, loft, garret.
Spital', *n.* -es, -s, pl. -täler, hospital.
Stadtthor, *n.* -es, -s, pl. -e, gate (of a walled town).
Stadt'viertel, *n.* -s, pl. -, quarter of (the) town.
Stall, *m.* -es, -s, pl. Ställe, stable.
Stockwerk, *n.* -es, -s, pl. -e, story, floor.
Stube, *f.* -, pl. -n, chamber.
Treibhaus, *n.* -es, pl. -häuser, hothouse.
Trep'pengeländer, *n.* -s, pl. -, staircase-rail.
Thurm, *m.* -es, -s, pl. Thürme, tower, steeple.
Umge'bungen, pl., environs.
Vor'zimmer, *n.* -s, pl. -, antechamber.
Vorstadt, *f.* -, pl. -städte, suburb.
Wand, *f.* -, pl. Wände, wall (partition).
Weinberg, *m.* -es, -s, pl. -e, vineyard.
Wiese, *f.* -, pl. -n, meadow.
Zeughaus, *n.* -es, pl. -häuser, arsenal.
Ziegel, *m.* -s, pl. -, tile.
Zie'gelstein, *m.* -es, -s, pl. -e, brick.
Zollhaus, *n.* -es, pl. -häuser, custom-house.

5.—FURNITURE. Mobilien.

Becher, *m.* -s, pl. -, tumbler, cup.
Bett, *n.* -es, -s, pl. -en, bed.
Bett'decke, *f.* -, pl. -n, coverlet.
Bett'lade, *f.* -, pl. -n, bedstead.
Betttuch, *n.* -es, -s, pl. -tücher, sheet.
Bla'sebalg, *m.* -es, -s, pl. -bälge, bellows.
Bü'cherbrett, *n.* -es, -s, pl. -er, book-shelf.
Bü'cherschrank, *m.* -es, -s, pl. -schränke, book-case.

Bü'geleisen, *n.* -s, pl. -, smoothing-iron.
Casserol'le, *f.* -, pl. -n, stew-pan.
Deckel, *m.* -s, pl. -, cover.
Eimer, *m.* -s, pl. -, bucket.
Faß, *n.* -sses, pl. Fässer, cask.
Fe'derbett, *n.* -es, -s, pl. -en, feather-bed.
Feu'erstahl, *m.* -es, -s, pl. -stähle, steel.
Feu'erstein, *m.* -es, -s, pl. -e, flint.
Feu'erzange, *f.* -, pl. -n, tongs.

Feu'erzeug, *n.* -es, -s, pl. -e, tinder-box.
Fußbank, *f.* -, pl. -bänke, footstool.
Gedeck', *n.* -es, -s, pl. -e, cover.
Gemäl'de, *n.* -s, pl. -, picture.
Handtuch, *n.* -es, -s, pl. -tücher, towel.
Herd, *m.* -es, -s, pl. -e, hearth, fireplace.
Holz'kohle, *f.* -, pl. -n, charcoal.
Kästchen, *n.* -s, pl. -, box.
Kessel, *m.* -s, pl. -, kettle.
Kerze, *f.* -, pl. -n, taper, candle.
Kiste, *f.* -, pl. -n, chest.
Kommo'de, *f.* -, pl. -n, chest of drawers.
Kopf'kissen, *n.* -s, pl. -, pillow.
Korb, *m.* -es, -s, pl. Körbe, basket, hamper.
Kron'leuchter, *m.* -s, pl. -, chandelier.
Krug, *m.* -es, -s, pl. Krüge, jug, pitcher.
Kübel, *m.* -s, pl. -, pail, tub.
Küch'engeschirr, *n.* -es, -s, pl. -e, kitchen utensil.
Lampe, *f.* -, pl. -n, lamp.
Later'ne, *f.* -, pl. -n, lantern.
Licht, *n.* -es, -s, pl. -e, -er, candle, light.
Licht'putze, *f.* -, pl. -n, snuffers.
Mörser, *m.* -s, pl. -, mortar.
Pfanne, *f.* -, pl. -n, pan.
Pfef'ferbüchse, *f.* -, pl. -n, pepper-box.
Pfropfen, *m.* -s, pl. -, cork.
Pfrop'fenzieher, *m.* -s, pl. -, cork-screw.
Pfühl, *m.* -es, -s, pl. Pfühle, bolster.
Polster, *n.* -s, pl. -, bolster.
Pult, *n.* -es, -s, pl. -e, desk.
Rahmen, *m.* -s, pl. -, frame.
Salzfaß, *n.* -sses, pl. -fässer, salt-cellar.
Schachtel, *f.* -, pl. -n. (See Kästchen.)
Schaufel, *f.* -, pl. -n, shovel.
Schaum'löffel, *m.* -s, pl. -, skimmer.
Schirm, *m.* -es, -s, pl. -e, screen.
Schrank, *m.* -es, -s, pl. Schränke, cupboard.
Schub'lade, *f.* -, pl. -n, drawer.
Schür'eisen, *n.* -s, pl. -, poker.
Schwe'felhölzchen, *n.* -s, pl. -, match.
Seife, *f.* -, pl. -n, soap.
Senftopf, *m.* -es, -s, pl. -töpfe, mustard-pot.
Serviette, *f.* -, pl. -n, napkin.
Sieb, *n.* -es, -s, pl. -e, sieve.
Sopha, *m.* & *n.* -s, pl. -s, sofa.
Stein'kohle, *f.* -, pl. -n, coal.
Sup'penschüssel, *f.* -, pl. -n, tureen.
Teppich, m. -s, pl. -e, tapestry, carpet.
Tiegel, *m.* -s, pl. -, skillet.
Tischtuch, *n.* -es, -s, pl. -tücher, table-cloth.
Topf, *m.* -es, -s, pl. Töpfe, pot.
Trichter, *m.* -s, pl. -, funnel.
Wand'leuchter, *m.* -s, pl. -, sconce.
Wärm'flasche, *f.* -, pl. -n, warming-pan.
Wasch'becken, *n.* -s, pl. -, wash-bowl.
Wiege, *f.* -, pl. -n, cradle.
Zuck'erdose, *f.* -, pl. -n, sugar-box.
Zunder, *m.* -s, tinder.

6.—DISHES. Gerichte.

Confect', *n.* -es, -s, comfit, sweet-meats.
Ei, *n.* -es, -s, pl. -er, egg.
Ei'erkuchen, *m.* -s, pl. -, omelet.
Erfrisch'ung, *f.* -, pl. -en, refreshment.
Fleisch'brühe, *f.* -, broth.
Gastmahl, *n.* -es, -s, pl. -mähler, banquet.
Ham'melfleisch, *n.* -es, mutton.
Ham'melkeule, *f.* -, pl. -n, leg of mutton.
Kalbfleisch, *n.* -es, veal.
Kalbs'cotelett', *n.* -es, -s, pl. -e, } cutlet.
Kalbs'cotelet'te, *f.* -, pl. -n, } cutlet.
Kloß, *m.* -es, pl. Klöße, dumpling.
Nudel, *f.* -, pl. -n, vermicelli.
Pfann'kuchen, *m.* -s, pl. -, pancake.
Rin'derbraten, *m.* -s, pl. -, roast beef.
Rindfleisch, *n.* -es, beef.
Schinken, *m.* -s, pl. -, ham.
Schwei'nefleisch, *n.* -es, pork.
Suppe, *f.* -, pl. -n, soup.
Torte, *f.* -, pl. -n, tart.
Wurst, *f.* -, pl. Würste, sausage.

7.—GRAIN AND VEGETABLES. Getreide und Gemüse.

Blu'menkohl, *m.* -es, -s cauliflower.
Bohne, *f.* -, pl. -n, bean.
Erbse, *f.* -, pl. -n, pea.
Gerste, *f.* -, barley.
Gurke, *f.* -, pl. -n, cucumber.
Hafer, *m.* -s, oats.
Hirse, *f.* -, millet.
Knoblauch, *m.* -es, -s, garlic.
Kohl, *m.* -es, -s, cabbage.
Korn, *n.* -es, -s, pl. Körner, corn, grain.
Kraut, *n.* -es, -s, pl. Kräuter, herb.
Kresse, *f.* -, cress.
Linse, *f.* -, pl. -n, lentil.
Mais, *m.* -es, maize.
Meer'rettig, *m.* -es, -s, pl. -e, horse-radish.
Pastina'ke, *f.* -, pl. -n, parsnip.
Petersi'lie, *f.* -, parsley.
Pflanze, *f.* -, pl. -n, plant.
Pilz, *m.* -es, pl. -e, mushroom.
Radieß'chen, *n.* -s, pl. -, turnip-radish.
Reis, *m.* -es, rice.
Rettig, *m.* -es, -s, pl. -e, radish.
Roggen, *m.* -s, rye.
Rübe, *f.* -, pl. -n (brassica rapa); gelbe Rübe, carrot; rothe Rübe, beet; weiße Rübe, turnip.
Salbei', *f.* -, sage.
Sau'erampfer, *m.* -s, sorrel.
Schwamm, *m.* -es, -s, pl. Schwämme. (See Pilz.)
Sell'eri, *m.* -s. *f.* -, celery.
Spargel, *m.* -s, asparagus.
Spinat', *m.* -es, -s, spinach.
Thy'mian, *m.* -s, thyme.
Trüffel, *f.* -, pl. -n, truffle.
Weizen, *m.* -s, wheat.
Wurzel, *f.* -, pl. -n, root.
Zwiebel, *f.* -, pl. -n, onion.

8.—Fruits and Fruit Trees. Obst und Obstbäume.

A'nanas, *f.* -, pl. -se, pine-apple.
Ap'felbaum, *m.* -es, -s, pl. -bäume, apple-tree.
Apfelsi'ne, *f.* -, pl. -n, sweet-orange.
Apriko'se, *f.* -, pl. -n, apricot.
Birnbaum, *m.* -es, -s, pl. -bäume, pear-tree.
Brom'beere, *f.* -, pl. -n, blackberry.
Citro'ne, *f.* -, pl. -n, lemon.
Dattel, *f.* -, pl. -n, date.
Erd'beere, *f.* -, pl. -n, strawberry.
Ha'selnuß, *f.* -, pl. -nüsse, hazel-nut.
Hei'delbeere, *f.* -, pl. -n, bilberry.
Him'beere, *f.* -, pl. -n, raspberry.
Johan'nisbeere, *f.* -, pl. -n, currant.
Kasta'nie, *f.* -, pl. -n, chestnut.
Mandel, *f.* -, pl. -n, almond.
Maul'beere, *f.* -, pl. -n, mulberry.
Melo'ne, *f.* -, pl. -n, melon.
Mispel, *f.* -, pl. -n, medlar.
Pfirsich, *m.* -es, -s, pl. -e, } peach.
Pfir'siche, *f.* -, pl. -n, } peach.
Pflau'menbaum, *m.* -es, -s, pl. -bäume, plum-tree.
Pomeran'ze, *f.* -, pl. -n, orange.
Quitte, *f.* -, pl. -n, quince.
Rosi'ne, *f.* -, pl. -n, raisin.
Sta'chelbeere, *f.* -, pl. -n, gooseberry.
Strauch, *m.* -es, -s, pl. Sträuche, Sträucher, bush.
Wallnuß, *f.* -, pl. -nüsse, walnut.
Weinstock, *m.* -es, -s, pl. -stöcke, grape-vine.
Wein'traube, *f.* -, pl. -n, grape.

9.—Forest Trees. Waldbäume.

Ahorn, *m.* -es, -s, pl. -e, maple.
Birke, *f.* -, pl. -n, birch.
Buche, *f.* -, pl. -n, beech.
Eiche, *f.* -, pl. -n, oak.
Esche, *f.* -, pl. -n, ash.
Espe, *f.* -, pl. -n, aspen.
Fichte, *f.* -, pl. -n, pine.
Linde, *f.* -, pl. -n, linden-tree, lime-tree.
Lärche, *f.* -, pl. -n, larch.
Pappel, *f.* -, pl. -n, poplar.
Rinde, *f.* -, pl. -n, bark.
Stamm, *m.* -es, -s, pl. Stämme, trunk.
Tanne, *f.* -, pl. -n, fir.
Ulme, *f.* -, pl. -n, elm.
Weide, *f.* -, pl. -n, willow.
Zweig, *m.* -es, -s, pl. -e, bough.

10.—Flowers. Blumen.

Auri'kel, *f.* -, pl. -n, auricula.
Distel, *f.* -, pl. -n, thistle.
Geißblatt, *n.* -es, -s, honeysuckle.
Jasmin', *m.* -es, -s, pl. -e, jessamine.
Levko'je, *f.* -, pl. -n, gilliflower.
Lilak, *m.* -s, lilac.
Lilie, *f.* -, pl. -n, lily.
Maß'lieb, *n.* -s, pl. -en, daisy.
Mohn'blume, *f.* -, pl. -n, poppy.
Myrthe, *f.* -, pl. -n, myrtle.
Nelke, *f.* -, pl. -n, pink.
Nessel, *f.* -, pl. -n, nettle.
Rit'tersporn, *m.* -es, -s, larkspur.
Rose, *f.* -, pl. -n, rose.
Schlüs'selblume, *f.* -, pl. -n, cowslip.
Son'nenblume, *f.* -. pl. -n, sunflower.
Tulpe, *f.* -, pl. -n, tulip.
Unkraut, *n.* -es, -s, weed.
Veilchen, *n.* -s, pl. -, violet.
Vergiß'meinnicht, *n.* -s, pl. -, -s, forget-me-not.

11.—Tools. Werkzeuge.

Ahle, *f.* -, pl. -n, awl.
Amboß, *m.* -sses, pl. -e, anvil.
Angel, *f.* -, pl. -n, fish-hook.
Axt, *f.* -, pl. Aexte, axe.
Beil, *n.* -es, -s, pl. -e, hatchet.
Brech'eisen, *n.* -s, pl. -, crowbar.
Büchse, *f.* -, pl. -n, rifle.
Dresch'flegel, *m.* -s, pl. -, flail.
Egge, *f.* -, pl. -n, harrow.
Feile, *f.* -, pl. -n, file.
Flinte, *f.* -, pl. -n, gun.
Gerüst', *n.* -es, -s, pl. -e, scaffold.
Haue, *f.* -, pl. -n, hoe.
Hobel, *m.* -s, pl. -, plane.
Kelle, *f.* -, pl. -n, trowel.
Leiter, *f.* -, pl. -n, ladder.
Meißel, *m.* -s, pl. -, chisel.
Pflug, *m.* -es, -s, pl. Pflüge, plough.
Pinsel, *m.* -s, pl. -, brush, pencil.
Säge, *f.* -, pl. -n, saw.
Schaufel, *f.* -, pl. -n, shovel.
Schleifstein, *m.* -es, -s, pl. -e, grindstone.
Schloß, *n.* -sses, pl. Schlösser, lock.
Schraube, *f.* -, pl. -n, screw.
Schraubstock, *m.* -es, -s, pl. -stöcke, vice.
Schub'karren, *m.* -s, pl. -, wheelbarrow.
Sense, *f.* -, pl. -n, scythe.
Sichel, *f.* -, pl. -n, sickle.
Sie'gellack, *m.* -es, -s, pl. -e, sealing-wax.
Spaten, *m.* -s, pl. -n, spade.
Walze, *f.* -, pl. -n, roller.
Zange, *f.* -, pl. -n, pincers.
Zirkel, *m.* -s, pl. -, compasses.

ELECTRICITY.—II.

INDUCTION — TORSION ELECTROMETER — DISTRIBUTION OF ELECTRICITY ON A SURFACE.

We have seen that electricity may be conveyed from one body to another by contact; we find, however, by experiment that it is not necessary for the charged body actually to touch the other, but that a certain amount of electricity is excited by its near approach. Thus, in bringing an excited tube or rod near the gold-leaf electroscope, we shall find that the leaves diverge some time before the rod comes into actual contact with the disc. This effect is attributed to *induction*, and as this is an important matter in the explanation of many electrical phenomena, it will be well to explain it before proceeding further. As already stated, similar electricities repel one another, while those of a contrary name attract. If, then, we bring a highly charged insulated body near to any conducting substance, the electricity in the latter will be decomposed, the negative portion being attracted towards the charged body, while the positive is repelled to the further end; or, on the theory of a single fluid, the electricity will be driven to the further end, which becomes, therefore, positively charged, while the other end is negative.

The best apparatus for showing these effects consists of two or three cylinders insulated by being mounted on glass rods (Fig. 3). These cylinders must be made of some conducting material, and brass is frequently employed. This, however, is expensive; but if we turn the cylinders from a piece of wood, carefully rounding the ends, and removing all roughness, and then coat them evenly with tin-foil, rubbing it smooth with a piece of ivory or bone, we shall have an apparatus that will answer our purpose as well as the more costly. As tin-foil will be required in the manufacture of many pieces of apparatus, it will be well for the student to procure a roll of it, remembering that it answers best if it be thin. An old tooth-brush handle will do as well as anything for smoothing it down, and it will stick on well with common paste.

Having prepared a cylinder or two in this way, put them end to end so as almost to touch one another, and place at the ends and middle of each a wire with a pith ball suspended from it by a piece of cotton. Now let the highly charged body, *m*, be brought near one end, the pith balls at the ends of each cylinder will at once rise, showing the presence of free electricity; those at the middle, however, will remain at rest, as at first. If, now, we touch a small gilt disc fastened to the end of a rod of glass or shellac against the different parts of the conductor, and then bring it near a faintly charged electroscope, we shall soon see that the end of the cylinder nearest the excited body is charged with negative electricity, while the further end is positive, the middle remaining neutral. On removing the charged body, the electricities will re-combine, and the cylinder become neutral as at first. If, however, while the charged body is near, we touch the positive end, some of the electricity will escape, and the cylinder will then be negatively charged.

Induction is only manifested when a non-conducting body is interposed between the excited body and the cylinder. The air in the experiment above was the non-conductor, but we may interpose thin sheets of glass or other insulating material, and the same effects will be produced. If, however, we interpose a thin sheet of metal, or even a piece of wire gauze, induction will cease at once. Those bodies which allow induction to take place through them are known as *di-electrics*. The intensity of the induction varies with the substance employed.

The effects of induction may be felt as well as seen; for if a person stands near to a large and highly charged conductor, which is then rapidly discharged, a faint shock will be felt, arising from the re-composition in the body of the electricities which have been separated by induction.

The distribution of electricity over the surface of any body depends mainly upon induction. The most important fact in relation to this is that electricity is always confined to the exterior surface. Thus, if a hollow cylinder made of tin or some other conducting substance be highly charged, so that sparks are freely given off from its exterior, we shall yet be unable to detect the presence of any electricity on its interior surface; or, if when it is in its natural state we touch it inside with a charged ball, all the electricity will immediately pass from the ball to the outside. The way in which we test for the presence of electricity in small quantities is by means of a disc of thin copper, or gilt card, attached to a rod of some non-conducting substance. This is called a *proof plane*, and when touched against any charged body, acquires a portion of its electricity, and on being brought near the gold-leaf electroscope at once reveals its presence by the divergence of the leaves. Now, if this proof plane be touched against the interior of a cylinder or of a hollow ball (Fig. 4), and then brought into contact with the electroscope, we shall find that the leaves will not diverge, showing that there is no free electricity present. If, however, we place a metal ball, connected with the ground, inside the cylinder, but without allowing it to tonch it, induction will be produced, and the presence of a small quantity of free electricity on the inner surface will be shown.

Various experiments have been tried, which prove most conclusively that, except in cases like the above, where induction is specially produced, all the electricity exists on the outer surface. A large metallic box was insulated and highly charged, so that sparks were freely given off from its surface, and yet, when a person with a delicate electrometer got inside, no effect at all was produced on him or on the instrument. So, too, a powerful battery may be discharged through a large case, inside which a person is concealed, withont his feeling it in any way. A simpler experiment, proving the same fact, is to mount a cylindrical or egg-shaped body on an insulating stand, and provide two hemispherical caps which, together, jnst fit it. These should be fixed to insulating handles. If now we charge the globe, and then place the covers on it, and quickly remove them, we shall find that all the electricity has left the globe and passed into the covers.

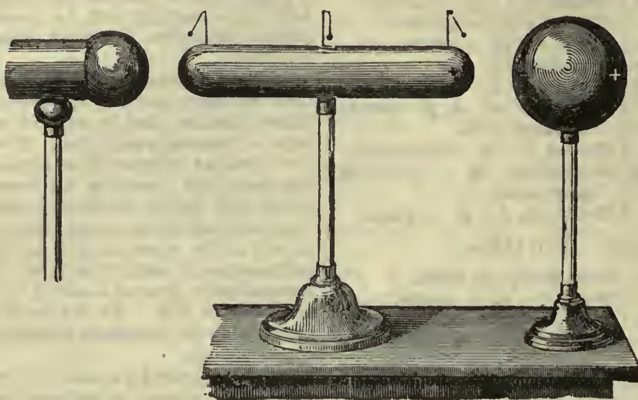


Fig. 3.

If we take a conical gauze net, and fix its open mouth to an insulated ring, and also fix two silk strings to its apex, so that by pulling one or other of these it may be turned inside out, we shall find, on charging it, that the electricity will always exist alone upon the outer surface, and no trace of it will be found on the interior.

Since, then, the distribution of electricity on any surface is thus affected by induction, we should expect to find that it is by no means evenly distributed over any charged surface; and such is the case, a larger portion being always collected on that side which has the best conducting surface opposed to it. Thus, if two metallic globes be suspended near together, and one of them be charged, the greater portion of its electricity will be attracted towards the side which is nearest to the other globe.

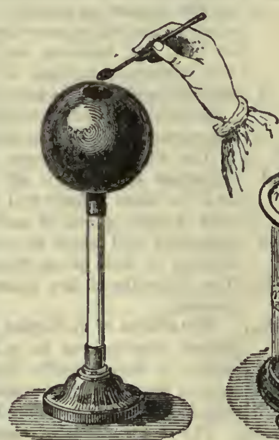


Fig. 4.

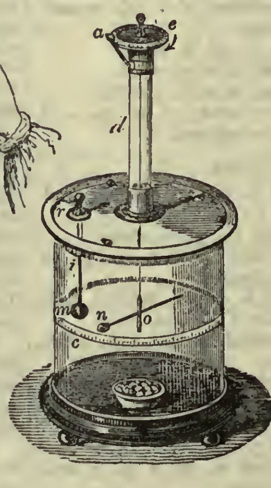


Fig. 5.

In these experiments we want some instrument which shall not only manifest the presence of electricity, but give us a better idea of its intensity than can be furnished by the electroscopes already described, and such an instrument is represented in Fig. 5. It consists of a needle of shellac carrying a small gilt disc, n, at one end. This is suspended by a loop, o, at the end of a very fine wire, or sometimes by a piece of unspun silk, and the degree to which this is twisted is the measure of the electricity. The wire is fixed at the upper end to a graduated circle, c, opposite one side of which is a pointer, a, which enables the angle throngh which the circle is turned to be easily read off. The needle is suspended in a glass case, round the inside of which a graduated ring is marked. At r is an aperture by which a metal ball, m, called the carrier ball, snpported on a glass rod, i, can be inserted. The zero point on the npper circle is then brought opposite to the pointer a, and the tube d is turned till the disc n is exactly opposite the ball. This ball is now removed, and allowed to touch the substance or part of the body whose electricity is to be determined. It thus acquires a portion of its charge, and, being replaced through the aperture r, it immediately attracts the disc n; after contact, however, it repels it with a force depending on the intensity of the charge, and to measure this we turn the wire by means of the circle at the top until the disc n is brought within a certain fixed distance, say ten degrees, of m. The angle through which the circle has to be turned in order to do this shows the intensity of the charge.

As the vapour of the air would rapidly carry away the electricity, a small saucer containing some substance, such as chloride of calcinm, that powerfully attracts the moisture, is placed inside the glass case, and serves to keep the air within perfectly dry. The apparatus is known as Coulomb's Torsion Electrometer.

If we take charged cylinders similar to that shown in Fig. 3, and examine the amount of electricity found on different parts of their surfaces, we shall find that there is always a much greater amount at the ends than at the middle. The reason of this is, that, being more curved, they face a larger area, and therefore are more powerfully acted upon by induction. If the ends taper there will be a still greater accumnlation, while if they end in a sharp point the induction will be such that the electricity will at once escape. Hence, in the manufacture of electrical machines and apparatus great care must be taken to avoid the presence of sharp points or rough edges. This also explains why we can obtain longer sparks from the end of the conductor of a machine than from its sides.

By means of the torsion electromete, we may also investigate the laws of the attraction and repulsion of electrified bodies, the most important of which is that the attraction or repulsion varies inversely as the square of the distance. Thus, if two bodies be removed to double the distance from one another, their attraction will only be one-fourth as great, at three times the distance one-ninth as great, and so on.

An amusing experiment, that may easily be tried, shows us more clearly the principle of induction. Take a sheet of glass, and having warmed it well, support it at the sides on two books, or blocks of wood, so that it may be about an inch above the table. Cut some figures out of stiff paper, or some balls of elder pith, and lay them on the table underneath the glass. On rubbing it now with a piece of silk or leather smeared with amalgam, the pieces of paper will begin to jump rapidly up and down between the table and the glass. An apparatus of this kind is now made as a toy, and sold under the name of the Merry Mountebanks. The explanation of these phenomena is simple. When the upper surface of the glass is rubbed, electricity is evolved on it; this sets free a corresponding amonnt on the other side of the glass, the light substances nnder it are therefore attracted, and rise to tonch it, but in so doing they acquire a certain portion of its electricity, and are accordingly repelled. On touching the table, however, they part with the superfluous charge, and are therefore again attracted, as at first

LESSONS IN GEOLOGY.—XII.

IGNEOUS ROCKS.

As may have been gathered from a previous chapter, igneous rocks are subdivided by some geologists into Volcanic and Plutonic: that is, into igneous rocks of a recent date of formation—in fact, those whose existence is due to volcanic action—and those which have been formed at great depths in the earth at a much more distant epoch. This division, however, is very unsatisfactory, for there are many rocks which it is impossible to class in either of these divisions, and therefore the best classification which is now generally accepted is :—

1. *Granitic Rocks.*
2. *Trappean Rocks.*
3. *Volcanic Rocks.*

The study of these rocks is attended with much difficulty. Not only is their composition somewhat complex, but two rocks having identically the same composition often present a totally different appearance, owing to the fact that they were cooled under different circumstances. We have proof of this in the case of molten glass: slight differences in the manner of cooling materially affect the character of the glass, so that from the same molten mass a transparent glass, opaque slag, or a vitreous stone may be obtained. Moreover, they have no definite order of superposition, but are found traversing the stratified strata in veins, which often intersect masses of igneous rock already solidified. They contain no organic remains by which their relative ages can be satisfactorily established. Hence they do not present that interest to the geologist with which the fossiliferous strata are invested.

Fig. 25.

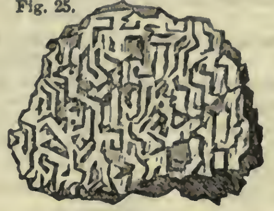


Fig. 26.

It is but right to warn the student that the igneous origin of these rocks is questioned. The main reasons for supposing that the operation of water has been material to the production of the igneous rocks are—(1) because we find water now present in them (minerals of the aluminous class almost invariably contain it); and (2) it is urged that sea and rain water, in percolating though the crust of the earth, must at length reach the regions of molten matter. However, in spite of these reasons, which are not insuperable objections, the igneous origin of these rocks is generally received. This the reader will gather for himself, as we shall find granite and other primary rocks in positions which they could only have occupied when in a molten state.

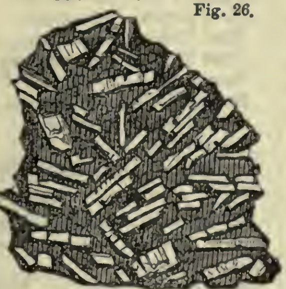


Fig. 23.

THE VOLCANIC ROCKS.

These, as their name indicates, are supposed to have their origin in volcanic action. They are being produced to-day by the various burning mountains in action, which eject from their craters scoriæ, ashes, lava, and other varieties of volcanic rocks. These rocks are found associated with the uppermost three formations—the post-tertiary, the tertiary, and the chalk—but below this their presence has not yet been discovered.

It is sufficient, for a brief notice, to divide them into two classes :—

1. *Trachytes.* 2. *Dolerites.*

The *Trachytes*, or *Greystones*, are so called from their rough feel (τραχυς, *rough*); they are generally light-coloured, hence their second name. They are chiefly composed of feldspar, which is rich in silica.

The *Dolerites* (δολερος, *deceptive*) are heavier than the trachytes, and are of a darker colour; they contain less silica, and more of the heavier bases.

THE TRACHYTES, OR FELDSPATHIC LAVAS.

Trachyte itself is fine-grained; its colour varies from light grey to deep iron-grey; occasionally it is tinted by the presence of iron. When closely examined it appears to be a mass of very minute crystals of feldspar.

Trachytic Porphyry.—The term *porphyry*, which is of frequent occurrence in every description of primary rocks, is derived from πορφύρεος, *purple*, which was the colour of an Egyptian mineral to which the name was applied; but now any rock is called a porphyry which exhibits large crystals embedded in a compact matrix. Hence trachytic porphyry is a trachyte through the mass of which crystals of glassy feldspar are disseminated. Sometimes this glassy feldspar is not in crystals, but in globules, from the size of a grain of sand to that of a nut; and these are in a compact mass, without any visible cement to hold them together. From the vitreous or glassy aspect of the mass, the mineral has been termed "pearl-stone."

Andesite is the trachyte of the Andes.

Clinkstone or *Phonolite* is a volcanic rock, which exhibits such a tendency to laminate, as to be capable of being used for roofing slate. As its name suggests, it is so compact as to ring when struck with a hammer. It is very probable that clinkstone is trachyte which has cooled under peculiar circumstances. It occasionally contains distinct crystals of feldspar, and is then called "clinkstone porphyry."

Fig. 24.

Obsidian or *Volcanic Glass* is another condition of trachyte, but it has been found that basalt, when melted and rapidly cooled, will produce obsidian; and here is another example of the difficulty of defining even apparently very distinct volcanic rocks, the conditions of their cooling have such an important influence on their ultimate appearance.

Pumice, the well-known lava, is this very obsidian, in a cellular form, blown up into its frothy state by the gases or steam it held when in a viscous condition.

Fig. 27.

THE DOLERITES

have a kindred composition to the trachytes, only their feldspar is of a kind known as Labradorite.

Basalt is the most prominent member of this group; it is a compact, very dark-coloured rock; occasionally detached crystals of angite, olivine, and magnetic iron are found in it. Its definition, according to Daubeny, is, "an intimate mixture of angite with a zeolitic mineral, which appears to have been formed out of Labradorite by the addition of water, the presence of water being in all *zeolites* the cause of that bubbling up under the blow-pipe to which they owe their appellation." The Giant's Causeway is composed of basalt.

Tufa, or *Volcanic Tuff*, is the mineralogical term for ashes ejected from volcanic cones; its grains range from dust, through lapilli (little stones), to breccias, or angular fragments. These showers of ashes sometimes collect in vast quantities. Pompeii and Herculaneum were covered by them, and in all volcanic regions they take a prominent position in the strata. They become frequently solidified by pressure, or by the percolation of water charged with mineral matter, which acts as a cement.

We have only noticed the prominent volcanic rocks. They contain many other minerals, which will be described in Mineralogy.

TRAPPEAN ROCKS.

These take their name from the fact that occasionally they are found terracing the sides of hills, cutting them into steps, for which word the Swedish is *trappa.* Unlike the volcanic rocks, they are never found associated with recent accumulations, but they have a far wider range, from the Silurian formation up to the Tertiary, both inclusive. But the division between volcanic and trap rocks is more one of position than distinct mineralogical character. This was expressed by Sir James Hall when he said, "I am confident there is not a lava of Mount Etna to which a counterpart may not be produced from the whinstones of Scotland," which are traps.

The traps are decidedly of igneous origin; we find them disrupting strata, and filling up the fissures, while the rock in the neighbourhood exhibits marks of induration, and other alterations by heat. The trap rocks bear a general division into *feldspathic* and *augitic* traps.

FELDSPATHIC TRAPS.

In these rocks feldspar predominates. *Felstone*, or *compact feldspar*, is almost a pure mass of this mineral; it is a compact flinty rock. Its colour is either grey, of various shades, or a greenish white; this latter kind is often translucent at the edges.

Pitchstone is a variety of felstone having a resinous lustre, hence its name.

Felstone porphyry has a basis of compact feldspar, with large crystals of the same mineral disseminated through the mass. The rock to which the term porphyry was originally, and is still applied, was of this very nature, the basis being of a dark brick-red colour, and the crystals white, or more generally of a flesh-colour. The appearance of such a rock is indicated by Fig. 23.

AUGITIC ROCKS.

In these the mineral augite is the chief ingredient. Augite and hornblende are considered by many mineralogists as synonymous terms.

Basalt, which we have briefly described, is a prominent trap rock, and the basalts of the north of Ireland are of this augitic class.

Greenstone is applied to a large class of trap rocks. Their colour is a dark green, owing to the presence of hornblende in great quantity. They are less compact than the basalts, and exhibit distinct crystals of their several ingredients. They are known in Scotland as *whinstones*.

When the composition of greenstone is mainly feldspar and augite, then it is called *dolerite*.

Serpentine, so much used to make ornamental vases, pillars, and mantelpieces, belongs to this class of rocks, though some geologists class it with the granites.

The enclosed minerals we shall treat of in another place.

THE GRANITIC ROCKS.

These rocks superabound in silica. The volcanic and trap rocks are chiefly classed according to the quantity of silica they contain, but it is always compounded with some base, such as potash, soda, alumina, or magnesia. But in the granites there was not sufficient of those bases for the silica to take up; hence it separated out, and can be distinguished in the rock in grains of transparent quartz.

True granite is readily recognised; as the derivation of the word indicates (granum, *a grain*), it is constituted of grains, very perceptible.

In a typical specimen those grains are—1. Quartz. 2. Feldspar. 3. Mica.

1. The *quartz* is commonly colourless, very rarely brown; it is easily recognised, being not unlike a piece of glass.
2. The *feldspar* may be *orthoclase*, or potash feldspar, which is generally flesh-coloured; or *albite*, or soda feldspar, which is usually dead white. These distinctive minerals are, however, only the heads of two classes, which contain a great variety, and which are found frequently mixing.
3. *Mica* is sometimes in small colourless plates, which give to the granite of which the houses in Dublin are built its spangled appearance; more generally it is black, and between these extremes is found in every shade of grey.

To gather the relative proportions of these constituents, we give this analysis of Wicklow granite by Professor Haughton:—

Feldspar	61·18
Quartz	24·98
Mica	13·37
	99·53

The grains of these minerals exhibit no signs of the action of water. They are not water-worn, neither is there any appearance of stratification. The nearest approach to it is in the case of graphic granite, the vertical section of which is drawn in Fig. 24, and the horizontal section in Fig. 25.

It will be seen that the black mica in the horizontal section has some resemblance to Hebrew characters, hence its name *graphic*.

Syenite, named from Syene, an Egyptian city, has four constituents; the mica is in a very small quantity, and has been almost wholly replaced by hornblende.

Protogine, or "first-formed"—so called from an erroneous supposition that it was formed before granite—has talc in its composition instead of mica.

Granitic rocks have evidently never cooled at the surface, for we never find any ashes, or anything corresponding to pumice; all is hard and compact. That they were once in a molten condition seems an inevitable conclusion, when we inspect such diagrams of granitic veins as those taken from Lyell's "Elements," and drawn in Figs. 26 and 27.

These veins are never found traversing rocks higher than the cretaceous, and instances are found in Norway where the granitic vein penetrates the strata without dislodging it or altering its dip; so that either the fissure must have been made by the shrinkage of the rock, on account of the proximity of heat, or else that after the upheaval took place the strata returned to its normal position.

LESSONS IN GREEK.—XXVIII.

THE student will find an advantage in comparing together the three voices. The relation of their leading parts may be seen in the following

CONSPECTUS OF THE THREE VOICES.

INDICATIVE MOOD, FIRST PERSON SINGULAR.

	Active Voice.	*Middle Voice.*	*Passive Voice.*
Present.	λυ-ω,	λυ-ο-μαι.	
Imperfect.	ε-λυ-ον,	ε-λυ-ομην,	
Future.	λυ-σ-ω,	λυ-σομαι,	λυ-θη-σ-ομαι.
First Aorist.	ε-λυ-σ-α,	ε-λυ-σαμην,	ε-λυ-θην.
First Perfect.	λε-λυ-κ-α,		λε-λυ-μαι.
First Plup.	ε-λε-λυ-κ-ειν,		ε-λε-λυ-μην.
Second Perf.	πε-φην-α,	P.F. λε-λυ-σ-ομαι.	
Second Plup.	ε-πε-φην-ειν,		
Second Aor.	ε-λιπ-ον,	ε-λιπ-ομην,	ε-τρι-βην.
Second Fut.			τριβ-ησ-ομαι.

GENERAL CONSPECTUS OF THE GREEK VERB.

ACTIVE VOICE.

	Indic.	*Subj.*	*Opt.*	*Imp.*	*Infin.*	*Part.*
Pres.	λυω,	λυω,	λυοιμι,	λυε,	λυειν,	λυων.
Imp.	ελυον.					
Fut.	λυσω,		λυσοιμι,		λυσειν,	λυσων.
1 Aor.	ελυσα,	λυσω,	λυσαιμι,	λυσον,	λυσαι,	λυσας.
1 Perf.	λελυκα,	λελυκω,	λελυκοι-μι,	λελυκε,	λελυκε-ναι,	λελυκως.
1 Plup.	ελελυκειν.					
2 Perf.	πεφηνα,	πεφηνω,	πεφηνοι-μι,	πεφηνε,	πεφηνε-ναι,	πεφηνως.
2 Plup.	επεφηνειν.					
2 Aor.	ελιπον,	λιπω,	λιποιμι,	λιπε,	λιπειν,	λιπων.

MIDDLE VOICE.

Pres.	λυομαι,	λυωμαι,	λυοιμην,	λυου,	λυεσθαι,	λυομενος.
Imp.	ελυομην.					
Fut.	λυσομαι,		λυσοιμην,		λυσεσθαι,	λυσομενος
1 Aor.	ελυσαμην,	λυσωμαι,	λυσαιμην,	λυσαι,	λυσασθαι,	λυσαμενος
2 Aor.	ελιπομην,	λιπωμαι,	λιποιμην,	λιπου,	λιπεσθαι,	λιπομενος

PASSIVE VOICE.

1 Aor.	ελυθην,	λυθω,	λυθειην,	λυθητι,	λυθηναι,	λυθεις.
1 Fut.	λυθησο-μαι,		λυθησοι-μην,		λυθησεσ-θαι,	λυθησο-μενος.
Perf.	λελυμαι,	λελυμε-νος, -ω,	λελυμε-νος, -ειην,	λελυσο,	λελυσθαι,	λελυμενος
Plup.	ελελυμην.					
P. Fut.	λελυσομαι,		λελυσοι-μην,		λελυσεσ-θαι,	λελυσο-μενος.
2 Aor.	ετριβην,	τριβω,	τριβειην,	τριβηθι,	τριβηναι,	τριβεις.
2 Fut.	τριβησο-μαι,	...	τριβησοι-μην,		τριβησ-εσθαι,	τριβησο-μενος.

We present another arrangement, showing the number of each tense in the Greek verb.

NUMBER OF EACH TENSE.

Present,	2, namely,	Present Active and Present Middl
Imperfect,	2, „	Imperfect Active and Imperfect Middle.
Future,	5, „	Future Active, Fut. Mid., Fut. Perf., 1st Fut. Pass., 2nd Fut. Pass.
Aorist,	6, „	Aor. 1st Act., 2nd Act., 1st Mid., 2nd Mid., 1st Pass., 2nd Pass.
Perfect,	3, „	Perfect 1st Act., 2nd Act., Perf. Pass.
Pluperfect,	3, „	Pluperfect 1st Act., 2nd Act., Plup. Pass.
	21 tenses in all.	

We remarked before in page 26 of this volume on the close connection in sense between the passive and middle. Thus we find the present and imperfect the same in both; and, in the same way, the perfect and pluperfect passive, as well as the future perfect, often bear a middle signification.

A glance at the general conspectus will show that this large array of separate tenses is not complete in all its parts. The right to appear in the conspectus may be disputed in the instance of the perfect subjunctive and optative of the passive voice, inasmuch as they have no separate and independent forms, but are each made up of a participle and a part of the verb *ειναι*.

Verify the statements made as to the number of each tense by writing out in full the several tenses in the order observed above.

Form for yourself, solely by the aid of memory, a general conspectus of the Greek verb, in imitation of the one just given, taking as your verb—

πιστευω (I believe), πιστευσω, πεπιστευκα, πεπιστευμαι.

ETYMOLOGICAL VOCABULARY.

Λυω, *I loose*, unbind.	Λυσινομος, breaking the law (*νομος, -ου, ὁ, law*).	Λυτρωτης, -ου, ὁ. a ransomer, *a redeemer.*
Λυσις, *a loosing.*	Λυτηριος, *loosing*, redeeming, healing.	Απο-λυω, *I buy off.*
Λυσιθριξ, τριχος, *having the hair loose* (*θριξ, τριχος, ἡ, hair*).	Λυτρον, *loosing-money*, a ransom.	Δια-λυω, *I separate.*
Λυσιμαχος, *putting an end to the fight* (*μαχη, -ης, ἡ, battle*).	Λυτροω, I buy off, *ransom.*	Κατα-λυω, *I dissolve*, break.
Λυσιμος, loosing.	Λυτρωσις, -εως, ἡ, *a ransom.*	Παρα-λυω, I remove, destroy; hence our word *paralysis.*

Each of these various compounds of λυω, namely, απολυω, παραλυω, etc., has its own set of derivatives. The student, then, in making himself thoroughly acquainted with λυω, has taken steps towards the acquirement of an immense number of Greek words.

THE PRESENT, IMPERFECT, FUTURE, AND FIRST AORIST TENSES, ACTIVE VOICE.

A few remarks on some of the forms of the verb, of which a full paradigm has been given, may be of service to the student of these lessons.

In the conjugation ω the person-endings in the course of time underwent changes, as may be learnt from the older conjugation, namely, that in μι, as well as from the dialects, or forms of the language in use among the Dorians, the Æolians, etc.—forms more ancient than the Attic, in which Xenophon wrote, whose Greek is considered the standard for ordinary prose. In the first person singular indicative and subjunctive of the active voice μι has been dropped, and τι in the third person singular; thus the forms originally were λυομι or λυωμι instead of λυω, and λυετι instead of λυει. So ν has been dropped in the first singular indicative of the first aorist, which was ελυσαν, instead of, as now, ελυσα. In the second person of the imperative active, θι was dropped, so that we have λυε instead of λυεθι.

The second person singular active has the termination σθα in the following forms :—οισθα (in Latin, *nosti*), *thou knowest*, from the perfect οιδα, used with a present signification, as *I know;* ηδεισθα and ηδησθα, the pluperfect to οιδα, used with an imperfect meaning, as, *thou knewest;* εφησθα, *thou saidst*, imperfect from φημι, *I say;* ησθα, *thou wast*, imperfect from εἰμί, *I am;* ηεισθα, *thou wentest*, imperfect from εἶμι, *I go.*

The original form of the first person plural active indicative was μες instead of μεν, resembling the Latin termination *mus.* Thus the Dorians said τυπτομες, *we strike*, instead of τυπτομεν: so in the Latin, percutimus; so also γραφ-ο-μες, *we write* (in Latin, scrib-i-mus).

The original form of the third person plural of the principal tenses, active voice, ended in ντι: the τ passed into σ, and the ν was dropped, and so βουλευοντι became first βουλευονσι, and then βουλευουσι, *they advise.*

In the first person singular of the pluperfect active the Attic writers, besides the form given in the paradigm, namely, ελελυκειν, had another form in η (contracted from the Ionic εα), as ελελυκη. The εισαν of the third person plural is commonly shortened into εσαν: thus, ελελυκεσαν instead of ελελυκεισαν.

The Æolic ειας, ειε(ν), ειαν, instead of αις, αι, αιεν of the optative first aorist active, is more usual than the form given in the paradigm.

In the second person singular indicative present and future, middle or passive, the Attics, in addition to the form in ῃ, have another form in ει, as λυῃ and λυει, λυσῃ and λυσει, λελυσῃ and λελυσει, λυθησῃ and λυθησει, τριβησῃ and τριβησει. This form in ει is exclusively used in the three following verbs, namely:—

βουλομαι, *I will;*	βουλει, *thou willest*	(subj. βουλῃ).
οιομαι, *I think;*	οιει, *thou thinkest*	(subj. οιῃ).
οψομαι, *I shall see;*	οψει, *thou shalt see*	(subj. οψῃ)

In addition to the termination of the third plural imperative, active and passive, in ετωσαν, ατωσαν, σθωσαν, there exists an abbreviated form in οντων, αντων, σθων, which is termed Attic, as being frequently used by writers in the Attic dialect. These abbreviated Attic imperatives correspond in all the tenses, except the perfect, with the genitive plural of the participle of each tense; and the middle form, σθων, corresponds with the third person of the dual voice :—

Present Active,	βουλευετωσαν and βουλευοντων.
Perfect Active,	πεποιθετωσαν and πεποιθοντων (Gen. of the part. πεποιθοτων).
Aorist First,	βουλευσατωσαν and βουλευσαντων.
Present Middle,	βουλευεσθωσαν and βουλευεσθων.
Aorist Middle,	σκεψασθωσαν and σκεψασθων.

When in the future of the active and middle σω, σομαι, in roots of two or more syllables, a short vowel, ᾰ, ε, ῐ, precedes the σ, the σ in many verbs is dropped, and a new form is produced, ending in ῶ, οῦμαι (mark the circumflex); thus, ελαω (commonly ελαυνω), *I drive*, ελασω, ελαω, ελῶ: and so in the other persons, ελᾷς, ελᾷ, ελῶμεν, ελᾶτε, ελῶσι. This abbreviated form bears the designation of *the Attic future*, because employed by Attic writers. Here are some other examples of

THE ATTIC FUTURE.

Τελεω, *I end*,	τελε-σ-ω, *Attic* τελῶ, -εῖς, -εῖ, -οῦμεν, -εῖτε, -οῦσι: τελε-σ-ομαι, τελοῦμαι, -ῇ, -εῖται, etc.
Κομιζω, *I carry*,	κομισω, *Attic* κομιῶ, -ιεῖς, -ιεῖ, -ιοῦμεν, -ιεῖτε, -ιοῦσι: κομιοῦμαι, -ιεῖ, -ιεῖται, -ιουμεθα, etc.
Βιβαζω, *I step, stride*,	βιβασω, βιβαω, βιβῶ, βιβῶμεν, etc.

These contracted futures are found only in the indicative, the infinitive, and the participle; thus, τελῶ, τελεῖν, τελῶν. The verbs which take this form are—1, ελαω (ελαυνω), τελεω, and καλεω (*I call*); 2, all verbs in ιζω: 3, a few in αζω: 4, of the verbs in μι, all that end in αννυμι, together with αμφιεννυμι, *I put on* (clothes), αμφιῶ.

The student should now have no difficulty in generally forming the parts of the verb required in the exercises that ensue. It may, however, be as well to enter a little into detail with the tenses.

KEY TO EXERCISES IN LESSONS IN GREEK.—XXVII.

EXERCISE 76.—GREEK-ENGLISH.

1. I might loose myself. 2. I would loose myself. 3. I loose myself. 4. I may loose myself. 5. I was loosing myself. 6. I loosed myself. 7. I shall loose myself. 8. I remained behind. 9. They loose themselves. 10. They were loosing themselves. 11. They loosed themselves. 12. You might have loosed yourselves. 13. I might have remained behind. 14. To have remained behind. 15. Having remained behind. 16. To have loosed one's self. 17. To loose one's

self. 18. Loosing one's self. 19. Loose yourselves. 20. I may have remained behind. 21. You loosed yourself. 22. He may have loosed himself. 23. Let them both loose themselves. 24. You two might loose yourselves. 25. Of one loosing himself. 26. You were loosing yourselves. 27. Having loosed themselves. 28. They might loose themselves. 29. We might have loosed ourselves.

EXERCISE 77.—ENGLISH-GREEK.

1. Λυοιμην. 2. Λυοιτο. 3. Λυοιντο. 4. Λυεσθαι. 5. Λυομενος. 6. Λυσασθε. 7. Ελιποντο. 8. Λιπηται. 9. Λιπεσθε. 10. Λυσοιτο. 11. Λυεσθω. 12. Λυσωμεθα. 13. Λυσονται. 14. Λυηται. 15. Λυσαισθον. 16. Λυσῃ. 17. Λυσασθαι.

EXERCISE 78.—GREEK-ENGLISH.

1. He was rubbed. 2. Thou mayest be rubbed. 3. Thou wouldest be rubbed. 4. He would be rubbed. 5. They two might have been loosed. 6. They might have been loosed. 7. Let him be loosed. 8. To have been loosed. 9. Being about to be loosed. 10. To have been rubbed. 11. Being about to be rubbed. 12. Thou wast loosed. 13. Ye were loosed. 14. Thou shalt be loosed. 15. We may have been loosed. 16. We might have been loosed. 17. They may have been loosed. 18. Having been loosed. 19. To be about to be loosed. 20. Having been rubbed. 21. Let him be rubbed. 22. I have been loosed. 23. I had been loosed. 24. I shall have been loosed. 25. They have been loosed. 26. They had been loosed. 27. Thou mightest have been loosed.

EXERCISE 79.—ENGLISH-GREEK.

1. Ελυθη. 2. Λυθῃ. 3. Λυθειη. 4. Τριβησεται. 5. Λυθησονται. 6. Ετριβη. 7. Λελυμαι. 8. Λελυμενος, -ης. 9. Λελυσονται.

EXERCISES IN EUCLID.—III.

PROPOSITION XIII.—In a triangle A B C (Fig. 13), if B O, C O, bisecting the angle A B C, B C A, and meeting in O, be equal, then shall A B be equal to A C. For since O B = O C, angle O B C = angle O C B; but angle O B C is equal to half-angle A B C, and angle O C B equals half-angle A C B; and, by Axiom 7, the halves of equal things are equal; therefore angle A B C = angle A C B. Therefore, by Euc. I. 6, A B = A C. Q. E. D.

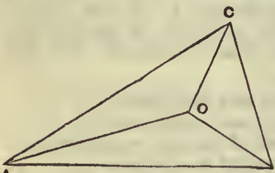


Fig. 13.

PROPOSITION XIV.—In a triangle A B C, if B O, C O, bisecting the angles A B C, B C A, and meeting in O, be equal, then A O will bisect the angle B A C.

Taking the figure of the last proposition, we have proved that if O B, O C be equal, then A B, A C are equal. Hence, since A B = A C, and A O is common, also base B O = base C O; therefore, by Euc. I. 8, angle B A O = angle C A O; *i.e.*, A O bisects angle B A C. Q. E. D.

PROPOSITION XV.—In the figure of Euclid I. 1, if the circles cut again in F (Fig. 14), and C A produced meet the circle again in H, then C H is greater than C F. Join H F, A F; then, since A H is equal to A F, being radii of the same circle (Def. 15), the angle A H F = angle A F H (Euc. I. 5). But the angle C F H is greater than the angle A F H (Axiom 9); therefore the angle C F H is greater than the angle C H F. Therefore, by Euc. I. 19, the side C H is greater than the side C F. Q. E. D.

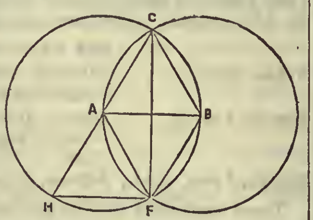


Fig. 14.

Corollary.—Hence it is obvious that the diameter is the longest line that can be drawn within a circle; for if C A H be a diameter, and F any point on the circumference, the angle C F H will be greater than the angle A F H; *i.e.*, than the angle C H F. Therefore C H will be greater than C F.

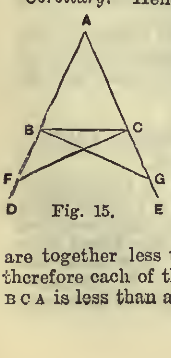


Fig. 15.

PROPOSITION XVI.—In the figure of Euclid I. 5 (Fig. 15), prove that B G must be greater than B C. By Euc. I. 17, any two angles of a triangle are together less than two right angles; therefore A B C and A C B are together less than two right angles. But they are equal; therefore each of them is less than one right angle. Therefore B C A is less than a right angle.

But by Euc. I. 13, angles B C A, B C G are together equal to two right angles, and B C A has been proved less than a right angle. Therefore B C G is greater than a right angle.

Again, by Euc. I. 17, B C G and C G B are together less than two right angles, and B C G is greater than one right angle; therefore B G C is less than a right angle. Therefore B C G is greater than B G C; therefore side B G is greater than B C. Q. E. D.

PROPOSITION XVII.—In the figure of Euclid I. 16, if E C be equal to E F (Fig. 16), the angle A B C will be equal to the angle B C F. For, by construction, A E = E C, B E = E F; therefore, if E C = E F, A E, E C, B E, and E F are all equal (Axiom 1). Also it is proved in Euclid I. 16, that angle B A E = angle E C F. But since E A B is an isosceles triangle, angle E A B = E B A (Euc. I. 5); therefore the angle E C F is equal to angle E B A. But because E B C is an isosceles triangle, angle E C B = angle E B C; and, from above, angle E C F = angle E B A; therefore, adding equals to equals, whole angle A B C = whole angle B C F (Axiom 2).

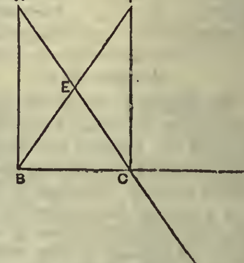


Fig. 16.

PROPOSITION XVIII.—In the figure of Euclid I. 22, if the circles cut again in L (Fig. 17), D K shall be equal to D L. Join F L, G L; then, since F K, F L are radii of the same circle, F K = F L (Def. 15); and, since G K, G L are radii of the same circle, G K = G L (Def. 15). Hence, in the triangles F G K, F G L, because G K = G L, and F G is common, also base F K = base F L, therefore angle F G K = angle F G L (Euc. I. 8).

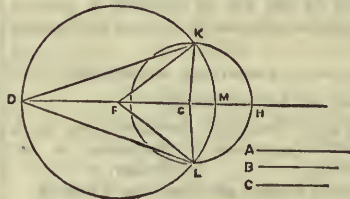


Fig. 17.

Again, in the triangles D G K, D G L, because G K = G L, and D G is common, also included angle D G K has been proved equal to included angle D G L, therefore, base D K = base D L. Q. E. D.

NOTE ON EUCLID I. 22.—Of the three straight lines, A, B, C, it is necessary that any two should be greater than the third, because, by Euc. I. 20, any two sides of a triangle are greater than the third. The necessity will also appear from the figure; for if the large circle cut D E in M, G H must evidently be greater than G M, or the small circle will not cut the large, and the construction will fail.

If G H be greater than G M, then G H is greater than the difference of F M and F G; C is greater than the difference of A and B; *i.e.*, C with either is greater than the third; and since A, B, C, are in order of magnitude, A with either of the others is greater than the third.

The proposition that any two sides of a triangle are greater than the third is obvious if a straight line be defined as the shortest distance between two points; from which it follows that a broken line between two points must be longer than a straight line. Hence two sides are greater than the third.

PROPOSITION XIX.—At a given point in a given straight line, to make an angle equal to a given rectilineal angle.

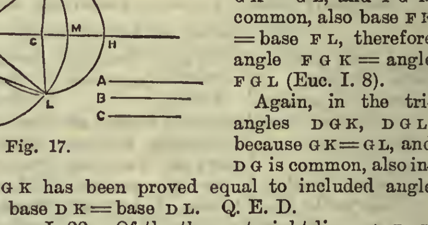


Fig. 18.

This is the same as Euc. I. 23, but the solution there given being of little use for practical purposes, the following modified form of it is suggested:—Let A (Fig. 18) be the given point in the given straight line A B, and D C E the given rectilineal angle. In C D, C E take two points, D, E, such that C D = C E, and join D E.

From A B cut off A F equal to C D (Euc. I. 3), and from centre A, at distance A F, describe a circle (Post. 3). With F as centre, and radius F G equal to D E, describe a circle, cutting the last described circle in G, G′. Join A G, A G′; then F A G, F A G′ shall be the angles required. For in the triangles F A G, F A G′, since A F, A G, A G′ are all equal, being radii of the same circle, and that A F is equal to C D or C E, therefore A F, A G, A G′ are equal to C D or C E. Also, because F G, F G′ are equal, being radii of the same circle, and F G is equal to D E, therefore F G′ is equal to D E. Hence, since A F, A G and A F, A G′ are equal to C D and C E, also bases F G and F G′ are equal to D E, therefore included angles F A G, F A G′ are equal to included angle D C E. Q. E F.

Both positions, G, G′, are given, since the enunciation does not state on which side of A B the angle is to be.

PROPOSITION XX.—In the figure of Euclid I. 15, if E F, E G (Fig. 19) be drawn at right angles respectively to A B and C D, the angle F E G is equal to the angle B E D or A E C; for since A E F is a right angle, and the angle C E G is a right angle, therefore A E F = C E G. From each take the common part, C E F, then the remainder A E C = remainder F E G. But, by Euclid I. 15, A E C = B E D; *i.e.*, angle F E G is equal to angle A E C or B E D. Q. E. D.

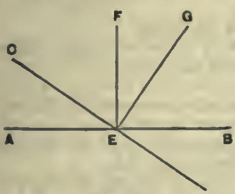


Fig. 19.

Our next article will extend as far as Euclid I. 32, and we shall prove the following propositions :—

PROPOSITION XXI.—Given two straight lines, A B, A C, meeting in A, and another line, D E, of limited length. Required to describe an isosceles triangle, A L M, such that A L may coincide with A B, and A M with A C, and L M may be equal to D E.

PROPOSITION XXII.—If A B C be an isosceles triangle of vertex A, with the base B C produced to D, and if from centre C, at distance C A, a circle be described cutting B A produced in E, then the angle E C D shall be equal to three times the angle A C B or A B C.

PROPOSITION XXIII.—In the figure of Euclid I. 5, draw C L at right angles to C B, meeting B A produced in L, and prove A L = A C.

PROPOSITION XXIV.—If in the figure of Euclid I. 5, the angles F B C, B C G be bisected by the lines C O, B O, meeting in O, then O A shall bisect the angle B A C.

PROPOSITION XXV.—In the figure of Euclid I. 1, if the circles cut again in F, and C A produced cut the circle in H, then H F will be equal to A B.

PROPOSITION XXVI.—If in a triangle A B C, B C be bisected in G, and A G joined, and the angle B A G be equal to the angle C A G, then B A shall be equal to C A.

PROPOSITION XXVII.—Given two straight lines, A B, A C, meeting in A, and another straight line, D, of limited length. Required to form a right-angled triangle, of which the base shall coincide with A C, one side shall coincide with A B, and the other side be equal to D.

PROPOSITION XXVIII.—If in the figure of Euclid I. 1, A B produced cut the circles in D, E, and the circles cut again in F, the figure C E F B is a rhombus, having each of the angles at D and E double the angles at C and F.

READINGS IN LATIN.—IV.

HORACE.

QUINTUS HORATIUS FLACCUS was born at Venusium in the year 65 B.C., and died 8 B.C., in his fifty-seventh year. He was the greatest of all the lyric poets of Rome, and his Satires, though not so biting and pungent as those of Juvenal, the acknowledged master of that branch of literature, are marked by as keen a sense of humour and power of observation. He has left us four books of Odes and one book of Epodes in various lyric metres, two books of Satires, two books of Epistles, and the "De Arte Poetica," a treatise on the art and practice of versification, in hexameters. The Odes and Epodes are the most beautiful of his works, though they are not the most original, being, for the most part, formed upon Greek models. There is an occasional obscurity in his language, and especially in the Satires and Epistles there are allusions to the events of his time to which it is difficult to find a key; but for the most part his writings are easy and graceful, and but few of the Odes present any but ordinary difficulties to the reader. The following extract is the ninth ode of the first book; it is addressed to his friend Thaliarchus, and requires no further introduction. It is in the Alcaic measure, so called from the Greek poet Alcæus, who employed it, and was credited with its invention :—

HORACE.—BOOK I., ODE ix.

Vides ut altâ stet nive candidum
Soracte, nec jam sustineant onus
Silvæ laborantes, geluque
Flumina constiterint acuto.

Dissolve frigus, ligna super foco
Large reponens, atque benignius
Deprome quadrimum Sabina,
O Thaliarche, merum diota.

Permitte divis cætera, qui simul
Stravere ventos æquore fervido
Deprœliantes, nec cupressi
Nec veteres agitantur orni.

Quid sit futurum cras, fuge quærere; et
Quem sors dierum cunque dabit, lucro
Appone: nec dulces amores
Sperne puer, neque tu choreas.

Donec virenti canities abest
Morosa. Nunc et campus, et areæ,
Lenesque sub noctem susurri
Composita repetantur hora.

Nunc et latentis proditor intimo
Gratus puellæ risus ab angulo,
Pignusque dereptum lacertis,
Aut digito male pertinaci.

NOTES.

1. Stet, *stands out*, owing to the greater clearness of the atmosphere. In summer the outline of the hills would be dim and hazy.

2. Soracte, a hill in the territory of the Falisci, about twenty-four miles from Rome, now called *Monte di S. Oreste.*

4. Acuto. So Pindar speaks of χιόνος ὀξείας, and we use the phrase "piercing cold." Constiterint, as having a passive sense, "have been stopped," takes gelu as a kind of ablative of the agent.

7. Sabina, generally described by Horace as a poor wine, "vile Sabinum" (Ode I. xx. 1), but this would be mellowed by having been kept four years (quadrimum).

8. Diota, *a two-handled jar* (δὶς, οὖς, ὠτός, *the ear*), abl. of the place *whence* a thing proceeds.

9. Simul more generally would be simul ac stravere, *as soon as they have quieted.*

10. Æquore, abl. of place.

11. Deprœliantes, *fighting it out.* The de has a sense of completing a thing, doing it thoroughly.

13. Fuge quærere, *seek not to know.* The infinitive is used as the object of (accusative case after) fuge, by a frequent construction borrowed from the Greek. So Virg. *Æn.* ix. 200, "adjungere rebus Nise fugis?" where adjungere is the object of fugis.

14. The construction is quem cunque (diem) dierum Fors dabit, *whatever sort of day Fortune gives, count it a gain.* Lucro appone, *set it down to the profit side of the account.*

18. Areæ, *open places*, around temples, for example.

20. Repetantur, *be sought for at the appointed hour.*

23. Pignus, *either a bracelet* (lacertis) or a ring (digito).

24. Male pertinaci, *that ill feigns resistance.*

The following ode is addressed to some fickle fair one who had betrayed the poet, who now congratulates himself on his escape :—

HORACE.—ODES, I. v.

Quis multâ gracilis te puer in rosâ
Perfusus liquidis urget odoribus
Grato, Pyrrha, sub antro?
Cui flavam religas comam

Simplex munditiis? Heu, quoties fidem
Mutatosque Deos flebit, et aspera
Nigris æquora ventis
Emirabitur insolens,

Qui nunc te fruitur credulus aureâ;
Qui semper vacuam, semper amabilem
Sperat, nescius auræ
Fallacis. Miseri quibus

Intentata nites! Me tabula sacer
Votiva paries indicat uvida
Suspendisse potenti
Vestimenta maris Deo.

NOTES.

1. In rosâ, *on a couch strewn with roses.*
5. Simplex munditiis, *plain in thy neatness.* Fidem, *the confidence which he reposed in you deceived.* Supply fælsam.
6. Mutatos Deos, *changed fortune.*
7. Æquora. The poet compares Pyrrha's changing humours to the fickleness of the weather. Like many others, he has been shipwrecked on her smiles, but he has got safely through it. Nigris, *black and scowling,* probably as bringing up the black storm-clouds.
8. Emirabitur, a strengthened form of miror, occurring only in this passage.
13. Me tabula, etc. The construction is—Paries sacer indicat votivâ tabulâ me suspendisse vestimenta uvida Deo potenti maris, and the allusion is to a custom of the Italian sailors, on escaping from shipwreck, to put up a votive tablet in the temple of Neptune, or some other sea deity, together with the clothes in which they were preserved.
16. Maris probably is governed by potens, according to a Greek construction, by which verbs of ruling govern a genitive case—for example, "Sic te Diva potens Cypri" (Odes, I. iii. 1).

The next extract is from the Satires, and is the beginning of an amusing description of the way the poet was pestered in the street, by a person who persisted in fastening on to him. The whole satire is peculiarly bright and vivid, and the description is so true to life, that it is as applicable at the present day as at the time when it was written.

HORACE.—SAT. I. ix.

Ibam forte Via Sacra, sicut meus est mos,
Nescio quid meditans nugarum, et totus in illis:
Accurrit quidam notus mihi nomine tantum,
Arreptaque manu, "Quid agis, dulcissime rerum?"
"Suaviter, ut nunc est," inquam; "et cupio omnia quæ vis."
Quum assectaretur, "Numquid vis?" occupo. At ille,
"Noris nos," inquit. "Docti sumus." Hic ego, "Pluris
Hoc," inquam, "mihi eris." Misere discedere quærens,
Ire modo ocius, interdum consistere, in aurem
Dicere nescio quid puero; quum sudor ad imos
Manaret talos. "O te, Bolane, cerebri
Felicem! aiebam tacitus; quum quidlibet ille
Garriret, vicos, urbem laudaret. Ut illi
Nil respondebam, "Misere cupis," inquit, "abire;
Jamdudum video; sed nil agis, usque tenebo;
Persequar. Hinc quo nunc iter est tibi?" "Nil opus est te
Circumagi; quendam volo visere, non tibi notum;
Trans Tiberim longe cubat is, prope Cæsaris hortos."
"Nil habeo quod agam, et non sum piger—usque sequar te."

NOTES.

1. Via Sacra, one of the principal streets of Rome, leading up to the Capitol through the Forum, from where the arch of Constantine now stands. It was called sacred as being the route followed by triumphal processions and religious pageants.
4. Quid agis. The common form of salutation in Rome. Where we say, "How do you do?" the Romans said, "What do you do?" Rerum goes with dulcissime, not quid.
5. Ut nunc est, *as times go.*
6. Occupo, *I ask him at once.*
7. Pluris, etc. *On this account, I reply, you will be more esteemed by me.* Pluris is the gen. of price.
10. Puero, the slave whom Horace had in attendance, according to the fashion of the day.
11. Bolane cerebri felicem, *I wish you were here, Bolanus, with your coolness,* apostrophising some outspoken friend, who would have got rid of the fellow summarily. Cerebri, genitive, signifying with respect to. So Pliny has "Miseros ambitionis," and in Greek we find, εὐδαίμων τῶν λόγων.
15. Jamdudum, etc., *I've seen it all along, but it's no use.*
17. Circumagi, *there is no need for me to take you out of your way.*
18. Cæsaris hortos, the gardens on the Janiculum, which Cæsar, when dictator, had assigned to the people as a public pleasure-ground.

The following are some of the canons for the treatment of dramatic subjects which Horace lays down in the "De Arte Poetica."

HORACE.—DE ARTE POET., 179.

Aut agitur res in scenis, aut acta refertur:
Segnius irritant animos demissa per aurem,
Quam quæ sunt oculis subjecta fidelibus, et quæ
Ipse sibi tradit spectator. Non tamen intus
Digna geri, promes in scenam; multaque tolles
Ex oculis, quæ mox narret facundia præsens.
Nec pueros coram populo Medea trucidet,
Aut humana palam coquat exta nefarius Atreus,
Aut in avem Progne vertatur, Cadmus in anguem.
Quodcunque ostendis mihi sic, incredulus odi.

NOTES.

179. Aut acta refertur, *or its occurrence is related.* The drama consists partly of action, partly of narrative; and the action which the spectators see with their own eyes naturally impresses them more strongly than that of which they merely hear secondhand. Still, there are subjects which, either from their being repulsive or unnatural, should be described rather than enacted, as the Greek poets have done in the case of Medea's murder of her children, or Atreus' horrible feast, or the unnatural transformations of Progne and Cadmus.
180. Segnius irritant, *impress less vividly.*
181. Fidelibus, *on the evidence of which he can depend.*
182. Quæ ipsi sibi tradit; *and for which he is his own authority.* Intus digna geri, *things which ought to be kept behind the scenes.*
184. Mox, *in due time.*
185. Pueros. In Euripides' play of "Medea," the cries of the children are heard on the stage, but the actual murder is not shown. If you choose such subjects as Medea or Atreus, you must treat the horrors of the story in the same way as the old Greek poets did.
188. Quodcunque, etc., *anything you show me in this way is repugnant to my reason and my taste.*

Translation of SALLUST—"CATILINA," v.

(See page 124.)

Lucius Catilina, the son of a distinguished house, was a man endowed with great capacities, both of mind and body, but he had a wicked and perverse disposition. From his boyhood he had revelled in the scenes of intestine strife, murder, rapine, and civil broil, which became his pursuits on arriving at manhood. Gifted with a constitution capable of enduring to an almost incredible degree, fasting, cold, and want of sleep, with a mind courageous, cunning, and shifty, capable of pretence or concealment to any extent; covetous of his neighbour's money, lavish of his own; outrageous in his desires; with plenty of eloquence but little wisdom to guide it; in his boundless ambition, ever straining after some extravagant object beyond the belief or aim of ordinary men; this man, ever since Lucius Sulla's dictatorship, had been fired with an irresistible desire to seize the reins of the state, and, provided he could gain the regal power he aimed at, he cared not one jot by what means it was to be attained. Day by day his views became more and more outrageous, spurred on by his want of money and the recollection of his crimes, to both of which results his former courses had contributed. An additional incitement was found in the corrupt state of morality in Rome, which was cursed by two abominable evils differing widely in their nature—luxury and avarice.

LESSONS IN ALGEBRA.—XVIII.

EXERCISE 30.—MISCELLANEOUS PROBLEMS IN SIMPLE EQUATIONS.

1. What two numbers are those whose difference is 10; and if 15 be added to their sum, the amount will be 43?
2. There are two numbers whose difference is 14; and if 9 times the less be subtracted from 6 times the greater, the remainder will be 33. What are the numbers?
3. What number is that to which if 20 be added, and from $\frac{2}{3}$ of this sum 12 be subtracted, the remainder will be 10?
4. A and B lay out equal sums of money in trade; A gains £120, and B loses £80; and now A's money is triple that of B. What sum had each at first?
5. What number is that, $\frac{1}{3}$ of which exceeds its $\frac{1}{4}$ by 72?
6. There are two numbers whose sum is 37; and if 3 times the less be subtracted from four times the greater, and the remainder be divided by 6, the quotient will be 6. What are the numbers?
7. A man has two children, to $\frac{1}{3}$ of the sum of whose ages if 13 be added, the amount will be 17; and if from half the difference of their ages 1 be subtracted, the remainder will be 2. What is the age of each?
8. A messenger being sent on business, goes at the rate of 6 miles an hour; 8 hours afterwards, another is dispatched with countermanding orders, and goes at the rate of 10 miles an hour. How long will it take the latter to overtake the former?
9. To find two numbers in the proportion of 2 to 3 whose product shall be 54.

10. A man agreed to give a labourer 12s. a day for every day he worked, but for every day he was idle he should forfeit 8s. After 390 days they settled, and their account was even. How many days did he work?

11. Three persons, A, B, and C, draw prizes in a lottery. A draws £200; B draws as much as A, together with a third of what C draws; and C draws as much as A and B both. What is the amount of the three prizes?

12. What number is that which is to 12 increased by three times the number, as 2 to 9?

13. A ship and a boat are descending a river at the same time. The ship passes a certain fort when the boat is 13 miles below. The ship descends 5 miles, while the boat descends 3. At what distance below the fort will they be together?

14. What number is that, a sixth part of which exceeds an eighth part of it by 20?

15. Divide a prize of £2,000 into two such parts that one of them shall be to the other as 9 to 7.

16. What sum of money is that whose third part, fourth part, and fifth part, added together, amount to £94?

17. Two travellers, A and B, 360 miles apart, travel towards each other till they meet. A's progress is 10 miles an hour, and B's 8. How far does each travel before they meet?

18. A man spent one-third of his life in England, one-fourth of it in Scotland, and the remainder of it, which was 20 years, in the United States. To what age did he live?

19. What number is that, $\frac{1}{4}$ of which is greater than $\frac{1}{5}$ of it by 96?

20. A post is $\frac{1}{5}$ in the earth, $\frac{3}{7}$ in the water, and 13 feet above the water. What is the length of the post?

21. What number is that, to which 10 being added, $\frac{3}{5}$ of the sum will be 66?

22. Of the trees in an orchard, $\frac{3}{4}$ are apple-trees, $\frac{1}{10}$ pear-trees, and the remainder peach-trees, which are 20 more than $\frac{1}{5}$ of the whole. What is the whole number of trees in the orchard?

23. A gentleman bought several gallons of wine for £94; and after using 7 gallons himself, sold $\frac{1}{4}$ of the remainder for £20. How many gallons had he at first?

24. A and B have the same income. A contracts an annual debt amounting to $\frac{1}{7}$ of it; B lives upon $\frac{4}{5}$ of it; at the end of ten years B lends to A enough to pay off his debts, and has £160 to spare. What is the income of each?

25. A gentleman lived single $\frac{1}{4}$ of his whole life; and after having been married 5 years more than $\frac{1}{7}$ of his life, he had a son, who died 4 years before him, and who reached only half the age of his father. To what age did the father live?

26. What number is that, of which if $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{2}{7}$ be added together, the sum will be 73?

27. A person after spending £100 more than $\frac{1}{3}$ of his income, had remaining £35 more than $\frac{1}{2}$ of it. Required his income.

28. In the composition of a quantity of gunpowder, the *nitre* was 10lbs. more than $\frac{2}{3}$ of the whole, the *sulphur* $4\frac{1}{2}$lbs. less than $\frac{1}{6}$ of the whole, the *charcoal* 2lbs. less than $\frac{1}{7}$ of the whole. What was the amount of gunpowder?

29. A cask which held 146 gallons, was filled with a mixture of brandy, wine, and water. There were 15 gallons of wine more than of brandy, and as much water as the brandy and wine together. What quantity was there of each?

30. Four persons purchased a farm in company for £4,755; of which B paid three times as much as A; C paid as much as A and B; and D paid as much as C and B. What did each pay?

31. It is required to divide the number 99 into five such parts that the first may exceed the second by 3, be less than the third by 10, greater than the fourth by 9, and less than the fifth by 16.

32. A father divided a small sum among four sons; the third had 9 shillings more than the fourth, the second had 12 shillings more than the third, the first had 18 shillings more than the second, and the whole sum was 6 shillings more than 7 times the sum which the youngest received. What was the sum divided?

33. A farmer had two flocks of sheep, each containing the same number. Having sold from one of these 39, and from the other 93, he finds twice as many remaining in the former as in the latter. How many did each flock originally contain?

34. An express travelling at the rate of 60 miles a day, had been dispatched 5 days, when a second was sent after him, travelling 75 miles a day. In what time will the one overtake the other?

35. A's age is double that of B, and B's age triple that of C, and the sum of all their ages 140. What is the age of each?

36. Two pieces of cloth, at the same price by the yard, but of different lengths, were bought, the one for £5, and the other for £$6\frac{1}{4}$. If 10 yards be added to the length of each, the sums will be as 5 to 6. Required the length of each piece.

37. A and B began trade with equal sums of money. The first year A gained £40, and B lost £40. The second year A lost $\frac{1}{3}$ of what he had at the end of the first, and B gained £40 less than twice the sum which A had lost. B had then twice as much money as A. What sum did each begin with?

38. What number is that, which being severally added to 36 and 52, will make the former sum to the latter as 3 to 4?

39. A gentleman bought a chaise, horse, and harness for £360. The horse cost twice as much as the harness, and the chaise cost twice as much as the harness and horse together. What was the price of each?

40. Out of a cask of wine, from which had leaked $\frac{1}{4}$ part, 21 gallons were afterwards drawn; when the cask was found to be half full. How much did it hold?

41. A man has 6 sons, each of whom is four years older than his next younger brother; and the eldest is three times as old as the youngest. What is the age of each?

42. Divide the number 49 into two such parts, that the greater increased by 6, shall be to the less diminished by 11, as 9 to 2.

43. What two numbers are as 2 to 3; to each of which, if 4 be added, the sums will be as 5 to 7?

44. A person bought two casks of porter, one of which held just three times as much as the other; from each of these he drew 4 gallons, and then found that there were 4 times as many gallons remaining in the larger as in the other. How many gallons were there in each?

KEY TO EXERCISES IN LESSONS IN ALGEBRA.

EXERCISE 26.

1. $x = 94$.
2. $x = (a + b) \times (h - d)$.
3. $x = 4$.
4. $x = \dfrac{abgm + adem - adgh}{dgm}$.
5. $x = 9 - \frac{1}{13}$, or $x = 8\frac{12}{13}$.
6. $x = 72$.
7. $x = 7$.
8. $x = 10$.
9. $x = 70$.

EXERCISE 27.

1. $x = \frac{1}{2}\left(\dfrac{a}{c} - \dfrac{d}{h}\right) + 2b$.
2. $x = \dfrac{h - 4}{a + 1}$.
3. $x = \dfrac{(a+d)\,h - 4b}{4\,(h - 1)}$.
4. $x = d + 1$.
5. $y = \dfrac{c\,(h - m)}{a + b}$.
6. $a + b : h - m :: c : y$.
7. $x = 2$.
8. $x = 3$.
9. $x = 12$.
10. $x = 2$.

EXERCISE 28.

1. $x = 104$.
2. $x = 3275$.
3. $x = \dfrac{(bc - a)\,(m + n)}{c}$.
4. $x = \dfrac{(abc - d)\,(l - m - n)}{c}$.
5. $x = mcd + \dfrac{ma}{b + c + d}$.
6. $x = 8$.
7. $x = \dfrac{abc\,(d - h)}{ab - ac + bc}$.
8. $x = 12$.
9. $x = 23\frac{1}{3}$.
10. $x = 25\frac{22}{47}$.
11. $x = \frac{1}{3}(1 - a)$.
12. $x = -3\frac{1}{15}$.
13. $x = \frac{4}{1}$.
14. $x = 6$.
15. $x = 1\frac{1}{3}$.
16. $x = 9$.
17. $x = 7$.
18. $x = 4$.
19. $x = 9$.
20. $x = 7$.
21. $x = 1$.
22. $x = 4$.
23. $x = 6$.
24. $x = 4$.
25. $x = 2$.
26. $x = 45$.
27. $x = 23$.
28. $x = 12$.
29. $x = 40$.
30. $x = 19$.
31. $x = 51$.
32. $x = 420$.
33. $x = 11$.

EXERCISE 29.

1. 7 and 4.
2. 5, 8, 2, 24.
3. 48.
4. £4,800.
5. 450.
6. 240 and 200.
7. 210 miles from London.
8. $200\frac{1}{16}$ miles from London.
9. 16, 32, and 12.
10. £116 13s. 4d. and £93 6s. 8d.
11. £1,000.
12. 45 and 15 years.
13. A's share, £416 13s.4d.; B's, £283 13s. 4d.; and C's, £316 13s. 4d.
14. 50.
15. 5,040.
16. 25 and 19.
17. 13.

RECREATIVE NATURAL HISTORY.

NIGHTSHADES.

Amongst botanists the nightshade family (*Solani*) are placed in the class Pentandria, order Monogynia, natural order Lurida. In a purely scientific point of view this arrangement is no doubt very complete and intelligible to those who are far too well informed to mistake a nightshade for any other plant; but it is our object to lay before such of our readers as are not acquainted with the anatomy and structural differences distinguishing botanical species, enough information, aided by illustrations, to guard them from the fate which a short time since unfortunately befel Captain Bawden and his party, whilst engaged in a search for minerals in the Isle of Man. Many of our readers will remember that, feeling fatigued and thirsty, he and his companions pulled up from the earth a plant, the root of which bore some fanciful resemblance to that of a wild carrot, and ate a portion of it. In less than fifteen minutes Captain Bawden paid the forfeit of his want of discretion with his life. The others, who partook more sparingly of the root, fortunately procured milk, which they found alleviated their sufferings, and in time recovered. Some time since we remember being witness to extraordinary popular excitement and consternation, caused by a number of people being taken suddenly and dangerously ill, through eating tarts and puddings made from an unknown fruit, which some stranger to the neighbourhood had been vending at a cheap rate, under the name of nettle-berries. An examination of some of the berries which remained unconsumed showed them to be the fruit of the deadly nightshade (*Atropa belladonna*) of which we shall have more to say as we proceed. Some members of the *Solani* with which we shall have to deal are indigenous to the soil of England; others have become acclimatised, and although originally natives of a warmer climate, now grow freely in this country. We will commence our remarks, then, with the most important nightshade in the world, a plant which may be said to rank next to corn in food-yielding importance in most civilised countries. *Solanum tuberosum*, the common potato of our fields and gardens, was first introduced by Sir Walter Raleigh, who brought the roots from Quito, and caused them to be planted in his own garden at Youghal, in Ireland. On the plants arriving at maturity, Sir Walter's old gardener, availing himself of the privileges of his situation, gathered some of the fruit, or "potato apples," as they are now called, and tasted them. Those of our readers who have eaten of this particularly unpalatable and unwholesome production will feel no wonder that the ire of the old man should have been raised. Breaking in unceremoniously on his master's studies, he exclaimed, "If this is your fine foreign fruit, I would not give it garden room, not I!" "Well," said Sir Walter, "if it is as bad as you say, dig it up at once; but if you find any roots worth looking at, bring them to me." It is, perhaps, needless to say that the roots proved very well worth examining. It was not, however, until about 1732 that regular potato crops were cultivated in Scotland. England followed the example set by the Scottish farmers, and grew the new root. So deep was the prejudice existing against this plant in the minds of the ignorant, that when the Russian government issued seed potatoes to the native cultivators, with orders to attend to the increase of the crop, the new tubers were called the "Devil's apples," a name which, in some remote districts of the Oural, they still bear.

In its wild state the potato grows its tubers very near and often even on the surface of the ground. They are small, acrid, and by no means tempting in appearance. The Spaniards and Portuguese appear to have discovered its value before its introduction to England by Raleigh. The word "potato," pronounced by the Spaniards *battata*, is no doubt a corruption of the original native name. In addition to its value as a culinary vegetable, the potato tuber is remarkable for producing by treatment an abundant supply of farina, from which a very large quantity of the tapioca sold in our shops is manufactured. Potato flour or starch, under the name of arrowroot, has also a considerable sale. The potato plant is probably too familiar to our readers to need description. The blossom, although of larger size, closely resembles that of *Solanum dulcamara*, represented at Fig. 1. The potato fruit is about the size of a large marble, and contains numerous seeds. *Solanum dulcamara*, woody nightshade, or bitter-sweet, is an indigenous plant, and common throughout England, and some districts of Siberia and Africa. It is found growing abundantly in hedgerows, and about old walls and ruins. It is a woody-stemmed but trailing perennial plant, flowering in June and July. The flowers, which are of a bluish-purple, with a projecting yellow spike in the centre, are followed by clusters of berries, which ripen in September and October. When ripe they present a most attractive and tempting appearance, being of a rich full red tint. A reference to Fig. 1 in the illustration on the opposite page will serve to show the form of the flower, leaf, stem, and fruit. All parts of the plant are poisonous, and, as would appear by the lamentable catastrophe we have before referred to, the root must be most virulently so, to destroy the life of a strong, robust man in a few minutes. The shoots and young leaves of this plant have been occasionally used in medicine, but we are not aware of their possessing any special quality to recommend them in a curative point of view.

Next in order we proceed to describe the plant known as the Deadly Nightshade "Dwale" (*Atropa belladonna*), and from which the so-called "nettle-berries" before mentioned were gathered. This is also a native of England, and is found growing wild in the hedges and woods of many districts. This plant, or rather bush, is also a perennial, and not unfrequently reaches from five to six feet in height. The leaves are ovate and entire, and the flowers somewhat the shape of the common harebell of our woods and hedges, but larger, and of a rich and lurid purple colour, each flower springing alone from axis or union between the leaf and stalk. As the flower passes away it is succeeded by the fruit, which, when mature, is about the size of an ordinary cherry, black in colour, rich in bloom, and of a sweetish and rather agreeable taste; but the growing plant when approached, particularly when the fresh dew of morning hangs on it, gives forth an oppressive and faint odour. This plant, like *S. dulcamara*, grows luxuriantly among fallen walls and the ruins of old buildings. Every part of the plant is both narcotic and poisonous, but in the hands of the pharmaceutical chemist it yields products of great medicinal value. Possessing, as its extract does, the curious property of dilating the pupillary opening of the eye, this property is taken advantage of by the oculist as an aid in prosecuting his examinations as to the condition of the eye, and in the prosecution of such operations on that organ as may be requisite. It is also used extensively in both neuralgic and pulmonary affections; so that deadly nightshade, like many other justly dreaded natural productions, is found to possess its good qualities as well as its evil ones, when we know how to avail ourselves of them. Fig. 2 in the annexed illustration represents the leaf, stem, flower, and embryo fruit of the deadly nightshade. The term *Belladonna* applied to this plant appears to have been derived from the practice which was at one time made of using the juices as a cosmetic; hence we have the name "Beautiful Lady." *Atropa* we have from the name of one of the Fates, "Atropos;" and *Dwale* from the French *deuil* (grief), a figurative destination at which you are pretty sure to arrive if you partake of the atropa fruit.

There is a plant found growing abundantly in almost every hedgerow in England, which has been by popular error commonly confounded with the plant just described, and incorrectly called deadly nightshade, or the "poison-berry." This plant is the *Bryonia* or Briony, but it is in no way related to the true nightshades or *Solani*, being a member of the family of *Cucurbitacea*, to which melons, gourds, vegetable marrows, cucumbers, etc., belong. Most of our readers will have observed this trailing, climbing plant, vine-like in foliage and mode of growth, throwing out its long corkscrew-shaped tendrils and greenish-yellow flowers in the months of June and July. These are succeeded in the autumn by clusters of very beautiful scarlet berries or fruit, which, from their currant-like and juicy appearance, are not unfrequently eaten of by children and ignorant persons. Every part of this variety growing in Great Britain is poisonous, although the young shoots of a plant of kindred species growing abroad are boiled and eaten, just as we eat asparagus, with impunity. The root of our hedge-briony at times grows to a very large size, and is not unfrequently mistaken for that of the mandrake, to be hereafter described. Fig. 3 represents the leaf, stem, and flower of the common Brionia. The berries are round, about the size of small peas, and contain an acrid, poisonous juice, which has been highly extolled as a remedy for ringworm. The root, too, has been much used in the treatment of the diseases of cattle. Next to this we have a true nightshade, *Solanum nigrum* (black or common garden nightshade), which is often found growing on the waste lands and in the rural districts of England. Few persons who notice wild plants will have failed to see it. The leaves are entire, and covered with fine hairs. The flowers are white, the fruit almost black, and the stalk easily broken. We are not aware of any use to which this plant has been applied.

Henbane, or hogbane (*Hyoscyamus niger*), is another true Solanum, and is found in many parts of England; it grows to about two feet in height, and is covered with fine bristles or hairs, which give off a fœtid odour. The flowers, which are arranged in a double row on the stem, are most peculiar, being of a rich chocolate-yellow tinged with brown, and veined with a perfect network of purple lines. A dark rich purple centre or eye serves to complete a flower which, when once seen, would not be readily forgotten. The seed-capsules, which also stand in a double row, are each capped with a sort of capsular lid, to lift which the aid of a knife is required. The seeds usually escape through perforations made by insects. All parts of the plant are poisonous. The extract is extensively used in medicine. Linnæus states that the roots, when cut up and thrown about the floors of a house, will cause all mice to at once depart.

The tomato or love-apple (*Solanum lycopersicum*), although not indigenous to England, is so well known as a culinary vegetable that it could by no possibility be mistaken for anything else. The Egg-plant, Jew's apple, or Mad apple (*Solanum melongenæ*), is also an exotic, but is used by Continental cooks as an ingredient in soups, hashes, etc. "Bringalls," a common vegetable of the Mediterranean Ports, much resemble these in growth and qualities, and are extensively used in cookery. The Mandrake or May apple (*Mandragora*) is a Solanum which has from very early periods of history been regarded with much superstitious dread, which has probably arisen, partly from its poisonous properties, and partly from its large and irregularly-shaped roots, which at times grow in the uncouth form of a man. Shakespeare writes—

> "And shrieks like mandrake torn out of the earth,
> That living mortals hearing them run mad."

The notion that prevailed in bygone days regarding the sounds of complaint uttered by the mandrake when being rooted up appears to have been widely entertained by the ignorant. Misfortune of the most serious kind was believed to be the portion of any one bold or rash enough to engage in disturbing the mandrake in its earth-bed. An old proverb says—

> "He who gathereth the mandrake shall die,
> Blood for blood is his destenie."

Notwithstanding this terrible threat, mandrakes have been from time to time dug up for medicinal purposes by herb collectors and others, without any very remarkable events following the audacity of the diggers. Fig. 4 shows the leaf, flower, and curious root of this plant. The Mandrake of Scripture was probably a plant of a very different description, but we are unable to say to what family it belonged. It is not our intention here to dwell on the various members of the Solanum group to be found in distant countries. Over 400 species have been already enumerated by botanists. It is our object to deal more particularly with plants and flowers of the nightshade family which may, perchance, come under the immediate observation of our readers at home. The plant-world, even in our little island home, is a tolerably large one, and we hope in a future paper to pay another visit to it, with our readers as pleasant companions.

Fig. 1.

Fig. 4.

Fig. 3.

Fig. 2.

LESSONS IN ENGLISH.—XXXIX.

THE CELTIC ELEMENT.

The Celtic element in the English language has received far less attention than it deserves. Till recently, indeed, its existence was scarcely known; and when at length it compelled recognition, its appearance was restricted to names of places, particularly the great outlines of the country, such as hills, mountains, headlands, rivers, etc.

The ordinary teaching of the schools was, that the original British natives of these islands were extirpated by the invading and conquering Saxons to such an extent, that the former were able to sustain themselves only in the mountain fastnesses of the extreme parts of the country, Scotland in the north, Cornwall in the south, and Wales in the west. In those parts, unquestionably, the native British successfully withstood their Saxon invaders, and there transmitted their vernacular tongue from generation to generation. Not less is it true that the British element in the population of the lowlands was neither uprooted nor absorbed. Extermination is a rare event in the migrations and changes of tribes and nations. Scarcely would it be too much to affirm that extermination never takes place. And even absorption is only partial. Besides, if blood is absorbed, it does not lose its primitive qualities. Still less easy of absorption is a language. A living language—that is, a language vernacular to the aboriginals of a country—stamps itself on the entire land and on the whole life of the people. That impression is all but indelible. Only the attrition and abrasion of centuries can wear the image down, much less wholly efface it. The language of the cottage is one of the few permanent things on earth; and when, by the extruding power of the language of the court, and of books, and of commerce, it is compelled to withdraw into narrower and narrower limits, it ceases to be a language only to become a dialect and a *patois* (the language of the peasants of a province), and still maintains an existence in what we call provincialisms and vulgarisms, when at length it is wholly banished from cultivated society. Nor only there does it survive; it lives on in the warp and woof of the spoken and written tongue. These allegations are borne out by the fact that in our present English, the original Celtic of these islands still remains to no inconsiderable extent.

The Celts (or, as the fashion now is, the Kelts), as far back as history goes, were the primitive inhabitants of England, Wales, Scotland, and Ireland. The race at large, in an ante-historic period, migrated from Central Asia into Europe, and, spreading over its surface, penetrated to its western limits.

The Celtic language is now acknowledged to have affinities with the important group of languages denominated the Indo-Germanic, of which the Sanscrit, the Greek, and the German may be taken as representatives. At the same time, the Celtic language, as being a language spoken by an independent family of nations, possesses essentially independent features.

There are still six Celtic tongues or dialects recognised in Europe. Of these, four belong to the British Islands. A fifth, the Cornish, now nearly or quite extinct, also pertained to the same insular home of the Keltai or Celts. The sixth, the Armorican, belongs to Brittany, a country connected with Britain in history as well as in name.

THE CELTIC TONGUES.

I. The Gallic or British, including	II. The Gaelic or Erse, including
1. Cymric or Welsh.	1. Fenic or Irish.
2. Cornish.	2. Gaelic or Highland Scotch.
3. Armorican or Breton.	3. Manx.

The statements that have been made as to the survival of the Celtic element in our national life and literature may be confirmed by a quotation from an author of merit, whose studies and whose subject would naturally incline him to give predominance to Saxon claims:—"Nothing is more common or less true than the exaggerated account of total exterminations and miserable oppressions in the traditional literature of conquered nations; and we may very safely appeal even to the personal appearance of the peasantry in many parts of England as evidence how much Keltic blood was permitted to subsist and even to mingle with that of the ruling Germans; while the signatures to very early charters supply us with names assuredly not Teutonic (or Saxon), and therefore possibly borne by persons of Keltic race, occupying positions of dignity at the courts of Anglo-Saxon kings."*

In a list given by the very learned German philologist Adelung (Mithridates II. 40) of genuine Celtic words found gathered from very ancient sources, and found in Teutonic tongues, the following have representatives in the English of the present day:—

Aber, as in *Aber*conway and several other Welsh names, denotes the *mouth of a river*, the confluence of a river with the sea; and hence a bay or harbour. It is found in the French *Havre* (Havre-de-Grace) and in the English *harbour*.

Alpes, the ancient Gallic designation for any high land; hence our *Albion*, so called from its lofty cliffs.

Bard, the Gallic name for *poet, singer, prophet*.

Bastard, from the Welsh bas, *low*, and tardd, *to come forth*; hence, persons of low and unworthy birth.

Becco, Gallic, our *beak*.

Beria, a *level field, a plain*; hence the numerous instances of *bery* as a termination of English names of places.

Braca, Gallic, *a dam, a limit*; Scotch, *bray*; French, *braie*, a hedge.

Braccæ, Gallic, *breeches*.

Brace, i.e., *corn*, whence the Gauls made their beer; hence the words *brew, brewer, beer*.

Bria, briga, perhaps from the Welsh *brig, brigyn*, a hill-top. Briga itself signifies in the Celtic a *town*, as in *Boroughbridge*.

Carn, a *group of stones* or *rocks*; hence our *Carn* or Cairn and Cornwall (stony Wales).

Carra, a Gallic four-wheeled carriage, a *car, cart*, to *carry, carter*.

Carruca, among the Gauls a convenient travelling carriage; French, *caroche*; English, *coach*.

Craig, in Welsh a *rock*, precipice; our *crag*.

Druid, the Gallic name for *priest*.

Dur, water; Welsh, *dwr*; as in *Der*went, *Der*by, *Dor*chester.

Foll, foolish; Welsh, *ffoll*; French, *fou*; Scotch, *fou* (tipsy); English, *fool*; German, *toll*.

Lancea, Gallic for *lance*.

Marga, marl; whence *Marl*borough and Albe*marle*.

Nant, water, river; whence *Nant*wich.

Pen, a *summit, head*; as in *Pen*craig in Hereford and *Pen*gover in Cornwall, *Pen*istone in Yorkshire, *Pen*rith in Cumberland.

Rit, a *ford*; hence the ending *rit* as in Cambo*ritum*, Cambridge.

Soldurii (sol, *bond*, and *wr*, Latin, *vir, a man*), *boundmen*, or men engaged to each other and to their leader in war; our *soldier*.

Spatha, a *two-edged sword*; whence, through the German *spaten*, is our *spade*.

Tan, land, as in Britain (Britannia, the land of the *Britti*, or painted people; so we say *the blacks, the whites, the fair*.)

The names *father, mother, sister*, and *brother*, are of necessity among the first. They are also the most enduring. Consult, then, this table:—

Breton.	*Welsh.*	*English.*
Tad (dad),	tad,	father, dad, daddy.
Mamm,	mam,	mother, mamma, mammy.
Breur,	brawd,	brother.
Choar,	chwaer,	sister.

Our words *father* and *mother* come to us from the Indo-Germanic stem; but the cottage words, the nursery words, the words of intimate affection, *dad, daddy, mam, mamma, mammy*, are derived from our British or Celtic forefathers. The oldest forms of a language are found in the cottage and on the hill-side. In both those spots, and in the provincialisms which still in a measure survive, a considerable number of Celtic words remain. These words are among the most expressive. Take the term *mettle*. Even Webster, after other great lexicographical authorities, originally derived this from the Greek root which gives us *metal*, namely, metallan, *to scrutinise, to seek for by digging*; as if *a man of mettle* and *a man of metal* were not as much opposed to each other as *a high-spirited man* and *a money-grub*. Turn to the Welsh, and you find in *meddwl* (*mind, courage*, which by the vulgar is called *pluck*), the exact idea which *mettle* conveys; for example—

> "The winged courser, like a generous horse,
> Shows most *true mettle* when you check his course."—*Pope.*

To fettle, is in the genuine Lancashire dialect a very expressive word, giving rise to the general idea of making a thing good, excellent, delicious; and, occurring in such instances as *to fettle a horse*, means to restore him to soundness; *to fettle a wife*, means to put her to rights; *fettled ale* means ale warmed with spice, spirits, eggs, etc. The word, together with our common

* "The Saxons in England," by J. M. Kemble, 2 vols. 8vo, 1849; Vol. I., p. 21.

term *fat*, of which *fettle* is a diminutive verbal form, has its origin in the Welsh *Ffaeth*, meaning *luxuriant, ripe, rich*

We have cast our eye down a page or two of an Irish dictionary, and found these coincidences:—

IRISH OR FENIC WORDS IDENTICAL WITH ENGLISH.

IRISH OR FENIC.	GERMAN.	IRISH OR FENIC.	GERMAN.
Abal, *an apple.*	*Apfel.*	Ball, *a ball, globe.*	*Ball.*
Acra, *an acre.*	*Acker.*	Bann, *a band* of men.	*Bande.*
Aer, *air* (Greek, *aer*).		Baran, *a baron.*	*Baron.*
Aes, *age* (Latin, *aetas*).		Barc, *a boat, barque.*	*Barke.*
Airc, *a chest, ark* (Latin, *arca*).	*Arche.*	Bard, *a poet, bard.*	*Barde.*
Airbhe, *a rib.*	*Rippe, ribbe.*	Barra, *a bar.*	*Barre.*
Aird, *a country, earth* (Scotch, *yird*).	*Erde.*	Be, *life, being.*	
Baban, *a baby, infant.*		Be, *is, be.*	
Babloir, *a babbler* (? Babel).	*Plapperer.*	Beach, *a bee.*	*Bien.*
Baiuis, *a wedding, the bans.*		Bear, *a bear.*	*Bär.*
Bairghin, *a son, bairn.*		Bearim, *I bear, carry, bring forth.*	
Bairile, *a barrel.*		Bearbaim, I shave the *beard* (Latin, *barba*).	*Barbieren.*
Baitsolcar, *a bachelor.*		Beathach, *abeast* (French, *bête*).	

From the Welsh the following among other instances have been given by the Rev. R. Garnett* :—

COINCIDENCES BETWEEN THE WELSH AND THE ENGLISH.

Basged, *a basket.*	Gwichet, *a wicket* (Fr. *guichet*).
Bottwm, *a button.*	Hem, *a border, hem* (Sax. *hem*).
Bran, *skin of wheat, bran.*	Llath, *a lath* (Sax. *latta*).
Brat, *a clout, a brat* or *pinafore.*	Matog, *a mattock* (Sax. *mattuc*).
Brodiaw, *to embroider* (Fr. *broder*).	Mop, *a mop.*
Bwyell, *a hatchet, a bill* (Germ. *biel*).	Paeol, *a pail.*
Cab, caban, *a hut, cabin* (Fr. *cabane*).	Pan, *a bowl, pan* (Sax. *ponne*).
Cae, *an enclosure, quay* (Fr. *quai*).	Parc, *an enclosure, park* (Fr. *parc*).
Ceubal, *cobble, a boat* (Sax. *cuople*).	Pelen, *a little ball, pellet* (Fr. *pelote*).
Crochan, *a pot, crockery* (Sax. *crocca*).	Piser, *a jug, pitcher.*
Crog, *a hook, crook* (Celt. *crok*).	Rhail, *a fence, rail* (Germ. *ralle*).
Dantaeth, *a choice morsel, dainty.*	Rhasg, *a slice, rasher.*
Darn, *a patch, darn* (Sax. *dearnan*).	Soch, *a drain, sough.*
Fflasged, *flasket* (Fr. *flasque*).	Tacl, *instrument, tackle* (German, *takel*).
Fflaw, *a shiver, flaw.*	Tasel, *fringe, tassel.*
Ffynel, *a funnel.*	

A knowledge of the laws which affect the permutation of letters in words as they appear in different languages or dialects would disclose to the student many Celtic terms in English, of which otherwise he would have no suspicion. I have given clear examples. Other very clear examples could be added. I shall for exercise subjoin a few Celtic words with their several meanings, leaving the student to discover the corresponding English terms.

EXERCISE.

CELTIC WORDS.	MEANINGS.	CELTIC WORDS.	MEANINGS.
Cic (kik),	*a foot.*	Llawd,	*a youth.*
Cluder,	*a heap.*	Llodes,	*a girl.*
Cnoc (knok),	*a rap.*	Mwygl,	*sultry.*
Cnol,	*a hillock.*	Posiaw,	*to embarrass.*
Coblyn,	*a sprite.*	Priawd,	*one's own, spouse.*
Cocru,	*to indulge.*	Pwmp,	*a knob.*
Chwant,	*desire.*	Rhwyb,	*to tear.*
Dwn,	*dusky.*	Souba,	*to dip.*
Esmwyth,	*even, soft.*	Tal,	*of high stature.*
Filawg,	*a young mare.*	Tariaw,	*to loiter, stay.*
Fug,	*deception.*	Tosiaw,	*to throw.*
Fwrw,	*down.*	Tripiaw,	*to stumble.*
Glyn,	*a valley.*	Troddi,	*to move forwards.*
Gweddu,	*to unite.*	Wyna,	*to bear lambs.*
Gwylaw,	*to weep.*		

MECHANICS.—XXII.

LAWS OF FALLING BODIES—PROJECTILES.

In all the cases given in the preceding lesson the accelerating force we have taken has been that of gravity. Sometimes, however, different forces act; but the following general rules embrace all:—

* "Proceedings of the Philological Society," Vol. I., p. 171. In these and the preceding examples, we have appended the corresponding words in German, French, and Saxon, in order to enable our readers to judge for themselves. It is more than possible that many of these words in the Welsh are borrowed from the English. It is a very difficult matter to separate the original words from those that are borrowed.

1. The velocity acquired under the action of a uniform accelerating force is equal to the force multiplied by the time. By force here, we mean velocity acquired in one second, and, as we have seen, a similar amount of velocity is produced in each second. The rule, therefore, is clear.

2. The space passed over is equal to half the force multiplied by the square of the time. Both these laws may be verified by comparing with the results obtained by the action of gravity.

If we take f to represent the force or velocity generated in one second, s the space in feet, t the time in seconds, and v the velocity, we have the following formulæ, which express these laws, and are easily remembered:—

$$v = f\,t$$
$$s = \tfrac{1}{2} f\,t^2,$$
$$v^2 = 2\,f\,s.$$

The third of these formulæ is deduced from the other two.

Now if a body be projected upwards with any given velocity, it will rise to the same height that it would have to fall from to gain that velocity, and when it again reaches the earth it will have the same velocity as it started with. The reason of this is that, as a result of the second law of motion, gravity destroys an upward motion in exactly the same degree that it produces a downward one. If, for instance, a stone is projected with a velocity of 48, it would rise that height in one second, but by gravity it falls 16 feet out of this, and thus only rises 32.

Hence if a stone be thrown upwards, it takes exactly the same time to rise as it does to fall; and thus, if we know how long it is in the air, we can tell the height to which it has risen.

For example: a stone is 6 seconds in the air, how high did it rise? It must have taken half the time, or 3 seconds, in falling; but in that time a body falls $3^2 \times 16$, or 144 feet. This, then, is the height to which it rose.

Or, again: a body is projected upwards with a velocity of 120, how high will it rise, and how long will it be before it reaches the ground again? We know here the value of v and f, and by the third formula, $v^2 = 2\,f\,s$, that is, $14{,}400 = 2 \times 32 \times s$, or $64\,s$; s therefore is $\frac{1}{64}$ of this, or 225 feet. Again, by the first formula, $v = f\,t$, that is $120 = 32 \times t$; t therefore is $3\frac{3}{4}$ seconds, and as it takes the same time to rise as to fall, the time it is in the air is $7\frac{1}{2}$ seconds.

There is a simpler way in which many of these experiments may be performed, and by which some of these laws were discovered by Galileo. A body is allowed to slide down an incline, and the time of falling noticed. The part of the weight which produces motion bears the same proportion to the weight itself as the height of the plane does to the length. Hence if we diminish the height we increase the time taken in falling. We find, however, that the velocity is always proportional to the vertical height fallen through, whatever be the length of the incline.

Fig. 99.

Galileo experimented by letting small wagons roll down inclines, which were made as smooth as possible so as to remove friction; and he discovered thus the "law of the squares," as it is called, *i.e.*, that a body will fall four times the distance in twice the time, nine times the distance in three times the time, and so on.

There are two remarkable facts that have been discovered in connection with the laws of bodies falling down an incline that we must just notice here. The first is, that if we take any number of chords, A E, B E, etc. (Fig. 100), all meeting in E, the lowest point of the circle, and make inclined planes parallel and proportional in length to them, a body will take the same time to fall down each of these inclines. B E, for instance, is much longer than D E, yet it is inclined at a much greater angle, and therefore a body will travel down it with a greater velocity, and it is found that this increase of speed exactly makes up for the greater distance.

The other fact is, that if a body has to fall from one point to another not in the same vertical line, as, for instance, from D to E, the line of quickest descent is not along the straight line joining these two points, but along some curve, as D F E. The reason of this is, that if the body be moving down the curve it will at any moment be at a lower level than it would if falling down the incline D E; and since the velocity of a falling body, as we have seen, depends upon the vertical distance passed over, its velocity is all along greater. The space passed over is, however, greater too; but this is more than compensated for by the increased velocity. The curve of shortest descent of all is found to be that which has the greatest curvature without rising as it approaches E. If a pencil be fixed so as to project horizontally from the rim of a wheel, and made to trace a curve on paper while the wheel is rolling on, it will be exactly that of shortest descent.

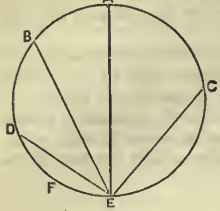


Fig. 100.

As we shall see further on, there are other remarkable and important properties possessed by this curve, which is called a *Cycloid*. (See Lessons in Geometry, XXIII., p. 309.)

PROJECTILES.

Having thus seen the laws which govern the motion of falling bodies, we pass on naturally to notice the movements of projectiles. Here, of course, as before, the resistance of the air impedes motion to a greater or less extent. This resistance increases as the square of the velocity, for if the speed of a body be doubled, it not only has to displace twice the bulk of air, but it must do it with twice the velocity, and for this a four-fold force is needed. As, however, our calculations would be much complicated if we took this into consideration, we will neglect it, but we must remember to make allowance for it in our results.

The path of a projectile is in a curve called a parabola, that is, a curve similar to the one which we should obtain if we were to cut a cone in a direction parallel to one side. (See Lessons in Geometry, XXI., page 251.) We can, however, trace this path in a simpler way.

When a body is projected with any velocity, as, for example, when a bullet is fired from a gun, it is acted upon by two forces —the original velocity with which it was started, which, as we are not considering the resistance of the air, we may consider to be a uniform force; and, secondly, the attraction of the earth, which is an accelerating force, causing it to fall 16 feet in the first second, 48 in the next, and so on. Now from a knowledge of these two motions we can easily tell at what point the body will be at any given moment; and by thus finding several different points in its course we can trace out its path.

Let the bullet be projected from the point A (Fig. 101), in the direction A B, with any given velocity, and take A C of such a length as to represent the space it would pass over in one second. Draw A D vertically downwards to represent 16 feet, and complete the parallelogram A D E C.

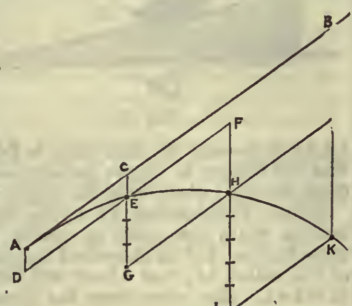


Fig. 101.

A C and A D represent, then, the two forces acting on the bullet; and, since each produces its full effect, it will at the end of one second have arrived at the point E. Since, however, the force of gravity is not uniform, the line A E, which represents its path, will not be straight, but curved upwards, for when a half of A C has been passed over, gravity will only have caused it to move over a quarter of A D. If now we draw through E a straight line E F, parallel to A B and equal to A C, it will represent the motion of the bullet from its original impulse during the next second. To represent gravity we must take E G, three times the length of A D, and thus, by completing the parallelogram, we find that at the end of this second the bullet has arrived at H. In the same way, by making H L equal to five times A D, we find K to be the point at which the bullet will have arrived after three seconds, and in this way we can map out its whole path.

We see from this the reason why the sights of a rifle are arranged as they are. If the bullet travelled in a perfectly straight line, the soldier would aim directly at the point he wished to hit; but the force of gravity acts on the bullet, and therefore he has to point the rifle at a point as much above it as the bullet will fall in the time it takes to travel the distance. If, for instance, it takes two seconds for the ball to reach the target, he must aim at a point 64 feet above it. To do this would be very inconvenient and uncertain, as he would be unable to tell whether the point he was aiming at was directly over the mark. The sight at the end next the stock is therefore made to adjust to different elevations above the barrel, according to the distance of the object aimed at; and thus, though the rifleman sees the two sights in a straight line with it, the barrel is really pointed considerably upwards, as will be evident to a bystander.

There is one other fact relating to projectiles, which, though it seems strange, is a necessary result of the second law of motion.

If a body be projected horizontally, no matter how great its velocity be, it will always reach the earth in exactly the same time as if it fell vertically. The speed in falling is not in any way interfered with by the horizontal motion.

EXAMPLES.

1. A stone is thrown up with a velocity of 100 feet per second. How high will it rise, and how long will it be before it reaches the ground again?
2. A bullet takes $5\frac{1}{2}$ seconds to fall from an elevation to the ground. What is the elevation?
3. With what velocity will a stone falling from a height of 400 feet strike the ground?
4. How long will a weight take to fall 784 feet, and how far will it move in the last second?
5. What space will a falling body describe in the 17th second?
6. How long will a ball dropped from a height require to attain a velocity of 192, and what space will be described in attaining it?

LESSONS IN ITALIAN.—XV.

After the following vocabulary and exercise, the pupil may study the uses of the particle *a*.

VOCABULARY.

Are for sale, *si tró-va da vén-de-re.*
Back, *dié-tro* (adv. behind).
Beautiful, *bél-lo*, m., *bél-la*, f.
Beggar, *men-dí-co*, m.
Bell, *cam-pá-na*, f.
Best, *mi-glió-re.*
Bottle, *fia-schét-ta*, f.
Boy, *ra-gáz-zo*, m.
Bridge, *pón-te*, m.
Calf, *vi-tél-lo*, m.
Cambric, *té-la ba-tí-sta*, f.
Cloth, *pán-no*, m.
Cologne, *Co-ló-nia.*
Colour, *co-ló-re*, m.
Copper, *rá-me*, m.
Dozen, *doz-zí-na* (*ds*), f.
Dress, *á-bi-to*, m.
Eau, *á-cqua*, f. (water).
Edward, *E-du-ár-do.*
Fig, *fí-co*, m. (pl. *fí-chi*).
Fine, *fí-no*, m., *fí-na*, f.
From, *da.*
Gold, *ó-ro*, s. m.
Good, *buó-no*, m., *buó-na*, f.
Has, *ha.*
Has been prohibited, *è stá-to pro-i-bí-to.*
Has only, *ha so-la-mén-te.*
Has received, *ha ri-ce-vú-to.*
He had hidden himself, *é-gli si é-ra na-scó-sto.*
Here are, *éc-co.*
It is, *és-so è.*
Lemon, *li-mó-ne*, m.
Man, *uó-mo*, m.
Meat, *cár-ne*, f.
Once, *ú-na vól-ta.*
One, *ú-no*, m., *ú-na*, f.
Our, *nó-stro*, m., *nó-stra*, f.
Pair, *pá-jo*, m.
Pound, *líb-bra*, f.
Present, *a-dés-so* (adv. now).
Ringing, *suó-no*, m.
Room, *stán-za* (or *cá-me-ra*).
Send me, *man-dá-te-mi.*
Shambles, *bec-che-rí-a*, f. (slaughter-house).
Shoe-buckle, *fíb-bia*, f.
Silver, *ar-gén-to*, s. m.
Smyrna, *Smír-na.*
Some of which you wanted, *del quá-le vo-le-vá-te a-vé-re.*
Spare me, *ce-dé-te-mi.*
Steel, *ac-ciá-jo*, s. m.
Stone, *pié-tra*, s. f.
Sweden, *Své-zia.*
Sword, *spá-da*, f.
Taffetas, *taf-fe-tà*, m.
Ten, *dié-ci.*
They wore, *si por-tá-va-no.*
Time, *tém-po*, m.
Twelve, *dó-di-ci.*
Two, *dú-e.*
Use, *ú-so*, m.
Velvet, *vel-lú-to*, m.
Vessel, *vá-so*, m.
Waistcoat, *gi-lè*, m. (pl. unaltered) *sot-tò-ves-te.*
Watch, *o-ro-ló-gio*(*o-ri-uó-lo*).
Wether, *ca-stró-ne*, m. (meat of ox, of calf, of wether).
What do you say? *che dí-te?* (with the case-sign *di*).
What do you think? *che pen-sá-te?* (with the case-sign *di*).
What means? *che si-gni-fi-ca?*
Which has been sent to you, *che vi è stá-ta man-dá-ta.*
Which I have bought, *che hó com-prá-to.*
Which you have demanded, *che a-vé-te do-man-dá-ta.*
Which you have received, *che a-vé-te ri-ce-vú-ti.*
Who follows him, *che gli va dié-tro.*
Whom he leads along with him, *ch' é-gli mé-na sé-co.*
Whom you see, *che ve-dé-te.*
Wood, *lé-gno*, m.
Yard, *bráс-cio*, m. (pl. *le bráс-cia*, f.).
Young ox, *mán-zo*, m.
Yours, *vó-stro*, m., *vó-stra*, f.

EXERCISE 12.

1. The present times are not the best. 2. He had hidden himself in the back room. 3. Our town has a stone bridge; yours has only one of wood. 4. Edward has received from London a gold watch, a silver sword, and a pair of steel shoe-buckles. 5. Once they wore cloth dresses and velvet waistcoats. 6. The use of copper vessels has been prohibited in Sweden. 7. Beef, veal, and mutton are for sale in the shambles. 8. What means this ringing of bells? 9. What do you say of the cloth which I have bought? 10. It is good and fine. 11. And of the colour? 12. It is beautiful. 13. What do you think of the man whom you see, of the boy whom he carries along with him, and of the beggar who follows him? 14. Here are ten yards of the taffetas, some of which you wanted, and twelve yards of the cambric which you have demanded. 15. Send me a dozen of the lemons, and two pounds of the figs which you have received from Smyrna. 16. Spare me a bottle of the eau de Cologne which has been sent to you.

THE PARTICLE *A*.

The use of this particle frequently coincides with the use of the preposition *to* in English grammar. Generally speaking, any kind of *direction*, expressed by a verb, *to* or *towards* a person or thing, is denoted by this word. The ideas of *similarity* or *resemblance*, of *approaching* or *approximation*, of a *direction* or mere *reference* to any thing, end, aim, or point of time, form, as it were, only parts or branches of this fundamental signification of the particle *a*; and whenever the action of the subject of a sentence (*i.e.*, of the nominative) expresses such direction or approach to or towards persons or things, *a* must be placed before them. For example:—

Ac-có-sta-ti ál-la tá-vo-la, approach thyself to the table.
Al cá-ne dá-te gli ós-si, give the bones to the dog.
Il fí-glio ras-so-mí-glia al pá-dre, the son is like the father.
Ne par-le-rò al cu-gí-no, I shall speak of it to the cousin.
Al cán-to si ri-co-nó-sce l' uc-cél-lo, by the song one knows the bird.
L' a-vá-ro non pén-sa che al da-ná-ro, the avaricious man only thinks of money.
I'-o lo dís-si al a-mí-co vó-stro, I told it your friend.
E'-gli lo dié-de a' pó-ve-ri, he gave it to the poor.
I'-o vá-do a Ró-ma, I go to Rome.
Non cre-dé-te a ló-ro, do not believe them.
Dís-si a lui, an-dá-te a cá-sa, I told him, go home (*i.e.*, to the house).
Pic-chiá-re ál-la pór-ta, to knock at the door.
Scrí-ve-re a qual-che-dú-no, to write to somebody.
Ag-giú-gne-re ú-na có-sa ad un' ál-tra, to add one thing to another.
Cé-de-re sú-o di-rít-to a qual-che-dú-no, to transmit or cede one's right to any one.
Co-strín-ge-re ú-no ad ú-na a-zió-ne, to compel or force any one to some action.
Ver-rò a méz-zo giór-no, a méz-za nót-te, ál-le dú-e, al tém-po fis-sá-to, al prí-mo del mé-se, I shall come at noon, at midnight, at two o'clock, at the appointed time, on the first of the month.

Phrases, not literally or strictly expressing an abode, residence, stay, continuance, or being in a place, but merely nearness or presence, require the particle *a* and not *in*, which always denotes a real and not merely imaginary continuance or being *in* (*i.e.*, in the interior of) a place or thing, or some action taking place in it. For example:—

E'-gli è al bál-lo, he is at the ball.
Al fe-stí-no, at the (dancing and gaming) evening party.
A tá-vo-la, at table.
Al con-cér-to, in the concert.
A giuo-cá-re, at play or game.
A stu-diá-re, (engaged) in study.

From what has been explained, it is obvious that in those phrases which merely denote the moving, approaching, or tendency to or towards a place or thing, and not strictly the entering or penetrating into it, *a* and not *in* must be used; for *in* means the actual motion or penetration into the interior of any locality. For example:—

I'-o vá-do al bál-lo, I go to the ball.
A tá-vo-la, to table.
A cé-na, to supper.
A im-pa-rá-re, to learn, *i.e.*, to (the pursuit of) learning.
A giuo-cá-re, to play, *i.e.*, to (the diversion of) playing.

The proper nouns of towns, cities, boroughs, or similar localities, are an exception to the last-mentioned rule, for it is quite allowable indiscriminately to place *a* or *in* before them whenever the abode, residence, stay, arrival, continuance, or being *in* or *within* them (*i.e.*, in their interior) is to be designated. For example:—

E'-gli è a or *in Ná-po-li*, he is at or in Naples.
Tro-ván-do-si é-gli ú-na vól-ta a Pa-rí-gi, being once in Paris.
E'l-la è ar-ri-vá-ta a or *in Var-sá-via*, she is arrived in Warsaw.

The verbs *par-tí-re*, to depart, to set out or off, and *con-ti-nu-á-re*, to continue, proceed on (one's journey), are another exception, for they require the preposition *per* before the name of that locality, or even country, towards which a journey or any motion is directed. For example:—

E'-gli è par-tí-to per Co-stan-ti-nó-po-li, per Pie-tro-búr-go, per la Svíz-ze-ra, he has started for Constantinople, for St. Petersburg, for Switzerland.
Con-ti-nu-á-re il sú-o viág-gio per la Po-ló-nia, per Mó-sca, to proceed on one's journey to Poland, to Moscow.

Next to *di*, the particle *a* is of the most extensive use, and though the relations in which this word stands to others are not quite so loose and vague as those of *di*, they are various enough to admit of modes of application which, even in Italian, might sometimes be more suitably dispensed with by the use of prepositions of a more logical distinctness, and consequently a greater clearness in special instances. For example:—

Mon-tá-re a ca-vál-lo (for *só-pra un ca-vál-lo*), to get or mount on horseback.
I'-vi a pó-chi giór-ni ri-tor-nò (for *dó-po pó-chi giór-ni*), he returned a few days after.
Fá-re a vo-lon-tá di cia-scú-no (for *se-cón-do la vo-lon-tà*), to act according to, or to conform to the will of everybody.
Bat-té-an-si a pál-me (for *cól-le pál-me*), they fought with the palms of their hands.
Le rot-tú-re fú-ro-no mu-rá-te a pié-tra e a cal-cí-na (for *con pié-tra e con cal-cí-na*), the breaches were walled up with stone and lime.
Non ci con-ver-rà com-bát-te-re a sì pó-ca gén-te (for *cón-tra sì pó-ca gén-te*), it will not become us to fight against so few.
Mól-ti fán-no bé-ne a spe-rán-za di gua-dá-gno (for *per i spe-rán-za*), many are honest through the hope of profit, etc.

It is obvious that this variety of the significations of *a* will, for the purpose of translating it into English, require the use of many prepositions or other words, and sometimes even of adverbial expressions or phrases, which only practice and a patient method of reading good writers, by accurately comparing the idioms and genius of the two languages, fully can teach. In a course of merely elementary lessons, I must naturally restrict myself to some, I think, useful hints in the following illustrations:—

The particle *a* may be translated by the *objective* case (without any preposition). For example:—

Fá-re ve-dé-re ad al-cú-no ú-na có-sa, to let any one see something.
Do-man-dá-re ad al-cú-no, to ask one.
Toc-cá-re ad al-cú-no, to concern one.
So-prav-ví-ve-re ad al-cú-no, to survive one.
Sup-plí-re a quál-che có-sa, to complete or make up something.

By the preposition *to*. For example:—

Ap-pli-cár-si ad ú-na có-sa, to apply oneself to something.
Vól-ger-si ad al-cú-no, to turn to somebody.
A si-ní-stra, a mán-ca, to the left.
A dé-stra, to the right.
An-dá-re, ve-ní-re a un luó-go, to go, come to a place.
Do-lén-te a mór-te, grieved to death.
Pas-sá-re a fíl di spá-da, to put to the sword (*i.e.*, to the edge of the sword).

By the preposition *at*. For example:—

Al le-vár del só-le, at sunrise.
Al prí-mo cén-no, at the first hint or sign.
A mí-o sén-no, to my mind, liking, taste, fancy, will.
Se-dé-re a tá-vo-la, to sit at table.
És-se-re (stá-re, tro-vár-si) a un luó-go, to be at a place.

By the preposition *on* or *upon*. For example:—

A pé-na di mór-te, upon (or under) pain of death.
Af-fi-dár-si ad al-cú-no, to reckon or rely upon one.

Ap-po-giár-si a quál-che có-sa, to lean, rest, or to depend on something.
In-si-ste-ra a quál-che có-sa, to insist on something.
A piè di, a ca-vál-lo, on foot, on horseback.
A con-di-zió-ne, on condition.
Ad im-pré-sti-to, on trust or credit.

By the preposition *in*. For example:—

A dú-e mé-si, in two mouths.
A'l-la sfug-gi-ta, in passing by or in flight.
Di-pín-ge-re a ó-glio, to paint in oil.
Ve-stí-to a bián-co, dressed in white.
A'l-la fran-cé-se, all' in-glé-se, in the French, English manner or fashion.
Dí-re all' o-réc-chio, to say or whisper in any one's ear.
A têm-po, in time, in the nick of time.
Ve-ní-re a grán-di schié-re, to come in great crowds or masses.

By the preposition *according to* (or after). For example:—

A ma-niè-ra, after the manner or fashion.
A óc-chio, according to a measure taken merely by the eye.
A vo-lon-tà di cia-sche-dú-no, according to the will or liking of everybody.

By the prepositions *against* or *towards*. For example:—

Ri-bel-lár-si ad al-cú-no, to rebel or mutiny against somebody.
All' o-riên-te, all' oc-ci-dên-te, towards the east, west.

By the preposition *with*. For example:—

A tre cól-pi l' uc-cí-se, he killed him with three blows.
An-dá-re a grán-di pás-si, to walk with long strides.
Stá-re a bóc-ca a-pêr-ta, a óc-chi a-pêr-ti, a brác-cia a-pêr-te, a cá-pochí-no, a chió-me sciól-te, to stand with an open or gaping mouth, with open arms, with the head inclined, with dishevelled hair.
A brí-glia sciól-ta, with slackened reins, at full speed or gallop.
Cor-ri-spón-de-re ad al-cú-no, to agree with somebody.
U-ní-to ad al-cú-no, united with somebody.
Pa-ra-go-ná-re ú-na có-sa a quál-che altra có-sa, to compare one thing with another.

By the preposition *for*. For example:—

Con-dan-ná-to a ví-ta ál-le ga-lê-re, condemned for life to the galleys.
És-se-re sen-sí-bi-le a quál-che có-sa, to feel compassion for (or to be susceptible of) something.

By the preposition *by*. For example:—

Lo fa-rái a fór-za, thou wilt do it by constraint.

By the preposition *of*. For example:—

Chié-de-re ad al-cú-no, to ask or require of somebody.

By the word *as*. For example:—

Mét-ter-si a sêr-vo con al-cú-no, to engage oneself to somebody as a servant.
A-vé-re a si-gnó-re, to have as a master.

By *at a time*. For example:—

A dú-e a dú-e, two at a time, two and two.

By adverbial *expressions* or *phrases*. For example:—

A buón mer-cá-to, at a small price, cheap.
A'l-la sca-pe-strá-ta, licentiously, dissolutely.
A'l-la pég-gio, as bad as possible.
A'l-la rin-fú-sa, confusedly, promiscuously.
A mén-te, a me-mó-ria, by heart (to learn or know).
A bóc-ca, by word of mouth.
Ve-ní-re ál-le má-ni, to come to blows, or to engage in close fight.
An-dá-re a spás-so, a di-pór-to, to take a walk.
A quál-tro óc-chi, a tê-sta a tê-sta, in private, alone, together (*i.e.*, between four eyes, *tête-à-tête*).
A ba-stán-za, enough.
A máno, at hand, near at hand, in readiness; with or by the hand; artificially; by election; underhand, by fraud or deceit.

I have already stated that to avoid hiatus by a succession of vowels, generally *ad*, in the place of *a*, is used before a vowel, and I shall conclude this explanation of the uses of *a* by the remark that, in Italian classics, not a few passages, where at first sight the particle *a* appears to be a somewhat arbitrary substitute for other prepositions or words, without any change of construction, will admit of a perfect elucidation by ellipsis.

Other uses, and some omissions, of the particle *a* will be commented on hereafter.

KEY TO EXERCISES IN LESSONS IN ITALIAN—XIV.

EXERCISE 8.

1. My father is good; he has also a good brother. 2. My mother is good; she has also a good sister. 3. We have seen your uncle; he has bought a large book. 4. Have you seen our garden? it is very large. 5. I have bought a pen; it is very good. 6. Thy book is little; but it is good. 7. We have a father who is good. 8. You have a mother who is good. 9. I have a book which is very small. 10. My sister has a pen which is very large. 11. The book that you have bought is good. 12. The garden that we have seen is very large. 13. Hast thou seen the book which my uncle has bought? 14. The book which your uncle has bought is very small, but it is good. 15. I have also bought a book, but it is large.

HISTORIC SKETCHES.—XLII.

THE ENGLISH IN FRANCE.—JOAN OF ARC.

UNTIL some time after George III. had been on the throne the style and title of our kings was "King of Great Britain, France, and Ireland." Even when James II. was a fugitive from his kingdom, and was magnificently entertained by Louis XIV. at St. Germains for a series of years, he still retained the empty title of king of the country where he was dwelling as a guest. To be sure, he was virtually as much King of France as he was King of England, but to the latter title he had much more than a mere pretension, and the title of King of France was historically bound up with it. Yet in James's time (1685-1688), even the echo of the old shout of Henry V., "No King of England if not King of France," had died away, and there was neither rhyme nor reason in keeping up a ridiculous delusion.

Time was, however, when the assumed title represented a reality; when, though not without dispute, the Kings of England were acknowledged to be also Kings of France. Let us look for a while upon a scene whereon the mark of the English domination was stamped with such indelible plainness that all the waters of oblivion that have flowed past it since have not sufficed to wash it away—a scene which will remain as an historical memory to the end of time, and which showed, incidentally at least, this, that the English were wholly unworthy of their position as lords of France.

At daybreak on the 30th of May, 1431, a priest entered the cell of a young woman at Rouen, and announced that he was come to prepare her for death. Not that the prisoner was ill—she was young, healthy, and in the full possession of her faculties; the death she was to suffer was a violent one—she was to be burned alive! Burned alive at one-and-twenty! What could the poor wretch have done? She had shivered the power of the English in France; she had, by means of an enthusiasm which rendered her obnoxious to the clergy, roused the French nation from the torpor into which it had been thrown by the stunning blows dealt to it by Henry V. of England, and she had dared to thwart the purposes and brave the anger of vindictive churchmen like the Bishop of Beauvais, and the Bishop of Winchester, Cardinal Beaufort. The prisoner's name was Jeanne Darc, or as she has been more commonly, but erroneously, called, Joan of Arc.

The priest's announcement took the poor maiden entirely by surprise. A week before she had been led out into a public place in Rouen, and compelled in a moment of weakness, when surrounded by enemies—not one kindly face among the crowd—and under circumstances of great excitement, to sign a document disavowing and solemnly abjuring certain charges of heresy which were preferred against her; and she had been told on that occasion that her life would now be spared, though she must resign herself to a sentence of perpetual imprisonment. The excuse for breaking faith with the poor girl was this, that since her abjuration she had said that St. Catherine and St. Margaret, with whom she asserted she was frequently in direct communion, had appeared to her, and rebuked her for her weakness in yielding to the threats of violence.

On first hearing the announcement of the priest, Jeanne's firmness gave way; she wept and gave vent to piteous cries, tore her hair, and appealed to "the great Judge" against the cruel wrongs done to her; but by degrees her self-possession returned,

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and she listened to the ministrations of the priest, received the last sacrament from him, and announced herself ready to submit to the will of God. At nine o'clock in the morning she was carried away in the hangman's cart to the market-place of Rouen, where had been already laid the funeral pyre on which the young victim was to be sacrificed. The Bishop of Beauvais, Cardinal Beaufort, and several other prelates, with the English military commanders, were there, and a vast crowd had come out to see "the Maid of Orleans" die.

In the centre of the market-place, about the spot where now stands a fountain surmounted by a figure of Jeanne Darc, the stake was reared, and aronnd it were piled the fagots. Soldiers guarded the place of execution. The ceremonial of death was begun on that beautiful May morning by a sermon in which the crime of heresy was vehemently denounced, then the sentence pronounced by the shepherds of the flock on the ewe lamb before them was published, and the signal was given to proclaim the last act of the tragedy. A soldier's staff was broken and formed into a rough cross which "the Maid" clasped to her breast. She was then bonnd to the stake, the fagots were lighted, the fire leaped up around her, and after suffering the agony indispensable to death by burning, her spirit returned to God who gave it. The English cardinal watched the whole proceedings with unmoved face, and when his victim's life was beyond his reach he ordered her ashes and bones to be gathered up and to be cast into the Seine.

Was it really heresy for which this poor girl suffered? Ostensibly it was, but had Jeanne's heresy stood alone, it would scarcely have provoked the interference of potentates like those who "did her to death." Upon her head, when bound to the stake, they fastened a cap on which was written her accusation, "relapsed heretic, apostate, idolatress," bnt they did not write the true cause of their unholy zeal in setting the church's law in motion against her, that cause being the crushing defeat Jeanne Darc had inflicted upon the English political influence in the country. But how came the English in the country at all? Was it by way of revenge for the conquest by William the Norman, or did it spring out of some after-born political entanglements?

The claim of the English kings to be kings also of France began to be seriously mooted when Edward III. was Prince of Wales, and when he came to the throne, the question was taken up with ardour when once he was aroused from the lethargy which in the earlier days of his reign seemed to be the forerunner of an inglorious era. In 1337, ten years after he had been on the throne, Edward lacked occupation, and manifesting a desire to let his energies find vent in true Plantagenet fashion, listened to the advice and remonstrance of some of those about him, who urged him to assert his right to the crown of France.

The way in which he claimed was almost too barefaced to be written down; and while it is certain that few of those who fought on his side so valiantly and well, knew the real merits of the case, it is likely that he himself was not very expert in tracing his genealogy. Those who had motives of their own for the war, and who hoped to win fortune and rank for themselves out of it, told him he had a righteons canse, and he, gladly convinced, believed them. It was the custom in France, borrowed from the Salian Franks, who had become absorbed in the nation, to exclude women from the succession to the throne, and when a woman came in the direct line of succession her place was taken by the male heir nearest related to the late king. This custom had been sanctioned by the approval of several hundred years, during which time no one who founded his title through a female had mounted the throne. When Philip the Fair died in 1314, he was succeeded by his son, Louis the Stubborn, who died without male issue, and Louis's brother, Philip the Long, succeeded him, being himself followed in 1322 by his younger brother, Charles the Fair.

Philip the Long had died without issue, and on the birth of a daughter to Louis the Stubborn, the estates of France decreed her exclusion, and the exclusion of all females in fnture. Charles the Fair's only child was a daughter, and with Charles was extinct the direct male line of Philip the Fair. Philip's fourth child was a daughter, Isabella, married to Edward II. of England, and it was taken for granted that the law of exclusion which applied to Louis the Stubborn's danghter, married to Charles, King of Navarre, and which applied to the daughter of Charles the Fair, applied also to Isabella, their annt. So thoroughly did this opinion prevail, that when Philip of Valois, nephew of Philip the Fair, claimed the throne on the death of his last male cousin, his claim was allowed as reasonable and unquestionable by the whole nation, and no one so much as thought of a claim being made on behalf of Isabella by her son. The exact position of affairs may be best seen from the annexed diagram.

Charles of
Valois—younger brother to—Philip the Fair.

Louis the Stubborn.	Philip the Long died.	Charles the Fair.	Isabella, married to Edward II. of England.
A daughter, married to the King of Navarre.		A daughter.	

Philip of
Valois.

Not only did Philip take undisturbed possession of the throne, bnt, as a matter of conrse, he snmmoned King Edward to do homage to him, as his liege lord, for the province of Guienne, which belonged to Edward as feudal tenant of the French king. Edward obeyed, rendered homage, and thus virtnally acknowledged Philip's right to be king. Bnt he did so only because it was not convenient to have a quarrel on his hands at the time. He had a Scotch war to fight, tronblesome subjects at home to curb, and there was a plentifnl lack of that sinew of war—money—without which it is nseless to back even the strongest claim. When these troubles were over he listened to the suggestions of Robert of Artois, a renegade French nobleman, who, having been treated badly by Philip the Fair, took an ignoble revenge by giving his services to the foes of his country. Edward looked about for allies before launching forth on a great war with France, and he secured the friendship of the Counts of Flanders, Brabant, Namur, Gueldres, and Hainault, and the powerful assistance of the rich citizens of Ghent, represented by the brewer, Jacob van Artevelde. Having gained these allies, and coaxed Parliament to give a large supply in aid of the war, Edward proceeded to pick a quarrel. He complained that Philip had helped the Scots in the late war between Scotland and England, and that he still protected the Scotch king, a personal enemy of his. Finally, he renounced his homage, and defied the French king, who, knowing that the contest must come, buckled to with a will, determined to suffer anything rather than admit Edward's claim to the French crown.

At first matters did not go happily; the English king, who elected to attack from the side of Flanders, had great difficulty in keeping his allies together; and though he did advance with 50,000 men into French territory, he did not fight, and returning into Flanders, disbanded many of his troops. Charges to the extent of £300,000 had been incurred; the money given by Parliament, and that raised by pawning the crown jewels and the personal effects of the king, was all gone, and not a foot of French land had been won. The Parliament, in the king's absence, refused supply except on the condition of redress of grievances, and it seemed as if the royal expedition after the French crown must end in an inglorious fiasco. Suddenly Edward appeared in London, wrung a heavy grant ont of the Parliament, and proceeded to fit out a fresh force against Philip, notwithstanding that the Parliament told him it owed him no allegiance as King of France, and that if won, France must ever remain a separate part of the kingdom.

On June 24, 1340, Edward's fleet, well manned and sound, came up, off Sluys, with the French fleet of fonr hundred sail, which Philip had prepared to intercept Edward's army in its descent on the coast. A bloody battle ensued. The English were the better sailors, and manœuvred so as to take every advantage of the enemy, who lost the greater part of their ships and upwards of 25,000 men. This crushing victory, of which Edward was not prepared at the moment to take advantage, fixed an unbridgeable gulf between the goodwill of the two nations. National prejndice, national hatred had their birth in it, and from the battle of Sluys dates the dreadful animus which existed down to quite recent times between the English and French. From the same event, however, dates the welding of the English nation into one homogeneous whole; the lords ceased to affect French ways and the French language—which, historically speaking, was theirs—and identified themselves with the country which was their new home. After the battle of Slnys the word "Englishman" ceased to be a term of reproach.

The battle of Sluys, the first brilliant victory of the English navy, was barren of immediate result so far as Edward's claim to the French crown was concerned. As usual, when a French war broke out, the King of Scotland broke the peace by way of diversion on his side, and Edward had to turn the whole of his strength against his northern enemy, who was, necessarily, to be crushed before a foreign war could be carried on. In 1346, however, Edward, with the English nation at his back, set out on the campaign which ended on the field of Creçy, and which was followed some years afterwards by the rout of Poictiers (1356), where the French king, John, was captured by the Black Prince, and brought prisoner to London. The exhausting efforts made during the campaign were such as to prevent Edward from following up his splendid successes, and he was glad to arrange, by the Treaty of Bretigni, for a long truce. Various reasons conspired to prevent the resumption of hostilities on a grand scale during the rest of Edward's long reign. The English remained masters of large portions of French territory, and the claim of the English king to the crown was not abandoned, bnt kept as a sword in the scabbard, for use at a convenient season. The son of the Black Prince, Richard of Bordeaux, who succeeded to his grandfather's crown, did not succeed to his energy or his ability, and the English claim was virtually dormant during the whole of his reign, while the French were employing the time in recovering from the effects of Edward's blows, and from the disastrous results of the long regency which continued all the years King John was in captivity. Henry IV. had not leisure from home troubles to pursue the war, though he seems to have been desirous of doing so, not only as King of England, but by way of paying out the French king for his something more than neglect of him at the time he was in exile as Henry of Bolingbroke. When Henry V. succeeded, he had a large stock of energy to expend, a quiet kingdom, and a fairly stocked treasury; he had plenty of brave spirits about him, and within him was an ambition which would have taken him to Constantinople or to the capital of the Great Mogul. He determined to assert his claim to the crown of France.

To a king in his frame of mind an occasion of declaring war could not long be wanting, and there were several causes which allowed of his choosing his own time and opportunity. He set about his work deliberately, sent a special embassy to France to demand his right, and when that embassy returned from its bootless errand, he prepared with diligence and the utmost circumstance to enforce his claim with the sword. In the month of August, 1415, he sailed from Southampton with one of the finest armies ever mustered in England, landed at Harfleur, which he besieged and captured, and then prepared to advance on Paris. An enemy worse than all the French armies put together came into his camp. Dysentery smote down hundreds of his men, including some of the bravest and wisest, and so weakened the remainder that they could scarcely walk. Henry was obliged to abandon the idea of going to Paris, and gave orders for a march to Calais, whence he proposed to embark his enfeebled army for England. At Agincourt, the French army, which had been hanging about him, barred his advance. It consisted of full three times the number of the English, and was commanded by the Dauphin, the French king's eldest son, and by the flower of the French nobility. The French were confident of victory, the English were in a desperate case, and the battle was joined with an amount of fury seldom witnessed even in those days. The French were utterly routed (October 25, 1415), vast numbers of them were slain, and the shattered remains of the English army pursued its march unmolested to Calais.

In the next campaign, which was not undertaken till two years afterwards, Henry met with but little resistance in the open country of Normandy, thongh Rouen was stoutly defended. He reduced Rouen and other towns, and marched to Paris, which he mastered, and dictated terms in the capital of his enemy. The French king, Charles VI., was imbecile, and the Treaty of Troyes, to which the Dauphin refused to be a party, provided that Charles should be called King of France during his lifetime, but that Henry should really administer the government, and that after Charles's death he and his successors should be acknowledged as kings of France. Henry strengthened the band by marrying Catherine, daughter of the French king, and during the rest of his life he did actually rule over France and receive the homage of her vassals.

In the height of his power Henry was struck down with fistula, which the doctors could not cure. He died, still a young man, and left his son, an infant of nine months old, to the guardianship of the Duke of Bedford and the Earl of Warwick. This was in 1422. For five years Bedford, who managed with singular tact and prudence, succeeded in keeping things pretty straight, in spite of numerous causes of trouble and disturbance, including, of course, the efforts of the Dauphin, who in the meantime had become Charles VII., to regain his father's throne. Charles had a large following, especially in the south-east of France, and he was able to possess himself of a few towns of strength and importance. Orleans was of the number, bnt it was closely besieged by the English under the best of their generals, and Charles despaired of relieving it, and thought of going to Languedoc, there to make a final stand.

Then arose Jeanne Darc, a peasant girl, who saw, or believed she saw, visions of the saints, especially of St. Catherine, who came to her and told her she must deliver France from the presence of the English. Her "voices," as she called them, bade her don man's attire, and directed her to fetch a certain sword from a neighbouring church dedicated to St. Catherine. She was permitted by the authorities to follow her bent, and was furnished with armour and a horse. At first the regular soldiers laughed at her, but soon they got to regard her as a prophetess, heaven-sent for the deliverance of France. Under her guidance —in strictly military operations she was assisted by Dunois, governor of Orleans—the men fonght with a courage which increased in proportion as her fame as a prophetess grew, and struck fear into the ranks of the English. Orleans was relieved by "the Maid" in person, and the garrison, now strong enough to attack its besiegers, sallied forth and drove the English from several of their positions. Subsequently another sally was made, a bloody battle was fought, the English lost 2,000 men, and Lord Talbot, afterwards Earl of Shrewsbury, was made prisoner. The Duke of Suffolk raised the siege, retiring to Paris, and Charles was crowned King of France with great solemnity at Rheims.

With these signs of returning prosperity many wavering nobles and towns declared for Charles, and the Duke of Bedford had enongh to do to hold Paris and the strictly English parts of France. Jeanne, believing her mission to be over, was anxious to return to her former home in Lorraine, but was over-persuaded by Dunois to remain with the army till the English should be driven out of France. She remained, and in a sortie made by the garrison of Compiègne, was captured and given over to the English authorities. The English, partly from superstition, partly to excuse the disgrace of their defeats, said that "the Maid" had a devil, and that she had done her work through magic. They hoped also by punishing their prisoner not only to take revenge, but to show the French that their prophetess was a woman after all.

The Duke of Bedford handed her over to the Church, with what effect we have seen already; and from the moment of her death the English power seemed to be stricken with mortal sickness. Place after place was wrested from them, Paris drove them out, the Duke of Burgundy forsook their alliance, and when in 1435 the Duke of Bedford died, their influence in France was at a very low ebb. A war of reprisals was carried on till 1443, and then a truce was agreed npon which either side broke or kept as it suited their convenience.

Then came the English Wars of the Roses, during which disastrous period the claims to France were not thought of, and it never happened to any prince after Henry VI. to have power or opportunity to pursue the right which was never formally renonnced. Kings of England continued, nevertheless, to write themselves down kings of France, even after the loss, in Mary's reign, of their last remaining possession, Calais. Indeed, it was not, as stated at the beginning of this paper, until George III. ascended the throne that the title appeared to those interested so ridiculous that it was ordered to be expunged from the style and description of his Majesty of Great Britain.

NATURAL HISTORY OF COMMERCE.

CHAPTER II.

Our National Home—Its Climate, Soil, and Consequences resulting therefrom—Latitude of the United Kingdom and Contrast of Corresponding Latitudes—Position of the United Kingdom relative to Europe—Climate—Diversities of Temperature—Diversities of Rainfall—Causes of Diversity—Gulf Stream—Deflection of Isotherms—Current and Counter-Current—Aërial Currents—Botanical or Floral Regions—Iberian or Asturian, Armorican, Germanic, and Boreal Regions—Minor Diversities of Climate and Vegetation—Chart of Floral Regions.

The United Kingdom, between 50° and 61° N. lat., by 2° E. and 11° W. long., comprises several hundred islands, of which Great Britain and Ireland are the chief, the remainder being unimportant.

Great Britain includes England, Wales, and Scotland, and is the largest island in Europe.

The British Empire comprehends, besides the United Kingdom, colonies and possessions in every zone, so extensively and widely dispersed as to give literal truth to the saying, that the sun never sets on the Queen's dominions.

The latitude of the United Kingdom corresponds with that of the cold and sterile regions of Labrador, in America, and the ice-bound shores of Kamtschatka, in Asia. In the southern hemisphere its like or analogue is the cheerless land of Tierra del Fuego. London is in the same latitude as the Strait of Belleisle and Cape Lopatka; Edinburgh, the northern metropolis, corresponds with Moscow, and also with Cape Horn.

These are striking contrasts. We cannot imagine a flourishing people living in the bleak and pitiless countries just referred to. From what, then, are our immunities derived? A well-known American writer says of England:—

"The territory has a singular perfection. The climate is warmer by many degrees than it is entitled to by latitude. Neither hot nor cold, there is no hour in the whole year when one cannot work. The temperature makes no exhaustive demands on human strength, but allows the attainment of the largest stature. In variety of surface it is a miniature of Europe, having plain, forest, marsh, river, sea-shore; mines in Cornwall, caves in Derbyshire, delicious landscape in Dovedale, and sea-view at Torbay; highlands in Scotland; Snowdon in Wales; in Westmoreland and Cumberland, a pocket Switzerland, in which the lakes and mountains are on a sufficient scale to fill the eye and to touch the imagination.

"From first to last it is a museum of anomalies. This foggy and rainy country furnishes the world with astronomical observations. Its short rivers do not afford water-power, but the land shakes under the thunder of its mills. There is no gold mine of any importance, but there is more gold in England than in all other countries. It is too far north for the culture of the vine, but the wines of all countries are in its docks; and oranges and pine-apples are as cheap in London as in the Mediterranean."*

Position of the United Kingdom relative to Europe.

The relative position and climate of the United Kingdom are both peculiar. Great Britain is insulated from the Continent, of which it is the natural boundary, its seasons are abnormal, and its temperature is artificial.

1st. *Position of the United Kingdom.*

For about a hundred miles west of Ireland the slope of the sea-bed is gradual, when a sudden descent occurs of more than 2,000 feet, forming submarine cliffs that mark the confines of the Old World. The bed of the German Ocean, on the other hand, is generally shallow. Its average depth is not over thirty or forty fathoms, which would not cover the chimney-shafts of many of our factories, and in no part are the soundings deep, except off the precipitous coasts of Norway, which the Atlantic, rather than the North Sea, may be said to lave. Traversing this sea are also many shoals and sand-banks, the largest being the Dogger, 350 miles long, running northward, midway between the coast of Northumberland and Jutland. Some of these banks come within six or seven fathoms of the sea-level.

The neighbouring lands on both sides the German Ocean assume the features of the sea-bed. Parts of Holland are forty feet below the sea-level, and are only protected from marine irruptions by embankments and sand dunes. Jutland is entirely alluvial. English "Holland," or the Fen districts, in the neighbourhood of the Wash, consists of land rescued from the sea, much of it so low-lying as also to require dykes and embankments to prevent inundation. In fact, the great European plain commences in the tertiary and alluvial deposits of England, takes in the German Ocean, embraces the Netherlands and Denmark, and then sweeps along the low lands and stoneless steppes below St. Petersburg, and extends to the Caspian Sea. The whole plain gives evidence of an ancient sea-bed, of which the sandy flats about Calais and Berlin, and the lake-plain of Pomerania, are parts, and with which England is conjoined. The United Kingdom consequently retains, in many respects, a European character, although insular.

2nd. *Climate of the United Kingdom. What is meant by Climate?*

"Climate," says Professor Ansted, "is a resultant of all the atmospheric phenomena, embracing the temperature of the air at various times and seasons, the range and variation of the temperature, the direction and force of the prevalent winds, the liability to storm, the amount of humidity in the air at various seasons, the quantity of mist and rain, the distribution of rain, and the varieties of electrical condition.

"These phenomena affect and depend on each other, but all may ultimately be traced to certain general causes.

"1. The position of the station in latitude.

"2. The size and figure of the land on which the station is situated, whether detached island, archipelago, or continent.

"3. The elevation of the station above the sea.

"4. The position of the land on which the station is placed, with reference to the neighbouring land.

"5. The position, distance and direction, magnitude and elevation, of the nearest continent.

"6. The nature, magnitude, and direction of the nearest great marine current to its shores."

The phenomena of the climate of the United Kingdom may be summarised under the heads of Diversities of Temperature, and Diversities of Rainfall.

1. *Diversities of Temperature.*

The western coast of Ireland is 10° warmer than the like latitude on the east coast of England. Scotland, compared with England, is cold and wet, although not subject to extremes. The winters, indeed, are so mild that the harbours generally do not freeze, as on the Continent, in similar and even in lower latitudes. The Western Islands have a uniform and genial climate, contrasting with the opposite coast. Unst, one of the Shetlands, and the Isle of Wight, correspond in winter temperature, although nearly 700 miles, or 10° of latitude, separate them.

Again, Devonshire and Cornwall, in point of winter temperature, are warmer than London by 5°; Penzance and Torquay, in mildness and salubrity, resemble Madeira, and are recommended to patients affected with pulmonary disease.

* "English Traits." By R. W. Emerson.

The diversities of temperature are tabulated in the following chart:—

East Side.

Locality.	Latitude.	Winter Temperature.	Summer Temperature.	Mean Temperature.
		Fahrenheit.		
Wick	58° 29′ N.	38·8°	55·3°	48·9°
Inverness	57 28	35·0	57·0	47·7
Aberdeen	57 8	39·0	59·5	49·2
Dundee	56 27	41·4	63·4	51·9
Leith	55 59	40·5	58·2	48·3
York	53 57	36·2	62·3	49·2
Bedford	52 8	40·5	62·8	51·6
London	51 30	39·5	62·9	50·8
Chichester	50 5	38·8	60·7	49·5
Unst	60 45	38·6	52·6	44·7

West Side.

Locality.	Latitude.	Winter Temperature.	Summer Temperature	Mean Temperature.
		Fahrenheit.		
Glasgow	55° 51′ N.	39·6°	60·1°	49·8°
Whitehaven	54 33	39·9	59·6	49·0
Isle of Man	54 15	41·7	59·1	49·8
Liverpool	53 24	41·3	61·1	50·8
Swansea	51 36	45·5	60·6	53·7
Penzance	50 7	44·2	60·9	51·7

Ireland.

Locality.	Latitude.	Winter Temperature.	Summer Temperature	Mean Temperature.
		Fahrenheit.		
Belfast	54° 36′ N.	41·4°	63·9°	52·3°
Antrim	54 43	36·7	58·1	47·7
Dublin	53 21	39·8	59·6	49·7

Mean Temperature of the whole Coast.	Winter.	Summer.	General Mean.
West Coast of Great Britain	40·3° Fahr.	59·0°	49·0°
East Coast of Great Britain	38·2	59·0	

Mean Temperature of hottest month (July), 60·0° to 65·0°.
Mean Temperature of sea on West Coast in winter is 41·0°.

2. *Diversities of Rainfall.*

Constant humidity rather than amount of rainfall distinguishes the United Kingdom; for the total rainfall is not actually greater than that of many other countries in the same latitude. Nevertheless we owe to it our numerous rivers and the fertility which makes nearly the whole land resemble a garden. Ireland is more humid than England, and the western sides of each island are more humid than the eastern. As a consequence, Ireland is essentially a grazing country, and in England pasturage is more common in the western than in the eastern counties, where tillage chiefly prevails. These facts are patent in the familiar terms of Irish butter, Devonshire cream, Cheshire and Gloucester cheese, Hereford shorthorns, Alderney cows; while Norfolk and Suffolk and the valley of the Thames are suggestive of corn.

At Keswick, Cumberland, the yearly average rainfall is 60 inches; in London, the average is 24 inches. The average for the whole of the United Kingdom may be between 30 and 40 inches.

The following diagram will give a better view of the rainfall:—

DIAGRAM OF THE RAINFALL OF THE UNITED KINGDOM.

Ireland.

EAST SIDE.		WEST SIDE.	
Londonderry	31·0 inches.	Westport, Mayo	46·0 inches.
Belfast	35·0 „	Cahirciveen	59·0 „
Dublin	30·8 „	Cork County	40·0 „
Portarlington	23·0 „	Castletownsend	42·0 „
Mean of Coast and Interior	29·7 „	Mean of West Coast and Interior	47·4 inches.

Great Britain.

EAST SIDE. *Coast and Interior.*		WEST SIDE. *Coast and Interior.*	
Inverness	27·0 inches.	Cape Wrath	38·6 inches.
Edinburgh	25·0 „	Rothsay	48·0 „
W. Denton, Northumberland	36·8 „	Glasgow	33·6 „
York	24·0 „	Lake Districts, from	50·0 to 140.6 „
Bedford	31·7 „	Liverpool	34·7 „
London	24·0 „	Swansea	35·4 „
Hastings	31·0 „	Penzance	43·0 „
Isle of Wight	30·9 „	Bath	32·0 „
Mean of East Side, etc.	27·4 „	Mean of West Side, etc.	45·5 „

3. *Causes of Diversity.*

Our western shores are bathed by an ever-flowing warm current from the Atlantic, called the Gulf Stream. The winds, for more than two hundred days in the year, blow in the track of this great marine current, and fill the air with humid vapours exhaled from its surface. The Gulf Stream originates in the embayed waters of Mexico, whence, heated and expanded by a tropical sun, it issues as an ocean river through the Narrows of Florida. Widening in its course northwards, it divides in mid-Atlantic. One current curves to the parched plains of Africa, and becomes lost in the equatorial waters. A polar prolongation, accurately defined, diverges till it fills the space between Iceland and Norway. By its influence the North Cape is freed from ice even in the depth of winter, and its effects are felt as far as Spitzbergen, where its interfusion with the ocean becomes complete.

The United Kingdom fully receives the beneficial influences of this stream. The warm air and heated flood combine to deflect the isothermal lines northward, raising the temperature and giving to high European latitudes the amenities of a southern climate. Now it is a physical law that every current, whether aërial or marine, has a corresponding counter-current. We find, therefore, firstly, that at an undefined distance to the west, a cold stream flows down Baffin's Bay, and past the Greenland shores, sinking by its density beneath the Gulf Stream, and completing its circuit; secondly, that, to the east, a polar counter-current blows over the distant Russian plains to complete the aërial circuit. Thus we are twice favoured: by the presence of the low, genial currents, and by the absence of the high, inclement counter-currents, which, respectively, determine the climate of their neighbourhood. While the western maritime borders of Europe are verdant, the coasts of Labrador are frostbound and barren; and the region of the intensest cold on the globe is in the Russian dominions.

During the vernal and autumnal equinoxes the aërial streams in the latitude of the United Kingdom come into conflict; then the cold easterly and north-easterly winds condense the vapours from the ocean, and produce characteristic fogs. These winds are trying, and often prevail for weeks together.

Botanical or Floral Regions.

Within the confines of the United Kingdom various botanical or floral regions have been defined with tolerable accuracy, each region being characterised by its own climate.

Our cloudy sky keeps off heat, prevents radiation, and is favourable to the growth of crops, whose variety makes up for the greater certainty of the harvests of the Continent. Though we do not enjoy uninterrupted fine weather, there is scarcely a day, except at the equinoxes, when the sun does not shine; and we rarely suffer from a succession of bad seasons.

1. *Iberian or Asturian Region.*

In the part principally open to the Gulf Stream and to the prevalent winds, the air is so charged with moisture, that the sun's warmth is absorbed before reaching the earth, and fruits that will ripen further north here seldom come to perfection. The peach tribe lose flavour, and grapes never reach maturity. The crops suffer less from drought than from too much wet. Botanists designate it as our Asturian or Iberian region, from its relation to the Asturias, the Biscayan province of Spain. The arbutus, London pride, bell heath, maiden hair fern, and about fifteen other species of plants not occurring in any other part of Great Britain, are common to both botanical regions. The provinces of Munster and Connaught in Ireland, and the county of Cornwall with the adjacent parts of Devonshire in England, represent this region. Myrtles are fragrant in the open air throughout the winter. The evergreen oak, and the arbutus, with leaves hidden under bosses of gorgeous fruit, are prominent in the overhanging woods of Killarney, and indigenous to its vicinity. A rich neighbouring slip of land running through the two counties of Tipperary and Killarney, has for centuries borne the proud name of the Golden Vale, and produces every season abundant crops.

2. *Armorican Region.*
The south-west of England, adjoining Devon and Cornwall, agrees in climate with the French provinces of Normandy and Brittany, whose flora is not prevalent elsewhere in the United Kingdom. Devonshire cyder, Worcestershire perry, indicate the English home of the apple and pear. "Normandy pippins" is an equally familiar term. Across the Channel the rural homesteads, the pastures, and orchards continue the natural aspect of England; while the oak, ash, and elm lend effect to the picture. Brittany, trending into the Atlantic, is even like Ireland in humidity and warmth. This district of France, the ancient Armorica, gives a designation to the English botanical region.

3. *Germanic Region.*
The vegetation of the midland and eastern parts of the United Kingdom, overlapping likewise every other climatal division, bears a close relation to that of Central Europe, and comprises the most important and numerous plants. It is the region of deciduous trees, and includes our chief varieties of timber, with an undergrowth of wild apple, cherry, holly, hawthorn, broom, furze, wild rose, bramble, and honeysuckle. Food-crops, both of corn and roots, here reach their highest perfection, and every kind of pulse and green vegetables, such as the turnip, carrot, potato, and cabbage, grow in abundance.

4. *Boreal Region.*
Farther north, the Scottish Highlands approximate in character to Scandinavia, the features being partially shared by the hills of Cumberland and Westmoreland. Vegetation greatly differs from that of the plains, and is analogous to the dwarfed progeny of the snow-clad Alps, or of the Arctic lands. Hence its botanical name, the Boreal, or Scandinavian Region. The favoured parts of Sweden, and even of Lapland, are so nearly alike in soil and climate to Great Britain, that three-fourths of their vegetation is common to this country. While, however, our highlands are nearly bereft of forests, and even England has yielded much of its forest land to the exigencies of husbandry, Sweden is covered with trees, and Lapland's woods are the chief source of its wealth. On the other hand, the summer scene presented by the wide-stretching archipelago upon which Stockholm is founded, might be transferred to the balmiest part of the English coast; for the larks of those islets fill the air with song, and the ground is matted with wild strawberries, interstrewn with bright pinks and dog-daisies; every breath of the balmy air seems redolent of wild thyme, meadow-sweet, and other fragrant plants.

Minor Diversities of Climate and Vegetation.
The prevalence of plants in groups has enabled us not only to define botanical districts or floral regions, but also to distinguish climate within short distances. If every condition were easily traced, the climate of any spot could be at once inferred; but our own country exemplifies the difficulties of accounting for the differences of climate in small areas. Brighton differs essentially from Torquay; Bath from Cheltenham; the climates of Malvern, Buxton, and Harrogate are unlike that of Scarborough, or the lake districts; and each in turn differs from all the rest. It would be a good mental exercise to trace the local or distant cause of these diversities :—

CHART OF FLORAL REGIONS OR BOTANICAL DISTRICTS.

Region.	Limits.	Characteristics.	Analogue.
Iberian or Asturian.	S.W. Ireland, Cornwall, and Devon.	Humidity. Evergreens.	Madeira and N. Spain.
Armorican.	S. & W. England, Channel Islands, S.E. Ireland.	Pastures and Orchard Fruits.	Normandy and Brittany.
Germanic.	N. & Cntrl. Ireland, Central England, Scotch Lowlands.	Deciduous Trees and Green Vegetables.	Germany and Mid-Europe.
Boreal, Arctic, or Scandinavian.	Extreme N. Ireland, Scottish Highlands, Eng. Lake District.	Fir Trees and Berries.	Alps, Sweden, Lapland.

CORRESPONDENCE IN FRENCH.—IV.

14.—Letter Sending First Order to a Firm.

Bremen, Feb. 1st, 1882.

Monsieur A. de Carvalho, Trinidad.

Sir,—Your firm has been recommended to me by a friend as one of the best and promptest in executing its correspondents' orders; I should therefore be glad to enter into business relations with you. I beg you to send me, by the first vessel sailing from your port to Bremen, the following goods :—

16 barrels of Virginia leaves, first quality;
15 barrels of new Carolina rice;
50 barrels of raw sugar.

As I have not the pleasure of being known to you, I beg to refer you for all information you may desire to Mr. Aguilar, of your city, an old friend of mine, or to Messrs. Andrada, the bankers.

You may draw, for the amount, upon Messrs. Julius Gerstenberg and Co., of London, who have received my orders to accept your drafts.

I am, Sir,
Your obedient servant,
Jacques Lemaitre.

Bremen, le 1er *Février,* 1882.

Monsieur A. de Carvalho, Île de la Trinité.

Monsieur,—Un de mes amis m'a recommandé votre maison comme un des plus solides et des plus exactes à exécuter les commissions de ses commettants; je serais donc bien aise d'entrer en relation avec vous. Je vous prie de m'envoyer par le premier navire qui partira de chez vous pour Bremen les marchandises suivantes, savoir :—

16 barriques de feuilles de Virginie, première qualité;
15 barriques ris nouveau, de la Caroline;
50 tonneaux de sucre brut.

Comme je n'ai pas l'honneur d'être connu de vous, vous pourrez prendre des informations sur mon compte, soit chez M. Aguilar de votre ville, mon ancien ami, qui vous fixera sur le degré de confiance que je mérite, soit chez Messieurs Andrada, banquiers.

Vous pouvez tirer pour le montant sur Messieurs Jules Gerstenberg et Cie, de Londres, qui ont reçu ordre d'accepter vos traites.

Agréez, Monsieur,
Mes civilités empressées,
Jacques Lemaitre.

15.—Letter proposing to Enter into Business Relations.

New Orleans, Feb. 10th, 1882.

Messrs. A. J. Smith Bros. & Co., Havre.

Gentlemen,—Mr. A. Rieu, of your city, whom we were fortunate enough to meet in New York, spoke in high terms of your firm, and assured us that we could not entrust our affairs to better hands than your own. We hasten, therefore, on Mr. Rieu's recommendation, to ask you if it will suit you to receive our consignments of tobacco and cotton, and take upon yourselves equally the liquidation of our engagements to the value of the goods so sent

Should you accept our proposition, be good enough to send us a *pro-formâ* account sale, in order that we may have some notion of the expenses and usages of your place.

We are, Gentlemen,
Most obediently yours,
Lewis Frisby, McHenry & Co.

La Nouvelle-Orléans, le 10 *Février,* 1882.

Messieurs A. J. Smith Frères & Cie, au Hâvre.

Messieurs,—M. A. Rieu de votre ville, que nous avons eu le plaisir de voir à New-York, en nous faisant l'éloge de votre loyauté en affaires, nous a assurés que nous ne pouvions mieux confier nos intérêts qu'à vous. Nous nous hâtons donc, sur la recommandation de M. Rieu, de vous demander s'il vous conviendrait de recevoir nos consignations de tabac et de coton, et de vous charger également de l'acquit d'engagements pour une somme équivalente à la valeur de nos envois.

Si vous acceptez notre proposition, veuillez bien, Messieurs, nous remettre un compte de vente *simulé,* afin que nous puissions nous rendre compte des frais et usages de votre place.

Agréez, Messieurs,
l'assurance de notre parfaite considération,
Lewis Frisby, McHenry & Cie

16.—Letter in Reply to the Above.

Havre, March 20th, 1882.

Messrs. Lewis Frisby, McHenry & Co., New Orleans.

Gentlemen,—We have to acknowledge the receipt of your favour of the 10th of February, and hasten to reply.

We willingly accept your proposals, and shall be delighted to see relations established between our two houses that may prove mutually advantageous. You may rest assured we will do all in our power to merit the good opinion Mr. Rieu has inspired you with, and show ourselves worthy of the confidence reposed in us.

We hasten to satisfy your wishes by sending you enclosed a *pro-formâ* account sale, that may serve you as a basis for future operations. Our own terms are 2 per cent. commission and 2 per cent. *delcredere.*

We shall be ready to make advances to the extent of two-thirds of the invoice amount of goods consigned to us for sale, on receipt of invoice, bills of lading, and orders for insurance.

It is unnecessary to observe that we shall send you accounts of the state of the market by all the boats leaving for New Orleans.

We remain, Gentlemen,
Your very obedient servants,
A. J. Smith Bros. & Co.

Le Hâvre, le 20 *Mars,* 1882.

Messieurs Lewis Frisby, McHenry et Cie,
à la Nouvelle-Orléans.

Messieurs,—Nous accusons réception de votre honorée en date du 10 Février, et nous empressons d'y répondre.

C'est avec le plus vif empressement que nous acceptons vos propositions, et que nous serons charmés de voir s'établir entre nos deux maisons des rapports suivis et réciproquement fructueux. Croyez bien que nous ferons tout ce qui dépendra de nous pour répondre dignement à l'opinion que M. Rieu vous a inspirée, et à la confiance dont vous voulez nous honorer.

Nous nous empressons de satisfaire à vos désirs en vous remettant sous ce pli un compte de vente *simulé,* afin qu'il vous puisse servir de base pour vos opérations futures. Nos conditions sont: 2 pour cent de commission et 2 pour cent de *ducroire.*

Nous sommes prêts à faire des avances pour les deux tiers du montant des consignations qui nous seront adressées en recevant facture, connaissement et l'ordre de faire l'assurance.

Inutile de vous dire que nous profiterons de tous les navires en partance pour la Nouvelle-Orléans pour vous tenir au courant de l'état de notre marché.

Agréez, Messieurs,
l'assurance de notre estime,
A. J. Smith Frères & Cie.

LESSONS ON ENGLISH LITERATURE.—IV.

CHAUCER AND HIS TIMES.

Geoffrey Chaucer, the great poet of this period, the greatest indeed whom England produced down to the age of Elizabeth, was recognised as such during his life no less than after his death. Naturally, therefore, from the notices of him in the writings of his contemporaries, and from public documents, we know many details of his later life, enough to enable us to form a very fair picture of his circumstances and mode of living. But of his early life and the circumstances of his birth we can learn little. As to his parents, nothing is known. We can only infer that they must have been moderately wealthy, from the education which their son's works show that he must have received. To the place of his birth we have no clue. Even the date of it cannot be ascertained with any certainty. Most writers state that Chaucer was born in 1328, but there is no positive evidence in favour of this date. Other accounts place his birth as late as 1344, but also upon insufficient authority. Probably of the two the earlier date is the more likely to be the true one or near the true one. Nor is there any more certainty as to his education. Some have said that he received his education at Cambridge, on the authority of a passage in his early poem, the "Court of Love," in which a visit to the court of Venus is related by one who calls himself "Philogenet of Cambridge, Clerk," by which title Chaucer is assumed correctly to describe himself. Some have said that he was educated at Oxford, but no evidence of this has come down to us. Others again have declared that he was both at Oxford and at Cambridge. It is commonly asserted, too, that he studied law as a student in the Inner Temple. But this is very unlikely; for it is at least extremely doubtful whether the lawyers had yet obtained possession of the Temple when Chaucer was a young man. All that can be said with confidence about his education is that every page of his works shows him to have been a man not only of rare genius, but of high culture, possessing an extensive acquaintance both with literature and science.

Chaucer, like almost all gentlemen of his day, spent some time in military service. In 1359 he was serving in France under Edward III., and was made prisoner. But he probably returned to England the following year. He soon afterwards married Philippa de Roet, daughter of Sir Payne Roet, a gentleman of Hainault, in the service of the Queen. Chaucer's wife had been a maid of honour to the Queen, and afterwards entered the service of Constance, the second wife of John of Gaunt, Duke of Lancaster. Thus probably began Chaucer's connection with the court, and particularly with John of Gaunt. But this connection was no doubt strengthened by the fact that Chaucer's wife was a sister of the notorious Katherine Swyneford, first the mistress, and afterwards the wife of John of Gaunt. It is certain that throughout nearly his whole career Chaucer attached himself steadily to the party of the Duke of Lancaster, and became his intimate friend and trusted adviser; and his fortunes rose and fell with the influence of his patron. In 1367 Chaucer was appointed a valet of the King's Chamber, an office commonly held by young men of birth and position. Soon afterwards we find him employed on a public mission to Italy; and during this visit there is some reason to think that he became acquainted with Francis Petrarch, the great poet of Italy. In 1374 Chaucer was appointed Controller of the Customs for the port of London. But, notwithstanding his holding this post, he still continued to be employed abroad from time to time upon various diplomatic missions, the precise nature of which cannot for the most part now be determined. In 1386 he sat in the House of Commons as a representative of the county of Kent. But in the same year, the party hostile to John of

Gaunt having come into power, Chaucer felt a corresponding reverse of fortune, and lost the office he had so long held. In 1389 the Lancastrian party were once more in the ascendant, and Chaucer was appointed to the valuable office of Clerk of the King's Works. But misfortune again overtook him. In about two years he lost all the offices which he had held; in his distress he was compelled to sell or mortgage the pensions which had been conferred upon him from time to time, and which had amounted to considerable sums; and was thus reduced to very great poverty. In this distress he seems to have continued for some years, until in 1394 he received a pension from the king, which was subsequently increased sufficiently to place him in comfort. He died on the 25th of October, 1400, probably at his house in Westminster, and was buried in Westminster Abbey.

Not only was Chaucer thns almost throughout his whole life brought into constant and close intercourse with some of the most eminent political and party leaders of his time, but he also appears to have lived on terms of intimacy with his brother poets and men of letters. Of these, as we have seen, the greatest was Gower, between whom and Chaucer a close friendship existed. His connection with John of Gannt, too, brought him within the circle of the great religious movement brought about by Wickliffe and his disciples. John of Gannt was Wickliffe's protector, and the Lancastrian party at that time leaned much npon the support of those large classes of the community who, like Wickliffe, rebelled against the dominion and revolted against the corruptions of the regular clergy. Hence we can trace throughout the works of Chaucer—in his vigorous, and no doubt somewhat exaggerated, pictures of wealthy and self-indulgent abbots, dissolute monks, and lying pardoners, contrasted with his attractive sketches of the poor and pious parish clergy—his sympathy with the movement of the Reformers.

It will easily be seen that the times in which Chaucer lived and the circumstances of his career were peculiarly favourable for a great and original poet, and especially for one with Chaucer's unrivalled power of catching and reproducing the peculiarities in character and habit of classes of men. Border countries are the favourite ground of picturesque writers. Types of character are more strongly marked and more sharply contrasted there than elsewhere. Thus Scott chose for his usnal field the border-land between England and Scotland, or the dividing line of highland and lowland. And the age of Chaucer may well be called the border-land between the dark ages and the modern period. In his own great poem he brings together the knight who had fought for the Cross in Prussia with his brethren of the Tentonic order, and the prosperous London merchant and the essentially modern country gentleman; and this was a true picture of the times. So in the literature of that age, as we have already seen, the formal and learned Gower and the rough and antique satirist Langlande were alike contemporaries of Chaucer; while in Italy Petrarch was writing poetry as polished and artistic as any that the world has ever seen. This was just the age in which the genius of Chaucer, with its singular variety of scope, and its power of seizing points of character, would find fullest play; and Chaucer's varied career was entirely in his favour. As soldier, courtier, scholar, diplomatist, and man of business, he must have had unusual opportunities of studying character and learning the real life of his age. And we find the character of his poetry in this respect just what we might expect to find it under these circumstances. He has left, in such poems as "The Flower and the Leaf" and "The Court of Love," perfect specimens of the fairyland in which the Troubadours delighted, with all their grace but all their fantastic unreality. But the same poet has left that marvellous photograph from real life, the prologue to the "Canterbury Tales;" and the genuine and simple pathos of the story of Griselda. The variety of character in the poetry of Chaucer keeps constantly before our minds that, though he is rightly called the source from which the stream of English poetry takes its rise, that source itself, like the great lake that feeds the Nile, derives its fulness not only from the springs that arise within its bosom, but from the streams whose waters it collects and makes its own. Some of the various channels of literature which converge in the works of Chaucer we have already pointed out in previous lessons, and we shall ask our readers to bear this observation in mind when we come to remark upon the poems of Chaucer singly.

Before proceeding to consider the poetry of Chaucer in detail, it is necessary to speak very shortly upon matters which have given rise to much controversy—the language in which he wrote, and the principle of versification which he adopted. Some writers have treated Chaucer as one who spoiled the purity of the English tongue by the wholesale introduction of French words into it; while others have regarded his works as the most perfect standard of the English spoken in his day. The truth appears to be that in the main Chaucer used the English language as it was usually spoken and written in his day by the aristocracy and among educated men, which would for obvious historical reasons be less purely Saxon and more mixed with French than the language of the lower orders. But it is also beyond doubt that Chaucer, in enlarging the range of ideas which were to be expressed in English poetry, must have found it necessary at the same time to enlarge its vocabulary, and that he did so by the adoption of words from the French. And though, many words used by him have since been lost, and many more have been introduced, it is still truethat the vocabulary thus formed is substantially the same as that now in use.

With regard to the forms of English words as written by Chaucer, a few points must be borne in mind by the reader, in order to a thorough understanding of the author. In its earliest form—the Anglo-Saxon—English was a language, like the classical Greek and Latin, with a complete system of inflections—forming, for instance, the cases of its nonns by appropriate changes in their termination, instead of by the use of prepositions, as in the present day. In the English of Chaucer, though it was not so to the same degree in that of some of his contemporaries, these case-endings, except the *s* or *es* of the genitive, are lost, the rest being represented, if at all, by an *e* at the end of the word, which *e* is sometimes sounded and sometimes silent. In words of French origin, also, the final *e* is in Chaucer, as in French poetry, as often sounded as mute. The presence of the final *e* in many words in which it is no longer written, and the fact that this final *e* is habitually sounded as an additional syllable of the word, is the one strongly marked difference between Chaucer's English and our own so far as the noun is concerned. But it will be noticed by every reader of Chaucer that the sounding of the final *e* is by no means an invariable rule; indeed, it is probably quite as often silent, especially before a vowel or the letter *h*, from which it may be inferred that in Chaucer's day the older pronunciation was beginning to give way to the modern. Thus such words as *poore* (poor) and *time* are sometimes, as the metre shows, to be read as we pronounce them now, and sometimes as *poorè*, *timè*. In the verb, also, there are a few old forms still retained in Chaucer which we have now lost. Thus the infinitive of the verb, instead of being, as now, *to seek*, is more commonly *to seeken*, or *to seekè*. The plural of the present tense, instead of being *we*, *you*, or *they seek*, was generally *we*, *you*, or *hi seeken*, the still older form ending in *eth* being occasionally found. The imperative mood is not *seek*, but *seeketh*. In the past participle Chaucer still habitually retains the old prefix *i* or *y* (corresponding to the German *ge*, as *gehabt*, from *haben*) at the beginning of the word. Thus he writes *itaught*, *ipinched*, *isett*, when we should say *taught*, *pinched*, *set*. With the exception of these points, however, and some others of minor importance, the chief differences between Chaucer's English and our own are differences of spelling. And as the eye becomes accustomed to the older spelling, and the few antique grammatical forms become familiar, every student will find that he meets no greater difficulty in reading Chaucer than that which arises from an occasional obsolete word, for which a dictionary has to be consulted.

The versification of Chaucer has been the snbject of much controversy. To some his lines have seemed absolutely without metre, rhythm, or order of any kind; while others have perhaps run into an opposite extreme, and represented his versification to be as regular as that of Pope or Goldsmith. The truth seems to be that in general Chaucer's versification is quite regular, the proper measure of syllables being found in the line and the proper number of accents. The seeming irregularity arises from not attending to the pronunciation of words in Chaucer's time. But, on the other hand, it is plain that Chaucer did allow himself far greater licence in the matter of metre than modern poets have done; and there are a large number of his lines in which, though a certain rhythm is preserved, the syllables will not bear counting. The main key to Chaucer's versification is to be found in what we have already explained—the sounding of the final *e*. It must also be remembered that many words of French origin, such as *courage*, *menace*, *liquour*, were not pronounced as we pronounce them, with a marked emphasis on the first syllable, *córage*, *ménace*, *líquour*, but as in French, with both syllables equally emphasised, *córáge*, *ménáce*, *líquóur*.

A thorough understanding of Chaucer's system of versification is of so much importance to any one beginning to read his works, that we give here the first twelve lines of the Prologue to the "Canterbury Tales" as they are commonly printed, followed by a metrical arrangement of the same. Both the text and the metrical arrangement of it are taken from Mr. Bell's edition of Chaucer:—

"Whan[1] that Aprille, with his[2] showres swoote,[3]
The drought of Marche hath perced to the roote,
And bathud every veyne in swich licour,
Of which vertue engendred is the flour;[4]
Whan Zephirus eek with his swete breeth
Enspirud hath in every holte and heeth
The tendre croppes, and the yonge[5] sonne
Hath in the Ram[6] his halfe cours ironne,[7]
And smale fowles[8] maken[9] melodie,
That slepen alle night with open yhe,[10]
So priketh hem nature in here corages,[11]
Thanne longen folk to gon[12] on pilgrimages."

"Whăn that | Āprīl | lĕ, wīth | hĭs schōw | rĕs swoōte,
Thĕ drōught | ŏf Mārche | hăth per | cĕd tō | thĕ roōte,
Ănd bā | thŭd ēve | rў̆ vēyne | ĭn swĭch | lĭcōur,
Ŏf whīch | vĕrtuē | ĕngēn | drĕd īs | thĕ flōur;
Whăn Zē | phĭrūs, | eĕk wīth | hĭs sweē | tĕ breeth
Ĕnspī | rŭd hāth | ĭn ēve | rў̆ hōlte | ănd hēeth
Thĕ tēn | drĕ crōp | pĕs, ānd | thĕ yōn | gĕ sōnne
Hăth īn | thĕ Rām | hĭs hāl | fĕ coūrs | ĭrōnne,
Ănd smā | lĕ fōw | lĕs mā | kĕn mē | lŏdiĕ,
Thăt slē | pĕn āl | lĕ night | wĭth ō | pĕn ȳhe,
Sŏ prī | kĕth hĕm | nătūre | ĭn hēre | cŏrāges,
Thănne lōn | gĕn fōlk | tŏ gon | ōn pil | grĭmāges."

The most instructive classification of the writings of a great author is almost always that founded upon chronological order, for such an arrangement shows us not only the author's works, but the history of his mind as well. The history of Chaucer's writings is so ill ascertained, that no chronological arrangement of them can be reliable. But they may usefully be grouped into certain classes, according to their general character. In the first place, we find a series of poems, some of them of considerable length, but by no means among the longest of Chaucer's poems, which distinctly belong, in subject, in form, and in treatment, to the school of the French romance-writers, who, as we have seen, had from the first supplied the literary appetite of the Normans in England. They are almost all dreams and allegories of love or kindred subjects. They are full of graceful fancy, ingenuity of invention, keen appreciation of the beauties of nature, and sweetness of versification. But they do not show the higher and rarer qualities of Chaucer's genius. To this class belong "The Court of Love," "The Assembly of Fowls," "The Cuckoo and the Nightingale," "The Flower and the Leaf," "Chaucer's Dream," and "The Book of the Duchess." Of these, the last-mentioned two refer, the one to the marriage, the other to the death, of Blanche, John of Gaunt's first wife. To the same class is to be referred the long poem, "The Romaunt of the Rose." This is a translation of a very famous French romance, the production in part of Guillaume de Lorris, in part of Jean de Meun, two poets who lived, one nearly a century and a half, and the other nearly a century before Chaucer. The work is, as usual, an allegory, in which, under the person of *Amant* or Lover, are detailed the adventures of true love in its pursuit of the rose, the object of its affection.

"The House of Fame" is a dream and an allegory, like the preceding poems, but an allegory of a very different class. The poet is borne by a golden eagle to the temple of Fame, where the goddess sits enthroned, and awards such measure of fame as she will to those who seek her honours, while the names of the great dead are inscribed in their appropriate places upon the temple. This scheme affords to Chaucer not only ample space for brilliant and impressive description, but for keen discrimination of the characteristics of those to whom he assigns a place in the temple; while the injustice of the goddess's decrees admits of that satiric treatment of which Chaucer was a master. The general character of this poem is known to most readers through Pope's modernised version of it, under the name of "The Temple of Fame."

The long poem of "Troilus and Cressida," and the series of tales published under the title of "The Legend of Good Women," are of a wholly different school. In them we find nothing of dream or allegory, nothing of the dreamy unreality of the romance. The subjects, no doubt, are very remote from our own time or from Chaucer's, but the interest of the poems is purely human and natural. "Troilus and Cressida," though many of its principal characters are Homeric, is founded on a story wholly unknown to, and, indeed, quite out of harmony with the notions of classical times. Chaucer, no doubt, derived the story from Boccaccio, just as Shakespeare afterwards borrowed it from Chaucer. The "Legend of Good Women" consists of a series of nine stories of women in ancient times famous for their constancy and devotion in love. It is said that this book is one of the very latest of Chaucer's works; and there is internal evidence to support the view. There is also a tradition that the work was intended as a kind of apology to the fair sex to atone for any harshness with which he might have treated women in his earlier works.

There are many other shorter poems of Chaucer which our space does not allow us to examine. And he has left us one separate work in prose, "The Testament of Love," a work of no great importance in itself, but which has been the subject of much discussion, in consequence of an idea, probably without foundation, that the book contains, under an allegorical guise, the story of the author's own life.

It remains only to consider Chaucer's greatest work, the "Canterbury Tales," which we shall do in the next lesson.

THE UNIVERSITIES.—VII.

DUBLIN UNIVERSITY.—II.

Having passed his final Michaelmas Examination, the student is publicly admitted to the degree of Bachelor of Arts (*Artium Baccalaureus*), in the Senate House, by the Chancellor or Vice-Chancellor of the University.

The proceedings on the occasion of conferring degrees are called "commencements." The fee which has to be paid for the degree of B.A. is £1; and three years after the taking of his B.A. the student, without keeping his name on the college books in the meantime, can proceed to the degree of Master of Arts (*Artium Magister*) by payment of the fee of £9 16s. 6d.

The three older Universities of Oxford, Cambridge, and Dublin admit the graduates of one university to the same degree (*ad eundem gradum*) in the other on payment of a fee of £1.

From the outline which we have given of an undergraduate's course in Dublin University, it will be seen that the entire cost of his course (if he be non-resident) will be—entrance, £15, and eight half-years' fees (eight guineas each); making, altogether, £82 4s. To this, of course, must be added the expense of at least nine journeys to Dublin during the four years, and the expense of stopping there each time about three days.

In the foregoing we have spoken only of what is the *minimum* of examinations required for a degree: there are numerous honours and prizes which the more ambitious student may obtain in all the departments of a university education. These we will now explain, first treating of those which are most likely to attract the attention of those whose limited means would render the aid thus offered to them a valuable boon.

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[1] When.

[2] *His* was used for *its* as well as for *his*; *its* being of much later introduction.

[3] Sweet.

[4] In such moisture as to form the power (virtue) by which the flower is produced.

[5] Early.

[6] In the sign of the Ram.

[7] Past participle for *run*. The form has been already observed upon.

[8] Small birds.

[9] The third person plural of the present indicative, like *slepen* in the next line, and *longen*. The form has been already noticed.

[10] Eyes.

[11] Nature so stimulates them in their passions. *He, hem, here*, are the usual forms in the English of Chaucer's day for *they, them, their*.

[12] It has already been said that the usual form of the infinitive is in *en*. Hence, by a natural contraction, the infinitive of *go* becomes *gon*, as in the text.

SIZARS.

Young men of limited means, on proving such in the form of an application to the Senior Lecturer before the 1st of June in each year, will be allowed to become candidates for a sizarship, the examination for which is held each year in Trinity Term, and the sizarships are granted, according to the number of vacancies, to the best answerers. A sizarship is tenable for four years from the date of a student's entrance, and candidates are allowed to "enter" as Sizars, instead of passing the ordinary Entrance Examination, if they desire to do so. In case of a man entering as a Sizar, the entrance fee is only £5 1s. 3d. The privileges of a Sizar are that he has not to pay any annual fees, and is allowed to dine in the College Hall free. In other words, any poor student who has sufficient ability to gain a sizarship, obtains his whole academic education, and his dinner during term for four years, free of charge. There are also minor offices in the college, such as Chapel Clerkships, open to him; and one who obtains a sizarship is sure to be able to get pupils to read with him, and so defray his personal expenses. A sizarship may be obtained either in Classics, Mathematics, Hebrew, or Irish.

The following are the subjects of examination:—

Classical Sizarships.—Greek and Latin Grammar, Ancient Geography, Greek and Roman History, English Prose Composition, Greek and Latin Prose Composition, *vivâ voce* examination in two Greek and two Latin authors, selected each year from the Entrance Course (the two selected are announced each year in the University Calendar), and examination by papers in Homer, Iliad, Books i.—xii.; Demosthenes, Philippics, De Coronâ; Euripides, Hecuba, Orestes, Phœnissæ; Xenophon, Anabasis; Horace; Virgil, Eclogues, Georgics; Livy, Books vi.—x. (inclusive); Terence, Andria, Heautontimorumenos, Adelphi; Cicero, Philippic Orations, i.—viii. (inclusive).

Mathematical Sizarships.—Geometry of the right line and circle; Algebra (including the general theory of equations); and Trigonometry (plane and spherical).

Hebrew Sizarships.—The Grammar, Exodus, chaps. i.—xx. (inclusive), Psalms i.—xli. (inclusive), and the Greek and Latin books appointed for the *vivâ voce* examination for Classical Sizarships.

Irish Sizarships.—For the encouragement of the study of Irish, one Sizarship is given annually to the best answerer, in the Entrance Course, together with the following course of Irish:—O'Donovan's, Wright's, and Neilson's Irish Grammars; Translation from English into Irish, and *vice versâ*; the Four Gospels, and Epistles to the Romans and the Hebrews, in Irish; the Gospels to be translated from Greek into Irish.

Sizars are required to reside in college.

SCHOLARSHIPS.

Scholars rank next to the Fellows of the College, and are members of the Corporate Body of the University. The Scholarships, which are tenable until the M.A. degree may be taken, are granted in both Science and Classics. (For the details of the examination, which is a very severe test of scholarship, we must refer the reader to the University Calendar.) Scholars only pay half tuition fees, and receive a small annual allowance in money from the college. They have their "commons" free, and only pay half the ordinary rent for their rooms.

MODERATORSHIPS.

Instead of proceeding to his B.A. degree by the ordinary Michaelmas Senior Sophister Examination, as already explained, a student may become a candidate for a Moderatorship, and obtain his degree by passing in one or more of the Moderatorship Courses, which are as follow:—Mathematics and Mathematical Physics—Classics—Logic and Ethics—Experimental Science—Natural Science—History and Political Science—Modern Literature. For each of these Moderatorships the course of reading prescribed is very extensive, and to gain the first Senior Moderatorship is a high university honour.

Two Studentships are given each year, one to one of the Senior Moderators in Classics, and the other to one of the Senior Moderators in Mathematics and Physics, the candidates being selected in accordance with the distinction they have gained in some one other Moderator Course at least. Those who obtain Studentships are paid £100 per annum by the College Board for seven years. They are not required to reside, and have no duties to perform. Thus these prizes are a great aid to those of limited means in the early years of their professional career.

There are numerous smaller distinctions and prizes given to students during their undergraduate course, which we cannot here enumerate; we have mentioned above the most important.

In addition to the undergraduate course in Arts, which we have explained, there are Schools in the various faculties of Divinity, Law, Medicine, and Engineering, with professors and lecturers attached to each, and numerous and valuable prizes. To mention the requirements in these schools for their respective testimonials and diplomas would occupy too much space.

Before joining any of these schools, and so becoming a "professional" student, the undergraduate must have passed a certain portion of his course in Arts, which varies for each school.

We may, in conclusion, mention that the University of Dublin was founded in the year 1591 by Queen Elizabeth, and since that time has given to the United Kingdom some of her most illustrious sons in all departments of scientific, literary, and public life. The present Chancellor and Vice-Chancellor of the University (1886) are the Right Hon. Lord Rosse, LL.D., and the Right Hon. John Thomas Ball, LL.D., both graduates of Trinity College.

COMPARATIVE ANATOMY.—XIX.

VERTEBRATA.

AMPHIBIA.

In the last lesson we described those animals which occupy the lowest scale of the vertebrate kingdom, live in water, and breathe by means of gills.

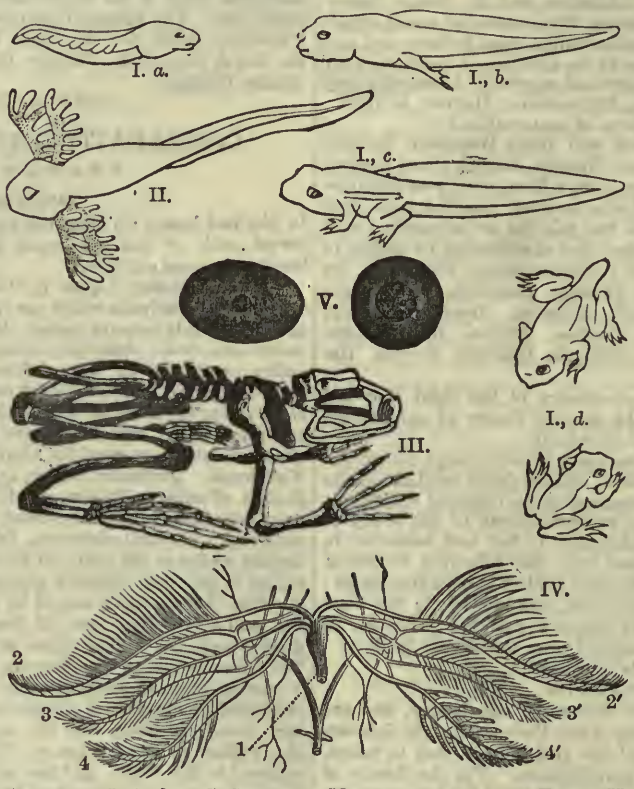
Proceeding a step higher in the ladder of vertebrate life, we come to those animals which can live either on land or in water, and are on this account named *Amphibia* (from the two Greek words *αμφι, both; βιος, life*), living in two elements. The Amphibia constitute an intermediate form of life between the strictly aquatic and the terrestrial animals. Cuvier classified them under the name of Batrachia in his fourth order of Reptilia; but recent zoologists have justly objected to this classification, and now consider them as a distinct division of the Vertebrata. Professor Huxley, in his recent work on the classification of animals, follows out this plan after a method much more scientific in its arrangement than that of any other recent observer. We shall, therefore, follow out his system of classification as far as the limits of this lesson will admit. In order to live in two such different media as water and air, it is requisite that these animals should be in possession of gills like the fish, and also of that form of breathing apparatus which predominates in the higher forms of vertebrate life, called lungs. The latter consist of membranous bags, divided internally into a number of small compartments or cells, over which the blood is carried by means of a delicate net-like arrangement of capillary vessels, in order that the oxygen element, so essential to the welfare of the component tissues of the animal, may be restored to the blood, and the carbonic acid removed from it. Nothing can exceed the beauty and extreme delicacy of the mechanism of the breathing apparatus, which, variously modified, is seen to play such a useful part in the economy of the higher animals. The Amphibia possess the typical characters of the Vertebrata, already described. Like fishes they are cold-blooded. Their blood is red and corpusculated. Fig. V. illustrates two red blood corpuscles of the frog, magnified 700 times, after drawings made by Dr. Lionel Beale. The blood corpuscles of the proteus and the siren are the largest known.

By Professor Huxley the Amphibia are divided into four orders, as follows:—

1. The *Urodela*, or those with persistent tails. 2. The *Batrachia*, or frogs. 3. The *Gymnophonia*, or Amphibia with naked snake-like bodies. 4. The *Labyrinthodonta*, so called from the labyrinth-like and complicated arrangement of their teeth.

The first order comprises the newts, salamanders, proteus, siren, etc. The second, toads and frogs. The third, those animals called by Linnæus, Cæcilia (*cæcus*, blind), or blind-worms. They are, however, not blind, as that naturalist supposed; they have eyes, but very small ones, and nearly hidden under the skin. The fourth are a genus of gigantic fossil Amphibia. Footprints of these animals have been found in the new red sandstone in different parts of this country.

The Amphibia undergo a remarkable change or metamorphosis as they advance towards maturity. They are for the most part developed from eggs deposited in the water and afterwards fecundated. The resulting young are called tadpoles. In their early stage they resemble fishes. They breathe by means of gills, which project from each side of the body behind the head. (Fig. II.) They have no fins, and in their early stage they are destitute of legs. (Fig. I., *a.*) As life advances these external gills disappear, the animal breathing by means of internal gills, which are suspended from arches, and bathed by the water in a similar manner as that arrangement described in fishes. Presently a pair of legs (Fig. I., *b*) may be seen to grow from the sides of the body. The hind legs make their appearance first, and the fore legs subsequently, in the frog. (Fig. I., *c.*) This is not always the case with the other Amphibia; for example, in the salamander the order of leg-appearance is reversed. In the siren the hind legs are wanting.



Amphibia.—I. (*a*, *b*, *c*, *d*) Successive Metamorphoses of the Frog. II. Tadpole of Frog, showing external gills. III. Skeleton of the Frog. IV. Blood-vessels of Tadpole of Frog, and their mode of distribution to the gills. V. Blood Corpuscles of the Frog (highly magnified).

Refs. to Nos. in Figs.—IV. 1, artery arising from a single ventricle, and dividing into six branches, which go to the three pairs of gills, 2 2′, 3 3′, 4 4′.

As the legs approach towards a state of perfect development, the tail gradually contracts and wastes (Fig. I., *d*), until it has completely disappeared. During this period changes are taking place in the internal as well as external economy of the body. Nature now prepares it for an extended sphere of action by endowing it with a pair of lungs, by which it is enabled to live either in its native element, or to extend its peregrinations to terrestrial soil, and live there also. This transition from the larval to the frog condition cannot fail to remind the student of another metamorphosis—namely, that which the caterpillar undergoes to become butterfly or moth. In the former the transit is from a strictly aquatic to a double form of life; in the latter from an earthy to an aërial state of existence. It is by such metamorphoses as these that Nature teaches man to aspire to a higher degree of intelligence and usefulness. The lesson comes with an equal force from the much-despised toad—whose hoarse croakings break the stillness of the night in its quiet reign of darkness over their marshy habitations—as it does from the pretty but irresolute butterfly, basking to and fro in the sunshine of day. In the frogs, toads, and newts the gills entirely disappear, and for this reason they have been named Caducibranchiate Amphibia.* Others are called Perennibranchiate Amphibia, from the fact that their gills remain permanently, even after the formation of complete lungs. Such are the proteus and siren; also the axolotl, to which the Mexicans are partial as an article of diet, especially when, as Dr. Baird remarks, dressed after the manner of stewed eels, and served up with rich and stimulating sauces.

The Circulatory Apparatus.—The heart of the Amphibia is indicative of progressive development. It consists of three chambers or cavities. Two of these are reception cavities, and named the systemic and pulmonic auricles; the third is a propelling one, and called the ventricle. The object of the ventricle is to propel the blood to the system and lungs—to the system for the purpose of carrying oxygen for the nutrition of the tissues, and to the lungs so that the oxygen element may be again restored to it from the atmosphere, and to expel from the blood the carbonic acid which results from the waste products.

It will be surmised that in those animals (for example, the frog, etc.) possessing only temporary gills, that, as the lungs usurp their place, a change must of necessity arise in the arrangement of the blood-vessels. This is the case. When the lungs come into play, the blood is diverted to them and away from the gills. (Fig. IV.) In those Amphibia with persistent gills this change is only partial. In the frog tribe the skin also acts as an organ of respiration by absorbing moisture. By reason of this it is enabled to live for a long time deprived of food and air. This fact has given origin to many amusing tales of toads being found alive entombed in coal-beds and blocks of stone, where they had evidently existed (believe it who chooses!) for hundreds of years.

The digestive and nervous apparatus undergo a slight increase in complexity from that described in the last lesson.

Frogs are destitute of ribs, and consequently have not an expansile chest. This necessitates them to breathe by swallowing the air. The skeleton of the Amphibia evinces decided advances towards that of the higher Vertebrata. This is very evident in the disposition and conformation of the bones of the limbs—*i.e.*, in those which possess the latter. The skull joins with the vertebral column by means of two condyles, which, Professor Huxley remarks, sharply distinguishes the Amphibia from the higher Vertebrata.

REPTILIA.

Far away beyond the confines of history—probably ages before the secondary organisation—the earth was tenanted by gigantic species of the class Reptilia. The reorganisation of the earth completed, and man placed upon its surface, we find the reptile again playing a prominent part. Scripture debits the snake with the credit of inducing our first parents to commit the sin of disobedience. Known from the earliest times, their ungainly appearance, their malignity of disposition, and the formidable attribute (poison-fangs) peculiar to an order of this class, have rendered them objects of hatred and fear. They are regarded by every one—except the enthusiastic naturalist—as the most despicable part of the whole of Nature's handiwork. Shakespeare drew from them an expressive illustration of dissimulation:—

> "And Gloster's show
> Beguiles him, as the mournful crocodile
> With sorrow snares relenting passengers;
> Or, as the snake, rolled in a flowering bank,
> With shining checkered slough, doth sting a child,
> That, for the beauty, thinks it excellent.

The Reptilia are now classified with birds as a sub-group of Vertebrata, which Professor Huxley calls the Sauropsida.*

In external appearances and configuration the orders of this class differ materially from each other. The Crocodilia have their bodies covered with horny plates embedded in the skin

* From *caducus*, easily falling; *branchiæ*, gills.

* Σαυρα, a lizard; οψις, appearance.

They have very short legs and webbed feet. The alligators have not webbed feet. Tortoises have a complete external skeleton, covered with thinner plates, which represents a part of the skin. The snakes are destitute of these thick outward investments, but have scales covering their bodies.

The Teeth.—The dental apparatus varies according to the reptile's mode of life. The crocodiles have long jaws, armed with a single row of conical teeth, held in bony sockets. In alligators, the front teeth (canine) of the lower jaw fit into a pit in the edge of the upper jaw. The Chelonia (tortoises, etc.) have no teeth. Their jaws are covered with a horny bill, which serves the purpose of teeth. The teeth of the Ophidia (serpents) are not lodged in sockets. In the cobra, rattlesnake, viper, etc., the teeth are grooved or perforated by a canal, which communicates with a poison gland (see Vol. II., p. 176), and serves to convey the poison into the wound made by the animal's bite. The opening of the canal is not at the extremity of the tooth, but at a point a little above it, so as not to interfere with the cutting action of the tooth. These teeth are attached to movable bones. When at rest, the poison-fangs are hidden by a fold of the gums. Behind them are rudiments of other fangs, to replace the former, if lost. The poison of these serpents prove rapidly fatal to hot-blooded animals when introduced into the blood current through a wound. When swallowed it is harmless.

The tongue in some of these animals is very long. In the well-known chameleon it is, when fully extended, nearly as long as the body. By means of an hyoid apparatus it can protrude and retract it with amazing rapidity. It serves as an organ of prehension.

The Alimentary Canal presents few differences from that already described in the Amphibia. It is comparatively short, and usually of great width. The gullet is wide and extensible, especially in the snake, which is said to be able to swallow animals of greater bulk than itself. The large and small intestines are very distinctly divided, and separated by a curtain or valve. In a tortoise of moderate size the whole length of the alimentary canal was found to be four feet. The small intestines were 20½ inches, and the large 16½ inches long. The stomach was 2 inches long. The intestines terminate in a cloaca, which is generally also the common point of termination of the urinary and generative organs.

The Respiratory Apparatus.—The Reptilia never breathe by gills at any period of their existence, like the two preceding classes, but by lungs. These are two in number, and made up of numerous cells, usually of large size, aggregated together. In snakes and lizards the lung called the principal lung is much larger than the other, and, in fact, the working lung. The smaller one, called the little lung, is either rudimentary or absent. Tortoises and turtles, like the ribless frogs, owing to their possessing immovable ribs, are necessitated to breathe by swallowing the air. The reptilian heart consists of three cavities. There is an evident tendency in many to the formation of a fourth, by a septal division of the ventricular cavity into two parts; so that the blood, arterial and venous, still mixes. In some this intraventricular septum is almost complete, forming a quadrilocular heart like that of the higher vertebrates.

The blood corpuscles are not very numerous. They are oval in shape and of large size, varying from $\frac{1}{[illegible]}$ to $\frac{1}{[illegible]}$ of an inch in the long diameter, and $\frac{1}{[illegible]}$ to $\frac{1}{[illegible]}$ of an inch in the short diameter.

The nervous system does not indicate any considerable advances in its general structure above that of the higher fishes. The brain is of small size in comparison with the skull.

The young of the Reptilia are developed from eggs. Some are hatched before being born, as in the viper. The majority, however, deposit their eggs in the sand on river banks, and leave them to be hatched by the heat of the sun. The egg of the crocodile is about the size of that of a goose. The turtle makes two or three visitations to the shore in the course of a year to deposit her eggs in a cavity she scoops out to receive them. Her eggs amount to about a hundred at each sitting. She carefully covers them with sand, and leaves them. The mode of development of the reptilian embryo resembles that of the higher Vertebrata. The Reptilia possess a completely ossified skeleton. The skull is small, the greater part of its bulk being made up of jaws. The head is articulated to the spinal column by means of a single condyle. The ribs are numerous in the crocodiles, lizards, and serpents. In the snake they amount to as many as three hundred pairs. In the latter they are free at one extremity, the breast-bone and limbs being absent.

The spinal segments form a series of ball and socket joints, so as to allow considerable latitude of motion. The tortoise is invested by a bony habitation, consisting of two plates, united at the sides, to the inner aspect of which it is immovably fixed. The anterior and posterior extremities are open, to allow the animal to protrude its head and limbs. The upper or back plate is called the carapace; the under or ventral one, the plastron. The upper plate consists of eight ribs flattened out, blended together, and solidly fixed to the backbone. The lower plate represents the breast-bone, arranged in a similar manner. It is composed of nine pieces. The shoulder and pelvic bones, which afford attachment to the limbs, are situated in the interior of this bony house. The neck and tail portions of the spinal column only are free. The bones of the (in Reptilia possessing) extremities are well developed, and approach in character those of the higher Vertebrata. The toes are usually five in number on each foot, movable, and armed with claws.

Classification.—Professor Huxley groups the Reptilia into the following orders:—(1) *Crocodilia*, comprising the modern crocodiles, alligators, and caimans, and the extinct Teleosauria and belodonts; (2) *Lacertilia*, lizards, blind-worms, and the chameleons; (3) *Ophidia*, or snakes; (4) *Chelonia*, turtles and tortoises. Besides these, there are five orders of fossil Reptilia.

Reptilia.—I. Anatomy of the Common Snake (after Milne-Edwards).

Refs. to Nos. in Fig. 1.—1, tongue and glottis; 2, gullet, cut across at 2′ to show the heart, etc., in situ; 3, stomach; 4, intestine; 5, cloaca; 6, anus; 7, liver; 8, ovarium; 9, ova, or eggs; 10, windpipe; 11, principal lung; 12, little lung.

LESSONS IN BOOKKEEPING.—XXVIII.

INVOICE BOOK.

ANY account or bill sent with goods sold to the party who has purchased them is called an *Invoice*. The invoices of goods sold in the country where the merchant resides are called *Invoices Inwards*, and the book which contains them the *Invoice Book Inwards*. The invoices of shipments or goods exported are called *Invoices Outwards*, and the book which contains them is called the *Invoice Book Outwards*. In invoices outwards, besides the cost of the goods exported, there is generally a statement of the *Charges* attending their exportation, the cost of insurance, etc. The date is generally placed at the bottom, and before the signature of the shipper the words *Errors Excepted*, or their initials, are written, in order that he may be afterwards allowed to correct any mistake he may have made to his own disadvantage. In large concerns, the Invoice Book itself is journalised monthly instead of passing the entries through the Day Book.

(1) INVOICE BOOK. (1)

INVOICE of sundry Goods shipped by White, Smith, and Co. on board the Dreadnought, Captain James, for Jamaica, by order, and on account and risk of Schofield, Halse, and Co., of Kingston, being marked and numbered as per margin.

	Nos.		£	s.	d.	£	s.	d.
S.	1 to 9	9 Bales Tow Osnaburgs, containing—						
S. M. & Co.		80 Pieces; 11,300 yards, at 5d. per yard .	235	8	4			
H.		Wrappers and Packing	0	16	8			
						236	5	0
S.	1 to 3	3 Cases Hats, containing—						
T. & Co.	1	6 Dozen Beaver Hats, at 37s. per dozen . .	11	2	0			
H.	2	6 „ Silk „ 35s. „ . .	10	10	0			
	3	6 „ Paris Nap „ 33s. „ . .	9	18	0			
		Casing and Packing	0	12	0			
						32	2	0
S.	1	1 Case, containing—						
W. P. & Co.		278 Dozen Paris Shoes, at 20s. per dozen .	278	0	0			
H.		Casing and Packing	0	15	11			
						278	15	11
S.	1	1 Bale Linen Tick, containing—						
J. P. & Co.		64 Pieces; 1,664 yards, at 6d. per yard . .	41	12	0			
H.		Canvas and Packing	0	8	0	42	0	0
S.	1 to 4	4 Cases Platillas	327	10	0			
M. & Co.		Casing and Cording	0	15	4			
H.						328	5	4
S.	1 to 8	8 Bales Lint Osnaburgs, containing—						
T. B. & Co.		96 Pieces; 13,350 yards, at 6½d. per yard .	366	19	7			
H.		Canvas and Packing	0	10	5			
						367	10	0
		CHARGES.				1284	18	3
		Entry, Cocket, Shipping, etc.	15	0	0			
		Duty, Freight, and Primage	28	10	0			
		Wharfage, Cartage, and Bills of Lading . .	7	18	0			
						51	8	0
		Commission, 5 per cent., on Goods and Charges .	66	15	0			
		Insurance on £1,500 and policy	33	18	9			
		Commission on do., at ½ per cent. . . .	7	10	0			
						108	3	9
					£	1444	10	0

London, 6th August, 1881.

E. E. White, Smith, and Co.

(2) INVOICE BOOK. (2)

INVOICE of 60 Barrels of Herrings, shipped at Liverpool by R. Hastie and Co., on board the Fury, Captain Thomson, for Barbadoes, on account and risk of Richard Sykes, of that place, being marked and numbered as per margin.

	Nos.		£	s.	d.	£	s.	d.
R.	1 to 60	60 Barrels of Herrings, at 20s., including Insurance and Shipping Charges . . .	60	0	0			
R. H. & Co.		Commission on do., at 5 per cent. . . .	3	0	0			
S.						63	0	0

London, 10th August, 1881.

E. E. White, Smith, and Co.

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(3) INVOICE BOOK. (3)

INVOICE of sundry Goods shipped on board the Rainbow, Captain Browne, for Jamaica, by White, Smith, and Co., on account and Risk of John Roberts, of that place, being marked and numbered as per margin.

	Nos.		£	s.	d.	£	s.	d.
J.	1 to 6	6 Bales Lint Osnaburgs, containing—						
J. O. & Co.		68 Pieces; 9,588 yards, at 6d. per. yard . .	239	14	0			
R.		Canvas and Cording	0	6	0	240	0	0
J.	1 to 3	3 Boxes Hats, containing—						
T. & Co.		4 Dozen Beaver Hats, at 60s. per. dozen. .	12	0	0			
R.		4 „ Silk „ 54s. „ . .	10	16	0			
		4 „ Paris Nap„ 50s. „ . .	10	0	0			
		Casing and Nailing	0	14	0	33	10	0
J.	1	1 Case, containing—						
W. P.		244 Dozen Pairs Shoes, at 21s. per dozen .	256	4	0			
R.		Casing and Packing	0	11	6	256	15	6
J.	1	1 Cask of Nails, weighing—						
W. S. & Co.		Net 8 cwt. 2 qrs. 21 lbs, at £10 per cwt. .	86	17	6			
R.		Hooping, etc.	0	12	6	87	10	0
J.	1 to 9	9 Bales Tow Osnaburgs, containing—						
T. B.		85 Pieces; 12,000 yards, at 5d. per yard .	250	0	0			
R.		Canvas and Cording	0	16	6	250	16	6
J.	1 to 6	6 Trunks Printed Muslins, containing—						
W. S. & Co.		560 Pieces; 13,440 yards, at 1s. per yard .	672	0	0			
R.		Trunks, Packing, etc.	3	12	0	675	12	0
J.	1 to 4	4 Cases. containing—						
J. B.		670 Pieces Scotch Linen; 16,140 yards, at 1s.						
R.		per yard	807	0	0			
		Casing and Packing	1	6	0	808	6	0
						2352	10	0
		CHARGES.						
		Entry, Cocket, Shipping, etc.	10	0	0			
		Freight, Primage, and Bills of Lading . . .	11	0	0	21	0	0
		Commission, 2½ per cent., on Goods and Charges .	59	7	0			
		Insurance on £2,550, and Policy	57	10	0			
		Commission on do., at ½ per cent..	12	15	0	129	12	0
						2503	2	0

London, 20th August, 1881.

E. E. White, Smith, and Co.

ACCOUNT SALES BOOK.

An *Account Sales* is an account showing the amount of the sales of goods imported and sold for the benefit of the merchant, or any of his correspondents, with the different charges attending the sales, and the net proceeds of the whole. The book in which snch accounts are entered is called the *Account Sales Book*, or simply *Sales Book*. An account sales is freqnently made up in the Dr. and Cr. form, the charges and the net proceeds being on the Dr. side, and the sales on the Cr. side. Sometimes, especially where the space admits of it, the charges, etc., are placed at the bottom of the acconnt, so that the whole may be contained in one page, as exemplified in the two acconnts in this book. The Account Sales Book is freqnently made np from other books, where the particulars are entered as they can be obtained from time to time. As an account sales can rarely be made up at the period when the goods are sold, the copy in the Sales Book must be marked with the date where it is entered in the Day Book, or the folio where it is entered in the Jonrnal; as, like the Invoice Book, the entries may be made at once in the Jonrnal, without passing through the Day Book.

(1) ACCOUNT SALES BOOK. (1)

ACCOUNT SALES of 7 Hhds. of Sngar (W. S. & Co.), received per the Ballarat, Captain Jones, from Barbadoes, and sold on account of Nathan Herschell, of that place.

1881.			£	s.	d.	£	s.	d.
Oct.	8	Sold per William Knight and Co., at public sale, 7 Hhds. of Sngar, net 78 cwt., at 60s. per cwt.				234	0	0
		CHARGES.						
		Insurance on £175, at 3 per cent., Policy 10s. 6d., and Commission ½ per cent.	6	13	0			
		Freight and Shipping Charges	23	15	4			
		Duties and Customs' Fees	107	8	7			
		Dock Dues, Warehonsing, etc.	5	19	6			
		Brokerage on £234, at 1 per cent.	2	6	9			
		Commission on do., at 2 per cent.	4	13	4	150	16	6
		Net proceeds due to N. Herschell, Esq.				83	3	6
						234	0	0

London, 24th November, 1881.

White, Smith, and Co.

LESSONS IN CHEMISTRY.—XXIX.

THE COMPONENTS OF THE ANIMAL FRAME.

Bones, which compose the rigid skeleton about which the animal organism distributes its muscles, nerves, etc., are formed of a dense cellular tissue of gelatine, made stiff by inorganic salts, chiefly phosphates of lime and magnesia and calcic carbonate. This admits of ready proof. Suspend a cleanly-scraped bone in water which has been acidulated with one-sixth of its bulk of hydrochloric acid. Effervescence commences over the whole surface, owing to the escape of the carbonic acid gas. In the course of three or four days, all the mineral salts will have been dissolved out. After several washings in pure water, the bone is found to be perfectly flexible, though it has retained its shape; if it be dried it will become of a transparent horny appearance, and when boiled for a few hours it will gradually dissolve. The solution on cooling will gelatinise. The following table will show that bones and teeth have a kindred composition:—

	Bones.	Teeth.	Enamel.
Animal matter	30·58	28·0	2·0
Calcic phosphate	57·67	69·6	96·5
Calcic carbonate	6·99		
Calcic fluoride	2·69		
Magnesic phosphate	2·07	1·0	1·5
Other salts	—	1·4	—

Horn.—Next in solidity to bones and teeth ranks that horny substance which appears in the shells and horns of animals, in nails, wool, hair, etc. It does not dissolve, as the gelatine will, from bones when boiled under pressure, but is softened by heat. It seems to take an intermediate place between gelatinous and albuminoid substances. Alkaline solutions have the power of dissolving it; when caustic potash is used, ammonia is given off. An idea of the composition of some of these bodies will be given by this table:—

	Nails.	Horn.	Hair.	Wool.	Silk.
Carbon	50·3	50·0	50·62	50·65	48·61
Hydrogen	6·9	6·8	6·61	7·03	6·50
Nitrogen	17·3	16·3	17·93	17·71	17·34
Sulphur	3·2	3·4	24·84	24·61	27·55
Oxygen, etc.	22·3	23·5			

The softer parts of the animal structure comprise various substances, the accurate analysis of which is so difficult that no satisfactory formulæ have been devised to express their composition; yet their main properties are well understood. They are classed under two heads:—

The *Albuminoid group*, which comprises albumen, fibrine, caseine, and legumine; and

The *Gelatigenous group*, which includes gelatine, chondrine, and osseine.

Albumen is found in almost a pure state in white of egg, and in the serous fluid of the blood. If white of egg be mixed with water and filtered, the filtrate neutralised exactly with acetic acid, then largely diluted, a copious flocculent precipitate falls, which may be collected on a filter: this is albumen. It is insoluble in water, but readily soluble if the water be slightly alkaline. The most characteristic property of albumen is the fact that it solidifies and becomes insoluble when heated to and above 60° Cent. The solution of albumen in alkaline water does not undergo coagulation when heated; a small portion of sulphur, however, is separated.

Alcohol precipitates albnmen from its solution; ether does not. The solutions of most of the metallic salts precipitate albumen; hence in cases of poisoning from such salts, the antidote is the white of eggs. Tannic acid, or infusion of galls, also gives a copious precipitate. In the human body albumen forms 7 per cent. of the blood; it is found in all serous exudations, but not in any of the fluids with which the body parts, except in the case of disease.

Fibrine, like albumen, occurs in a liquid and in a solid state; in the former condition it constitutes 25 per cent. of the blood, and in the latter it forms the largest part of the muscular tissue. It may be procured by whipping, with a bunch of twigs, freshly-drawn blood in the act of coagulating, which it always does when removed from the influence of life; it attaches itself to the twigs in white, opaque, elastic filaments, which under the microscope appear to be composed of small globules arranged in strings. It occurs in muscle in bundles of fibres, hence its name.

In a solution of very dilute caustic alkali, fibrine is soluble.

Caseine constitutes nearly 3 per cent. of milk, and forms the bulk of all cheese. Like albumen, it is insoluble save in alkaline solutions. In milk it is in its soluble state, owing to the presence of a little free alkali. If this be neutralised by a little sulphuric acid, the milk "curdles," the coagulum is collected, re-dissolved by the aid of a little sodium carbonate, and allowed to stand until the fats and oils rise, when the liquid containing the caseine is drawn off by a siphon; to this acid is again added, and the caseine again precipitated; this process is repeated several times, and finally it is treated with ether to remove all traces of fat.

It appears as a white curdy substance. When dissolved in a weak alkaline solution, as it is in milk, caseine does not coagulate upon boiling; by this means it may be distinguished from albumen; but when its solution is hot, it absorbs oxygen from the air, and becomes covered with a skin. The most remarkable action caseine undergoes is produced by the secretion from the mucous membrane of the stomach. This is taken advantage of to make cheese. The inner membrane of the fourth stomach of a calf is salted and dried; when the milk is slightly warmed and brought in contact with this, *rennet*, the caseine coagulates, and carries down with it all the fatty compounds in the milk, leaving a clear liquid, *whey*. This *curd*, submitted to strong pressure, becomes cheese.

Legumine is the form in which azotised matter appears in the vegetable kingdom. It is so closely similar to caseine that many eminent chemists pronounce them to be the same body. It appears in the seeds of leguminous plants. To prepare it, digest the pulp of crushed peas in warm water for two or three hours. The undissolved portion is separated by straining, the liquid is allowed to deposit its starch, then, on the addition of a little acetic acid, the legumine falls as a flocculent precipitate. It behaves like albumin, and even undergoes coagulation by rennet, which fact enables the Chinese to make a kind of cheese from dried peas, which contain a fourth of their weight of legumine.

The relative composition of these albuminoid substances will be indicated in the following table:—

ALBUMINOID GROUP.

	Albumen.	Fibrine.	Caseine.	Legumine.
Carbon	53·5	52·7	53·83	50·53
Hydrogen	7·0	6·9	7·15	6·91
Nitrogen	15·5	15·4	15·65	18·15
Oxygen	22·0	23·5	22·52	24·41
Sulphur	1·6	1·2	0·85	
Phosphorus	0·4	0·3	—	
	100·0	100·0	100·00	100·00

Proteine.—When a solution of any albuminoid substance is neutralised a flocculent precipitate falls, which proves to be the same for each of the four members of the group. At first this was considered to be the base of the group, the members being its compounds with sulphur and phosphorus. Hence it was called *proteine*, from *πρωτος*, *first*—the foundation of the group. But this idea has been abandoned, and proteine is considered to be a product of the action of the alkali on an albuminoid substance.

The Gelatigenous group.—These substances contain less carbon and sulphur, but more nitrogen than the preceding group, and have no representative in the vegetable kingdom.

Gelatine is the main component of the walls of the cells which, filled with albuminoid matter, build np the material of the animal frame; it is, as we have noticed, the organic constituent of bone.

Gelatine is found in almost a pure state as *isinglass*, which is prepared from the floating bladder of the sturgeon. Glue and size are impure varieties. It is soluble in hot water; corrosive snblimate, platinic chloride, and infnsion of galls precipitate it.

But with *tannic acid* it forms a compound of a buff colour, which is the basis of *leather.*

Glue and *size* represent the commercial value of gelatine. The parings of hides, the ears and hoofs, etc., are steeped in lime-water to remove the hair and other impurities; they are then exposed to the air, that the lime may become carbonate, and thus innoxious. When washed they are introduced into a copper with a false perforated bottom; the water is heated by injections of steam. As soon as a portion of the liquid gelatinises on cooling, the copper is emptied, and the liquid allowed to cool. A fresh supply of water is added to the copper; this produces an inferior kind of glue, while the product of the third dilution is *size.* The process of drying the glue is the most delicate part of the manufacture. The soft gelatinous mass is cut into slices by wire, and these are exposed to the air on nets. But a sudden rise of temperature will liquefy the whole; a frost or a fog will be equally injurious. The marks on a cake of glue are from the meshes of the net.

Leather is made by steeping the skins in lime-water, and removing the hair by scraping. They are next submitted to the action of a very dilute solution of sulphuric acid, which clears them of lime and opens the skin to the action of the tan. The "tanning" is a long process; oak-bark is used to supply the tannic acid; this combines with the gelatine in the cuticle, forming leather.

The leather used for boots and shoes undergoes the process of *currying,* by which it is impregnated with oil, which renders it more supple and impervious to moisture.

Chondrine may be distinguished from gelatine by becoming coagulated by vegetable acids and by alum. It is produced by boiling any of the cartilages; its solution gelatinises on cooling. There is reason for believing that chondrine oxidises into gelatine.

Osseine is the gelatine procured from bones. The composition of this group is given in the following table:—

GELATIGENOUS GROUP.

	Gelatine.	Chondrine.	Osseine.
Carbon	50·40	49·97	50·4
Hydrogen	6·64	6·63	6·5
Nitrogen	18·34	14·44	16·9
Oxygen } Sulphur	24·62	28·58	26·2
Sulphur		0·38	
	100·00	100·00	100·0

The *liquids* which circulate through animals may be divided into three classes: (1.) Those which are secreted by various glands, and aid the progress of digestion. (2.) Those which are the products of digestion, as blood and milk. (3.) Those which come away from the body, carrying off the used-up material.

(1.) The *saliva* is secreted by glands in the neighbourhood of the mouth, and is poured into the food during the process of mastication. It contains a very active principle, *ptyaline,* which can convert starch into sugar. Its inorganic constituents are salts of sodium, potassium, and calcium, together with lithates of the alkalies. These are sometimes deposited on the teeth, forming *tartar.*

Gastric juice is secreted by the lining membrane of the stomach, whence it issues to carry on the work of digestion—that is, of rendering the food soluble. Its active principle is *pepsin,* which has a remarkable solvent power on albumen. When the process of digestion is going on, the gastric juice contains a free acid which, according to Miller, is a mixture of hydrochloric and lactic acids. The saline constituents are chlorides of calcium, sodium, and magnesium, sodic lactate, and a trace of phosphates of lime and iron.

The *pancreatic fluid* is the product of the pancreas—the sweetbread of culinary language. It carries on the work commenced by the saliva, saccharifying the starch; it seems also to have an action on fatty matters. It is one of the few fluids in the body which contain albumen in a soluble state.

The *bile* is secreted by the large and important gland, the liver, from the venous blood; it is collected in the gall-bladder, from which it is passed by a duct into the digesting food. Its colour is greenish-yellow, and from containing mucus it is ropy. From the latter it may be separated by dissolving in alcohol. It is found to be a compound of sodium with two resinous acids, *glycocholic* and *taurocholic,* but it is a very complicated compound, and in its analysis there appear several peculiar substances.

Cholesterine is ever present in very small quantities, but it is extremely insoluble, and when once too much is secreted it becomes deposited in the gall-bladder, forming "gall-stones;" when these get into the duct, violent pains at once ensue.

(2.) *Blood* is the great agent which builds up and repairs the body, and furnishes material from which the glands extract their secretions. Hence it contains all the elements necessary to renew every part of the frame. When allowed to stand it soon coagulates; this is brought about by the fibrine refusing to remain in a fluid state when separated from the action of life. If this fibrine be removed, as previously described, the blood will remain fluid. Under the microscope it appears not as a fluid of uniform colour, but as consisting of *serum,* a yellowish transparent liquid, in which float red

Blood corpuscles.—These the fibrine as it coagulates gathers together mechanically, and thus the blood is separated into its two parts. These corpuscles owe their colour to *hæmatine,* which contains no less than 6·6 per cent. of iron. This may be removed without materially affecting the colour.

The corpuscles are flattened discs, the shape of which varies in different animals.

The blood which flows back to the heart by the veins owes its dark colour to the presence of carbonic acid gas; whilst the bright red of the arterial blood is due to the free oxygen which it contains. The supposed process of respiration was alluded to in the lesson on carbonic acid.

The normal constitution of the blood is albumen, fibrine, hæmatine, globuline; oleic, stearic, lactic, phosphoric, sulphuric, and hydrochloric acids combined with sodium, potassium, ammonium, calcium, and magnesium; small portions of cholesterine and phosphorised fat.

Chyle.—The intestines are lined with a set of vessels, termed *lacteals;* these absorb from the digested food this incipient blood, which is a milky fluid, and empty it into the *thoracic duct,* from which it enters into the general circulation.

Its composition, determined from the few specimens which have been obtained, is similar to that of blood, and some few of the red corpuscles are found in the thoracic duct. The true nature of chyle and blood is not well understood; it may yet be found that the red corpuscles are animal organisms.

LESSONS IN LATIN.—XL.

DEVIATIONS IN THE THIRD CONJUGATION (*continued*).

4. *Perfect in* -IVI; *Supine in* -ITUM.

THESE verbs in the perfect and supine really follow the fourth conjugation, and so form a kind of hybrid conjugation, a compound of the third and the fourth.

i. Cupio, cupĕre, cupivi, cupitum, *to desire.*

ii. Pĕto, petĕre, petivi, petitum, *to strive after, aim at;* ab aliquo, *to ask from, entreat.*

iii. Quæro, quærere, quæsivi, quæsitum, *to seek.* The compounds are in quīro, quisīvi, quisītum; as, exquīro, *to search out.*

iv. Rudo, rudĕre, rudivi and rudi, ruditum, *to roar.*

v. Tero, terĕre, trivi, tritum (E. R. *trite*), *to rub.*

vi. Arcesso, arcessĕre, arcessivi, arcessītum, *to send for.*

vii. Capesso, capessĕre, capessivi, capessītum, *to take in hand.*

viii. Facesso, facessĕre, facessivi, facessitum, *to make, take yourself off;* negotium facessere, *to give trouble.*

ix. Incesso, incessĕre, incessivi (no supine), *to fall upon.*

x. Lacesso, lacessĕre, lacessivi, lacessītum, *to challenge.*

VOCABULARY.

Adipiscor, adipisci, adeptus sum, dep., *to obtain.*
Aratrum, -i, n., *a plough.*
Atterĕre, *to rub at,* or *wear down.*
Caveo, cavi, cautum, *to take care, avoid.*
Cupide, *eagerly.*
Expeto, -ivi, -itum, *to desire, demand.*
Externus,-a,-um, *foreign, of another country.*
Fastidio, 4 (with acc.), *to disdain.*
Lepor, or lepos, -ōris, m., *joke, wit.* [Mark the difference between this word and lepus, lepŏris, *a hare.*]
Par, paris, n., *a pair.*
Propĕre, *hastily.*
Religiose, *religiously.*
Repetĕre, *to seek back, repeat, borrow.*
Suscipio, -ĕre, -cepi, -ceptum, *to undertake, begin.*

Exercise 151.—Latin-English.

1. Sæpe homines, res quas vehementer cupiverunt, adepti fastidiunt. 2. Audistine ut leones rudiverint? 3. Bellum ita suscipiatur ut nihil aliud nisi pax quæsita videatur. 4. Quum omnem antiquitatem memoriâ repetivĕris, tria vix amicorum paria invenies, qui alter pro altero vitam deponere parati erant. 5. Cave ne judices de re priusquam eam accurate exquisivĕris. 6. Erechthei filiæ cupĭde mortem expetiverunt pro vitâ civium. 7. Omnis Romanorum philosophia repetita est a Græcis. 8. Legĭmus Romanos sæpe consŭles suos ab aratro arcessivisse. 9. Multa sacra, ab exteris nationibus adscita atque arcessīta, Romani religiosissime coluerunt.

Exercise 152.—English-Latin.

1. Who does not know that Hannibal once wore down the resources of the Romans? 2. Never do good men desire bad things. 3. I shall never disdain what I shall obtain. 4. Dost thou think that, having obtained money, thou wilt not disdain it? 5. Neither despise nor disdain any one. 6. Call thy generals from the plough. 7. Do not give trouble to that good man. 8. Bad pupils give trouble to the best teachers. 9. In war we seek for peace. 10. Peace is sought for by us in war. 11. My children eagerly desired death for my life. 12. It is certain that our citizens will fall on the enemy.

5. *Perfect in* -I; *Supine in* -TUM.

a. The stem ends in *b* or *p*.

i. Capio, capĕre, capi, captum, *to take*. Compounds in cipĕre, cipio, cepi, ceptum; as, percipio, *to take up wholly*.

ii. Rumpo (rupo), rumpĕre, rupi, ruptum, *to break*. Scabo, scabere, scabi (E. R. *scab*), *to scratch*, wants the supine.

b. The stem ends in *c*, *g*, *qu*.

iii. Ago, agere, egi, actum, *to lead, drive, do, handle*, etc.; so, circumagere, *to drive round;* peragere, *to drive through*. The other compounds have ĭgo, ĕgere, egi, actum; as, abĭgo, *to drive away;* exigo (used of time), *to spend;* subigo, *to subdue;* cogĕre, *to bring together, compel* (cum and agere), has coēgi, coactum.

iv. Facio, facĕre, feci, factum, *to make, do*. Fio is used as the passive of facio. *A* in facio, passes into *i* in efficio (ef and facio), etc. In the imperative, facio makes fac; but perficio (*to complete*) has perfice; the other compounds retain fac; calefаce (from calefacĕre, *to warm*), however, occurs.

v. Ico, icĕre, ici (not very good), ictum, *to strike*, used of a treaty. Of the present, we find only icit; the other forms are supplied by ferire, *to strike*.

vi. Jacio, jacĕre, jeci, jactum, *to cast, throw*. Compounds, jĭcio, jēci, jectum, jĭcĕre; as, rejicio, *I throw back*.

vii. Lego, legĕre, legi, lectum, *to read;* so allĕgo, *I choose for myself;* perlĕgo, *I read through;* prelĕgo, *I read before;* relĕgo, *I read again;* sublego, *I read under*. The following, however, have, in the present, lĭgo; as, collĭgo, *I collect* (collĭgere, collēgi, collectum); delĭgo and elĭgo, *I choose out;* recollĭgo, *I collect again;* seligo, *I select;* but dilĭgo, *I love or esteem;* intelligo, *I understand;* and negligo, *I neglect*, have, in the perfect, exi; as, dilĭgo, diligĕre, dilexi, dilectum.

viii. Frango, frangĕre, fregi, fractum, *to break*. Compounds, fringo, fringere, fregi, fractum; as, perfringo, *I break through*.

ix. Linquo, linquĕre, liqui, lictum, *to leave*.

x. Vinco, vincĕre, vici, victum, *to conquer*.

c. The stem ends in *m*.

xi. Emo, emĕre, emi, emptum, *to buy*. Compounds in ĭmo, imĕre; as, exĭmo, exēmi, exemptum, eximĕre, *to buy off;* but in coemo, *to buy at once*, the *e* remains.

d. The stem ends in *u* or *v*.

xii. Acuo, acuĕre, acui, acutum, *to sharpen*. The compounds are without the supine.

xiii. Arguo, arguĕre, argui, argutum (part. fut. active arguiturus), *to convict*. Instead of argutum and argutus, convictum and convictus are used. Argutus, in good Latin, occurs only as an adjective.

xiv. Exuo, exuĕre, exui, exutum, *to go out, put off*.

xv. Induo, induĕre, indui, indutum, *to go in, put on*.

xvi. Imbuo, imbuĕre, imbui, imbutum, *to dip into, fill with*.

xvii. Luo, luĕre, lui (no supine, the part. luiturus), *to wash*.

xviii. Minuo, minuĕre, minui, minutum, *to lessen*.

xix. Nuo, nuĕre, nui, *to wink, nod;* found only in the compounds; no supine, yet abnuiturus.

xx. Ruo, ruĕre, rui, rutum, *to rush, fall* (ruĭturus).

xxi. Spuo, spuere, spui, sputum, *to spit*.

xxii. Statuo, statuĕre, statui, statutum, *to make fast, appoint*. Compounds, stituo, etc.; as, destituo, *to abandon*.

xxiii. Suo, suĕre, sui, sutum, *to sew*.

xxiv. Tribuo, tribuĕre, tribui, tributum, *to impart, to assign*.

xxv. Solvo, solvĕre, solvi, solutum, *to loosen*.

xxvi. Volvo, volvĕre, volvi, volutum, *to roll;* congruere, *to agree;* metuĕre, *to fear;* pluere, *to rain;* sternuere, *to sneeze*, want the supine. The ensuing two have *the perfect in i*, and *the supine in itum:*—Fugio, fugĕre, fugi, fugitum, *to fly;* lambo, lambĕre, lambi, lambĭtum, *to lick*.

Vocabulary.

Affecti simus, *let us feel*. (The subjunctive of the first person plural here, as often is used as the imperative.)
Afficĕre, *to make, to affect*
Benefactum, -i, n., *a good deed, benefit*.
Delinquere, *to do wrong*.
Disjicere, *to cast asunder, split*.
Dominatio, -ōnis, f., *lordship, tyranny*.
Excerpere, *to take out*.
Existimatio, -ōnis, *esteem*.
Fœdus, fœdĕris, n., *a treaty*.
Furiosus, -a, -um, *mad*.
Modo, *only now, but now*.
Potestas, -ātis, f., *power*.
Transigere, *to bring over*.

Exercise 153.—Latin-English.

1. Eodem modo erga amicos affecti simus, quo erga nosmet ipsos. 2. Acti labores jucundi sunt. 3. Sola virtus in suâ potestate est; omnia præter eam subjecta sunt fortunæ dominationi. 4. Unus dies, bene et ex præceptis philosophiæ actus, peccanti immortalitati anteponendus est. 5. Conscientia bene actæ vitæ multorumque benefactorum recordatio jucundissima est. 6. Victus est Xerxes magis consilio Themistŏclis, quam armis Græciæ. 7. Hostes, fœdere quod modo icĕrant rupto, subito in castra nostra irruperunt. 8. Plinius nullum librum legit quem non excerperet. 9. Cives ab hostibus subacti, omni libertatis recuperandæ spe ademptā, miseram transegerunt vitam. 10. Milites hostium aciem perfregerunt et disjecerunt. 11. Fœdera icta ab hostibus fracta sunt.

Exercise 154.—English-Latin.

1. Your troops will break the treaty they have formed. 2. Will the enemy break through our line? 3. Never can the enemy scatter our forces. 4. Wicked men pass their life in misery. 5. Dost thou think that wicked men pass their life in misery? 6. The king has taken away all hope of regaining peace. 7. Make extracts from (*excerpere*) that book (acc.). 8. Our soldiers, taking up their arms (abl. abs.), will make an attack upon the enemy. 9. I wish to be affected in the same way towards the old as towards the young. 10. Religion alone is in its own power. 11. Whatever it pleases (*placet sibi*) it can do, God being its helper.

Fabula.—Capra et Lupus.

Lupus capram in altâ rupe stantem conspicatus, "Cur non," inquit, "relinquis nuda illa et sterilia loca, et huc descendis in herbidos campos, qui tibi lætum pabulum offerunt?" Cui respondit capra: "Mihi non est in animo, dulcia tutis præponere."

Fabula.—Canis et Boves.

Canis jacebat in præsepi bovesque latrando a pabulo arcebat. Cui unus boum, "Quanta ista," inquit, "invidia est, quod non patĕris ut eo cibo vescamur, quem tu ipse capere nec velis nec possis!"—Hæc fabula invidiæ indŏlem declārat.

Vocabulary.

Capra, -æ, f., *a she-goat*.
Herbidus, -a, -um (herba), *grassy*.
Indŏles, -is, f., *character*.
Latro, 1, *I bark*.
Præsepe, -is, n., *a manger*
Vescor, vesci, 3 dep., *I feed on, eat* (with abl.).

KEY TO EXERCISES IN LESSONS IN LATIN.—XXXIX.

Exercise 147.—Latin-English.

1. In all matters, before you approach them, deliberation is necessary; but when you have deliberated, approach the thing itself speedily. 2. Socrates, on the last day of his life, discoursed many things concerning immortality. 3. The fight having begun (literally, *hands having been joined*), our soldiers excelled in bravery. 4. The mind sets in motion that body over which it has been placed. 5. Zeno placed a happy life in virtue alone. 6. Nature has produced in man a desire to arrive at truth. 7. A love of themselves has been produced by nature in all animals. 8. Alexander, the conqueror of so many kings and peoples, became a slave to anger. 9. I hope that you will always apply yourself to letters with the greatest zeal. 10. Men endowed with the greatest intellects, regarded the sanctity of tombs; (there) clung to their minds (an idea) that death is not annihilation, blotting out all things, but, as it were, a certain migration of life.

Exercise 148.—English-Latin.

1. Consulistine patrem? 2. Consule tuis liberis. 3. Ubi bene consuluerint rem aggrediantur. 4. Milites manus conserebant. 5. Quis militum in prœlio excelluit? 6. Deus animum corpori præposuit. 7.

A sapientibus vita in unâ virtute posita est. 8. Felicitatem pono in Dei amore. 9. Estne tibi cupiditas verum inveniendi? 10. Natura animis talem cupiditatem ingenuit omnibus. 11. Et divitibus et pauperibus amor sui ingenitus est. 12. Fratres tui iræ succubuerunt, et, consertis manibus, pugnaverunt. 13. Pater meus progredietur urbem obsessurus. 14. Copiæ progressi sunt domosque diripiunt.

APPLICATIONS OF "COLO."

1. The steward has been appointed for the sake of tilling the land. Not all fields which are tilled are fruit-bearing.

2. Inhabit the city, O my Rufus, and live in that light (*distinguished place*).

3. Thou, Jupiter, who carest for and nourishest the race of men. Let it be your object to take care of your breast by noble means.

4. He cultivated the study of philosophy from early youth.

5. Now clearly I am able to pursue neither that diet nor that way of life.

6. I love you, because you regard me. By whom we seem to be carefully regarded and esteemed.

7. What is it you say why the gods should be worshipped by men, when the gods not only do not look upon men, but, indeed, care nothing about them? We ought both to adore and worship these gods.

EXERCISE 149.—LATIN-ENGLISH.

1. Regard for our body is implanted in us. 2. Where there is no sowing, there is no reaping. 3. Everything which was gross and corporeal, God made subject to the mind. 4. You have put down the reproaches and hatred of ill-disposed persons by your way of living. 5. The governor, Probus, planted the Golden mountain, near Mœsia, with vines. 6. The battle having begun, all places far and wide were strewn with weapons, armour, and dead bodies. 7. The consciousness of despised virtue torments the wicked man. 8. Tell me why you have despised my counsel. 9. Listen, boy, your mother asks you why you have forgotten to eat the buttered bread. 10. Loveliness (*venustas*) and beauty of person are not separated from health. 11. Cato addressed the people.

EXERCISE 150.—ENGLISH-LATIN.

1. Insitus est pectore liberorum nostrorum amor. 2. Meum consilium spreverunt. 3. Consilium meum ab illis spretum est. 4. Spernam nullius consilium. 5. Mi puer, butyro obline panem. 6. Se oblinent malis moribus. 7. Boni a malis secernendi sunt. 8. Pueros secrevi a puellis. 9. Cicero concionabitur. 10. Victoriâ regnante, Britanniæ potentia mirum in modum crevit. 11. Amicitia nostrâ cum ætate crescet.

RECREATIVE SCIENCE.—II.

ARTIFICIAL ILLUMINATION.

THE imitative faculty of man has, no doubt, prompted many notable discoveries which might probably never have been conceived if Nature had not first suggested the primary idea. The great lamp, the sun, burning and shining continually in the heavens during the day would, by its very absence at night, even to the most ignorant of savages, suggest the thought of making a substitute, an imitation—in short, an artificial fire or illumination.

Thus the primary idea realised by a rude fire of wood would be gradually worked out, the commencement being made with a pine torch, and the light-giving agent elaborated, until the construction of the most elegant and perfect lamp was attained.

The ancients, according to Fortunio Liceti, do not appear to have been satisfied with a mere lamp. Their ambition appears to have led them to suppose that the sun could be more closely imitated, and that lamps might be made *perpetual*. Liceti contended vigorously for the possibility of constructing a "perpetual lamp," and he quotes in support of his arguments the famous lamp of Olybius, said to have been discovered in the year 1500 at Atesta, near Padua. Some peasants digging the earth to a considerable depth, came to a tomb, in which they found two earthen urns, one within the other. The inner vessel is said to have contained a burning lamp, placed between two phials, one filled with *liquid* gold, and the other with *liquid* silver. But, unfortunately, the rustics who found this inestimable treasure were not sufficiently careful, and so the lamp was broken and extinguished. Liceti seems to have confounded the myth of a perpetual lamp with the fact that lamps were kept burning night and day in certain temples. There was the lamp of Demosthenes in the temple of Minerva at Athens, and the vestal fires at Rome, which were not self-supporting, but were religiously watched by the vestal virgins, and supplied with continual aliment.

The ordinary materials which furnish artificial light during the act of combustion are oils, wax, tallow, spermaceti, paraffin, rock oil, and gas from coal, rosin, wood, or other suitable organic matter. The extraordinary light-giving agents are oxygen and hydrogen gases, burning and directed on to a ball of lime; the combustion of the metal magnesium in air, or of phosphorus in oxygen gas; the voltaic battery, in which zinc is consumed and incandescence is produced by the current of electricity; the magneto-electric machine, worked by steam power, and therefore consuming coal instead of zinc, to produce the electric light.

The predominating elements in the ordinary light-giving substances are carbon and hydrogen, and when any of them are subjected to destructive distillation, these elements unite and form two important compounds, the one called olefiant gas, and the other light carburetted hydrogen; and if coal is used, a number of other compounds are also produced. The distillation of coal is easily conducted on a small scale by placing some roughly-powdered coal in an old pistol barrel, and having plugged the touch-hole, and fitted a piece of pewter pipe with some plaster of Paris to the muzzle of the barrel, the latter may be thrust between the bars of an open grate in which a brisk fire is burning. In the first instance, moisture only distils over; at a dull red-heat more water, a thick smoke, and but little or no gas; and it is only when a full cherry red-heat is attained—viz., a temperature of 1500°—that gas of high illuminating power is evolved. The crude gas being very impure, and containing many things useless for illuminating agents, is subjected at the gas-works to purification, and even then does not consist only of compounds of carbon and hydrogen, but of hydrogen and other gaseous bodies. Dr. Letheby states, that coal gas may contain from 25 to 50 per cent. of hydrogen gas, 35 to 52 per cent. of light carburetted hydrogen and from 3 to 20 per cent. of olefiant gas, and other hydro-carbons mixed with gases, such as carbonic oxide, carbonic acid, cyanogen, ammonia, oxygen, nitrogen, some aqueous vapour, and sulphur compounds.

The only gases required out of this complex mixture are the compounds of carbon and hydrogen; and hence tallow, oils, wax, paraffine, turpentine, etc., used in candles and lamps, which are miniature gas-works, yield a gas purer than the heterogeneous one derived from the distillation of coal. That a burning candle is a gas-maker is shown by blowing out a lighted composite candle; a column of smoky gas ascends from the wick, which may be set on fire by holding a burning match at the top of the column, when the flame runs down in a very curious manner to the hot wick, and the candle is re-lighted. In a candle the retort is the wick, and this when first lighted burns down until the heat reaches that part which is saturated with the tallow, composite, or wax: at this point destructive distillation commences; the heat from the increased combustion now melts more of the solid material; and this, being drawn up into the wick by capillary attraction, is decomposed in its turn, and furnishes fresh gas for combustion. In the above case the gas is generated and burnt directly it is produced. With coal gas the generating process is over, and the gas only is burnt. Capillary attraction (from *capillus*, a hair), in allusion to the nature of some of the bodies having this property, is an illustration of the adhesion between solids and liquids. If a slice of salt is cut out of the solid block, and placed upright in a plate containing a little ink, the latter soon runs up the white salt, and first attacking it by capillary attraction, the liquid is introduced into the pores, the salt partly dissolves, and the remainder crumbles down into the plate.

A bit of cane, cut free from joints, and about six inches long, placed upright in a bottle containing some turpentine, soon draws up with its hair-like tubes the combustible fluid, and this may be set on fire at the top of the cane, which acts, of course, like the wick of a candle. The experiment is hastened by sucking up the fluid with the mouth, or by reversing the cane after one end has been immersed in the turpentine for some minutes.

On examining the flame of a candle, it is found to consist of three distinct portions. That nearest the wick is almost black, the next is very bright and luminous, and the third emits so feeble a light that it is hardly visible. A picture of the flame of a candle is easily sketched on a wall or on a white sheet of paper, by placing it between the wall and a lens condensing a sunbeam passed through a hole in the shutter of a darkened room. The shadow of the flame may be seen distinctly, and the darkest part is actually the brightest, whilst the more distinct portion of the shadow is that of the outer part emitting the very feeble light. The movement of the air past the flame is also well shown. The ascending current drags the flame out to a pointed figure, and, whilst rushing past the candle, keeps the outside of the cup containing the melted wax or tallow cool. The air that rushes by so quickly burns up the carbon and hydrogen of the outer part of the flame, but does not affect so materially the next structure, where the hydrogen is chiefly burnt and the carbon deposited. Here the flame is the brightest, because of the ignition of the precipitated carbon, and hence the reason that the shadow of this portion should appear so dark. In the inner layer the unburned gas is found waiting its turn to pass to the exterior, to go through the phases of partial combustion and precipitation of the carbon, ending with complete combustion at the exterior.

That the interior of a candle flame does consist of unburnt gas may be shown by placing a narrow glass tube in the inner cone of the flame. The tube must be inclined, and if nicely managed the hot gas passing upwards may be inflamed at the top. The same fact is shown by holding a slip of card across the flame. The interior of the cone does not scorch the card, which is blacked at the two points or opposite sides of the centre.

The tube may be adjusted so as to draw away the finely-divided carbon deposited in the luminous portion of the flame, and if this is conducted into a separate small hydrogen flame, the latter becomes luminous in consequence of the incandescence of the carbon derived from the candle. A hydrogen flame affords little or no light, but if a small bit of tow, saturated with benzole or ether, is placed in the bottle containing the materials for generating hydrogen, and the tube or jet fitted into the neck of the bottle, on lighting the hydrogen it is now very luminous, in consequence of the carbon, the solid matter derived from the benzole or ether, being precipitated, ignited, and burnt. To distinguish the bright from the almost unluminous part of the flame, the latter is sometimes called the *mantle*, because it is the outermost cone.

The best method of showing the structure of flame is to place some ether in a tin dish three inches in diameter and half an inch high. On setting fire to the ether a very large flame is produced, and into its centre may be introduced a cup containing phosphorus, which only sublimes, bnt does not burn. By very careful manipulation, and when the air is still and not disturbed by open doors or windows, gunpowder may be dropped down a tube held across the hot stratum, and will fall unburnt into a porcelain or other cup, placed in the centre of the flame. A very few grains of powder should be used nntil the operator has sufficient confidence to perform the experiment steadily. The structure of flame being understood, it is easy to see how the illuminating power of an ordinary flame may be increased by admitting the right proportion of air to the interior. The argand burner furnishes the best illustration of this well-known principle: if the central tube is corked and the chimney removed, the flame is smoky and nnsteady; on replacing the chimney, the current of air rushes with increased velocity past the exterior, and more light is obtained; but the maximum of light is only procured when the cork is removed, and air allowed to pass to the interior as well as the exterior of the flame.

When the supply of air is too great, the luminosity of the argand burner is seriously affected, especially if the gas is not rich in hydro-carbons, because the carbon is burnt up at once, and no time is allowed for its precipitation; hence it is now usual to adjust the central or internal tube of the argand burner to the quality of the gas. The diameter of the internal aperture should be less than half an inch—viz., 0·42 of an inch for eleven-candle gas, and half an inch for fifteen-candle gas, if used with a glass chimney seven inches long, and burning at the rate of five feet an hour.

If coal-gas is mixed with a considerable qnantity of air before it is burnt, as in a smokeless burner, or the gauze-burner, the flame is no longer brilliant, because the carbon is burnt with the hydrogen.

When the combustible oil, such as turpentine or camphine, contains a very large proportion of carbon, the chimneys are increased in length, and have a peculiar construction, becanse more air must be supplied to burn the excess of carbon, and to prevent the flame smoking.

The Bude light consists of a small argand lamp, burning colza oil; and instead of supplying air to the interior tube, a jet, conveying oxygen gas from a bladder or small india-rubber bag, is attached; the smoky flame immediately burns most brilliantly, and if the wick is very thick and the oil good, it will afford a considerable amount of light.

It is a curious fact that when the pressure of the air is reduced the luminosity of a burning candle is materially affected. Messrs. Tyndall and Frankland burnt some candles on the summit of Mont Blanc, and although just as much stearine was consumed at that altitude in a given time as at Chamouni, the aspect of the flames was completely altered. They seemed, to use their language, to be the mere ghosts of the flames "which the same candles were competent to produce—pale, feeble, and suggesting a greatly diminished energy of combustion."

The cause of the diminution of the light is not due to any reduction of the rate of burning, but to a more perfect diffusive effect; the oxygen of the air penetrates the flame more perfectly, and the matter of the flame passes more rapidly into the air; and thus, by the mutual interpenetration of the one into the other, the carbon is more rapidly burnt out. Dr. Frankland also discovered the interesting fact, that by compressing the air round the flame of alcohol, which burns with a smokeless flame, it became as bright as coal gas, and at a higher pressure could even be made to smoke. The intensity of any given flame is reduced 5 per cent. for every fall of one inch in the barometer, or increased in the same proportion with each rise of one inch. Dr. Frankland has also shown that the comparative cost of light equal to that obtained from twenty sperm candles, each burning ten hours at the rate of 120 grains per hour, would be as follows:—Wax, 7s. 2½d.; spermaceti, 6s. 8d.; tallow, 2s. 8d.; sperm oil, 1s. 10d.; coal gas, 4¼d.; cannel gas, 3d.; paraffin candles, 3s. 10d.; paraffin oil, 6d.; rock oil, 7¾d. Consequently paraffin and rock oils are the best sources of light for domestic purposes. They are the cheapest, give the greatest amount of light, and, what is of still greater importance, they do this with the least development of heat.

The extraordinary light-giving agents, with the exception of the combustion of magnesium in air or of phosphorus in oxygen, require more elaborate apparatus than the beginner in science is likely to be able to afford. The oxy-calcium light is one of the most simple, and is obtained by forcing a jet of oxygen through the flame of a spirit-lamp, and directing the resulting fire on to a ball of lime. This light will do very nicely for the exhibition of photographs on a small screen in a moderate-sized apartment.

If a more brilliant light is required, the lime or oxy-hydrogen light may be used. It is, of course, easy to place two volumes of hydrogen and one of oxygen in a large bladder furnished with a stop-cock, and then to burn the mixed gases from a Hemming's jet. This is undoubtedly the cheapest, but not the safest method, especially if the bladder is squeezed by the hands. A steady pressure is absolutely necessary, and this can only be obtained by nsing pressure boards. Indeed, it is far better not to attempt either the oxy-calcium or the oxy-hydrogen lights without proper caoutchouc bags, pressure boards, and jets, all of which may now be obtained at a very moderate price of the instrument-makers. The cost of an accident to person or property by the explosion of a large bladder full of the mixed gases in a dwelling-room is very likely to be greater than the purchase of the proper appliances.

Althongh the electric light is the most brilliant artificial light that can be procured, it is only thoroughly effective on a large scale. A voltaic battery on Grove's principle, of forty cells and a good electric lamp, will give excellent results, whilst a smaller arrangement is continually flickering, and the constant movement of the charcoal points becomes tiresome, and fatigues the eyes of those who may be invited to see the experiments. Here, again, a good apparatus is the cheapest in the end.

The magneto-electric machine will also give a continuous and brilliant electric light, but as the armature must revolve many hundred times in a minute, and can only be worked effectively with the aid of a steam-engine, such a light is a luxury to be used only by a rich body such as the Trinity House brethren, who have employed Professor Holmes' magneto-electric light for many years at the North Foreland lighthouse.

The lighted candle in the cottage window has guided many a weary husband over fell and moor to his home; but this magneto-electric light is so large in amount that, with proper optical arrangements, such as Fresnel's lamp, it will flash its friendly rays twenty-five miles across the ocean, and almost rival

"Those cold candles fix'd in heaven's air."

ELECTRICITY.—III.

CYLINDER ELECTRICAL MACHINE—PLATE MACHINE—ARMSTRONG'S HYDRO-ELECTRIC MACHINE.

It is now time for us to pass on to consider the mode in which we can obtain electricity in large quantities. This is done by means of an electrical machine, which consists essentially of three parts: firstly, the substance to be rubbed, usually a cylinder or sheet of glass; secondly, the rubber; and, lastly, the conductor or reservoir to hold the electricity.

Originally a globe of sulphur was employed as the substance to be rubbed, but it was soon discovered that a globe of glass would answer better, and this was accordingly substituted. At present, however, a cylinder is usually employed (Fig. 6). These are made specially for the purpose, and can be obtained for a moderate amount at glass-works, or at philosophical instrument makers'. In shape they resemble a square-shouldered bottle with a neck at each end. Caps are turned out of some hard wood to receive these, and should be so shaped that their ends may serve as bearings for the cylinder. The winch is fixed to the squared end of one of the caps.

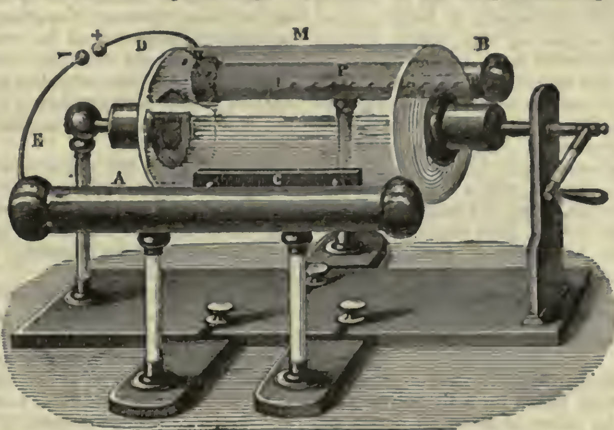

Fig. 6.

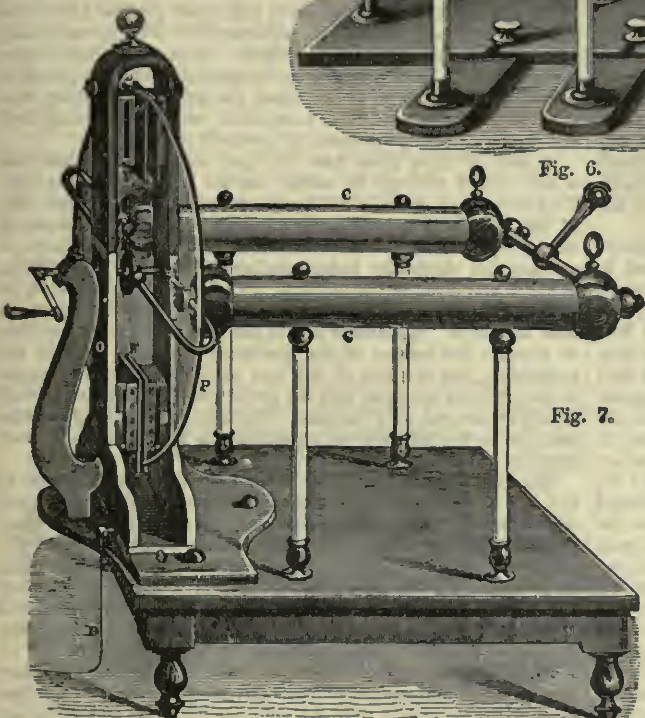

Fig. 7.

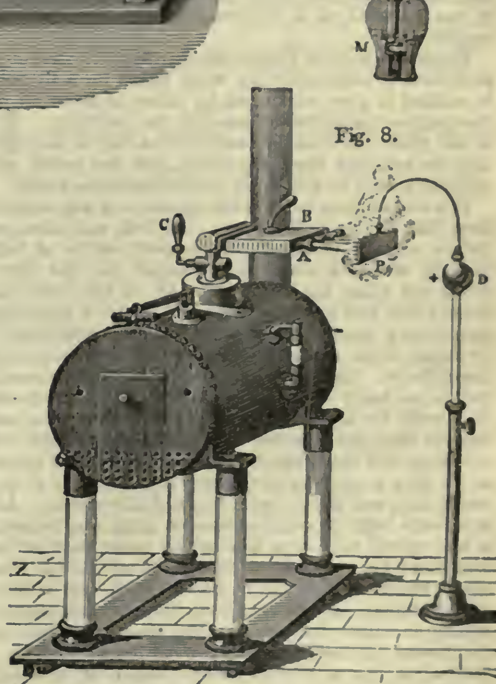

Fig. 8.

At one side of the cylinder is placed the rubber, C, which consists of a cushion of wash-leather stuffed with horse-hair or tow, and a piece of black silk (not represented in the figure) passes from the under side of this over the cylinder nearly to the points on the other side. A conductor, A, is sometimes fixed behind the rubber, and serves to collect the negative electricity. On the other side of the cylinder is the prime conductor, B, with a row of points along one side to receive the electricity. Holes are bored at different parts of this, in order that brass balls and rods or other pieces of apparatus may be inserted when required.

On turning the cylinder, if the machine has been carefully warmed and dried, and a little amalgam spread upon the rubber, vivid sparks, several inches in length, will pass from the conductor to the knuckle or any other body held to it; or if bent wires with balls at the end be inserted in the two conductors, as shown at D and E, a series of sparks will pass between them. It is necessary, if positive electricity is to be used, that the rubber should be connected with the ground, and this is usually done by means of a chain or a piece of wire. In the same way, if negative electricity is required, the conductor must be uninsulated.

As we hope that a great many of our readers will set to work and make one of these machines for themselves, we will give rather fuller instructions as to the mode of proceeding. Be assured of one thing at starting, and that is that you can easily succeed if you only persevere, and are not disheartened by apparent failure at first.

We should recommend you to procure a proper cylinder if possible; one nine or ten inches long by six or seven inches in diameter is a very good size, and should not cost more than about five shillings; considerable power may even be obtained from a smaller one. Failing this, a large round bottle will answer, but not so well, nor is it nearly so convenient. Some people recommend, when a bottle is used, that a hole should be punched through the bottom, but there is considerable difficulty and risk in doing this. The better plan is to procure a disc of wood a little larger than the bottom of the bottle, and fix it on by means of electrical cement. This cement is used for many purposes, and may be easily made. It consists of resin, plaster of Paris, bees'-wax, oil, and red lead. The resin is first melted in an earthen pipkin, a small lump of bees'-wax and a little oil being added to render it more tough. When fully melted, the plaster is stirred well in, together with some red lead, to impart a better colour to it. The bottle and disc of wood should then be well warmed, and the cement poured upon the former, and if the disc be kept from slipping until it gets cold, the cement will hold firmly. The larger the proportion of plaster used the harder will be the cement. The winch is put on an axle affixed to this disc, and a plug of wood inserted in the mouth of the bottle serves for a bearing at the other end.

When a cylinder is used, caps should be turned of mahogany, or some hard wood, so as to fit loosely on the ends of the cylinder; these are then fixed on by the cement above referred to, and great care must be taken to ensure the cylinder being mounted so as to run perfectly true. If the frame-work of the machine be made first, it can be put in before the cement is fully set, and carefully watched while it is being turned round; it must not, however, be left in its bearings to set. As the machine is usually warmed before use, an aperture must be left for the escape of the air; a hole is therefore drilled through the cap at the end away from the winch, and, while the cement is being poured into the cap, this is filled by a greased wire, which may be removed as soon as the cement becomes hard.

A better plan of mounting the cylinder has, however, lately been tried. The inside is first rendered perfectly clean, and then thoroughly dried by exhausting the air, and allowing a fresh supply to enter through a drying tube. When it is thus prepared, the caps are put on so as hermetically to seal it. The surface of the cylinder is rubbed before use with a rag wetted with turpentine, so as to remove all grease, lumps of amalgam, etc., and it is then polished with prepared chalk. This imparts a greatly increased power to the machine, for sparks of a much greater length can be in this way obtained, and there is little need of warming the cylinder before use. Another advantage is that the damp does not condense so readily upon it, and thus it can be used at a lecture-table or in a room filled with people.

The frame-work of the machine can easily be made. It should be formed of thoroughly dry wood, baked for a little time; and in making it, great care must be taken to avoid all points and sharp edges which draw off much of the electricity. The support at the winch end should be made with a cap, so that the cylinder may be removed when necessary, and the under side of the cylinder should be five or six inches above the board.

It is simpler, too, to make the rubber in a way rather different from that shown in the figure. As it is not often required to obtain negative electricity, the support may be of baked wood, and the whole should then be shaped like the letter T, the lower end being hinged to the edge of the board, and a hole made about two inches up, through which a thumb-screw may pass into a wooden block placed a little way from it, so that by means of the screw the rubber may be pressed firmly against the cylinder. Care should be taken in the construction of the rubber, as much of the power of the machine depends upon it. It should be about one and a-half inches wide, and rather shorter than the cylinder. Wash-leather answers well for its covering, and the horse-hair or tow in it should be so arranged as to give a uniform pressure. The silk flap is fixed to the under side, and passes up in front of the rubber. At the back is a small hook, to which a piece of chain may be attached, and a wire should come from this to the under part of the rubber, and there be connected with a piece of tin-foil running the whole length of it. This is often omitted, but as the materials of the rubber are not good conductors, this simple addition greatly increases the power. The chain from the hook should be allowed to touch the gronnd, or, better still, be connected with a gas pipe, as thus a plentiful supply of electricity will be obtained from the earth, which is the great reservoir of it. The conductor of the machine may be made as shown in Fig. 6, but is rather more convenient, if mounted on a separate stand. The points, too, instead of being placed along the side, may be fixed on a separate piece fitting into one end of the conductor. A very good fork may be made by rounding the ends of a piece of wood about the size of a small ruler, covering it with tin-foil, and inserting a row of needles along one side. The prime conductor, also, may be made of wood covered with tin-foil, and should have its end somewhat bulging, as shown in the engraving.

When the machine is wanted for use, every part should be carefully rubbed dry and clean with warm cloths. The rubber screw should be loosened, and the rubber turned back, so as to allow of the old amalgam being scraped off, and a fresh supply placed on the cushion under the silk flap. It may then be replaced and pressed firmly against the cylinder by means of the screw, or by the pressure of the hand on it.

Now turn the cylinder, and if the machine be in a darkened room, flashes of blue light, accompanied by the peculiar smell of electricity, and by a faint crackling noise, will be observed passing round the cylinder and issuing from the edge of the silk flap. Now bring the conductor so that the points of the fork may nearly touch the cylinder, the electricity will then be collected, and sparks several inches in length may be obtained by holding the knuckle or any conducting substance near it. If the rubber were insulated, similar sparks might be drawn from it, but they would be of negative electricity. The great point to be remembered in using all electrical apparatus is to have every part of it perfectly dry and free from dust.

This form of machine is by far the most common. In it, as we have seen, friction is the exciting cause; hence the power will be found to depend upon the extent of rubbing surface. With a view to increase this, two rubbers opposite to one another have sometimes been affixed to the same machine, and two conductors placed between them; this, however, adds so greatly to the complication of the machine, that the plan is nearly discarded.

If we remove the chain or wire connecting the rubber with the ground, and place one so as to make a communication between the rubber and conductor, we shall find that no spark can be obtained from either, showing that the quantities of positive and negative electricity are exactly equal, and therefore neutralise each other.

Though the cylinder machine is that most generally used, its place is sometimes taken by the plate machine (Fig. 7), especially when great size and power are required. By some this form is preferred as being more compact and ornamental, and the power is usually supposed to be about equal for an equal rubbing surface; but when the cylinder is mounted on the plan mentioned above, the advantage in point of power is on its side.

A plate of thick glass has its edges carefully smoothed and a hole drilled through its centre for the axle to pass through. This is made of brass, with flanges to press against each side of the plate and hold it firmly; but as brass is a conductor of electricity, a part of the winch is usually made of glass, to prevent the electricity being conducted away. Two rubbers, F, F, are employed in the machine, and they are made double, so as to grip the plate between them, and thus cause friction on each side of it. Quadrants of silk are also affixed to the rubber to prevent the escape of the electricity before it reaches the conductor, just as a flap of silk was used for the same purpose in the cylinder machine, and the power will be much augmented if this be covered with varnish. The main disadvantage in this machine is the difficulty of insulating the rubber so as to draw negative electricity from it.

The conductor is sometimes made in two pieces, as shown at C, C, and the further ends are then connected by a brass rod, but more frequently it is semicircular, and supported by a single glass upright. The fork should be bent round so as to collect the electricity from both sides of the plate, instead of from one only, as is frequently the case. Great care is required in warming this machine, lest the plate should become unequally heated and crack. The best plan is to lay some silk handkerchiefs over it, and let it stand a little way from the fire.

Ebonite or vulcanite is now sometimes used in place of glass for the plate, and possesses many advantages over it. A larger amount of electricity may be obtained from it, and it is not liable to crack as a glass plate is, nor does the damp condense on it so readily. Still, it is much softer, and therefore will not wear quite so long. For an ebonite plate, hareskin is one of the best materials for use in the construction of the rubber. It must be thoroughly cleansed from grease, and the amalgam used must be softer than that used with glass.

Plate machines have occasionally been constructed with two or more plates fixed parallel to one another on the same axis. A much greater increase of power is, however, obtained by the use of a very large plate. At the London Polytechnic there was one with a plate abont seven feet in diameter, and driven by a small steam-engine, from which sparks of great length and power may be obtained; and even this size has been exceeded, for some time ago there was one at the Panopticon with a ten-feet plate. Machines of this size require, of course, great care in their use, as a spark from one of them would be nearly sufficient to knock a man down, and injurious effects might possibly be produced.

Several other machines for producing electricity, or modifications of the preceding, have been tried with varying degrees of success, but scarcely any of them are enough used to call for our attention here. The only one we shall refer to is that known as Armstrong's hydro-electric machine (Fig. 8). Some years ago it was noticed that when steam was issuing rapidly from a boiler, sparks were at times given off from it. Sir William Armstrong investigated the phenomenon, and was thus led to devise the machine we are now about to explain.

The body of it consists of an ordinary steam-boiler, complete with furnace, tubes, etc. A water-gauge, to show the level of the water, is seen at the side, and a safety-valve is fitted to it above. When the steam has acquired sufficient pressure, the tap, C, is turned on, and the steam then escapes through the jets at A. These jets are formed of box-wood, as shown in section at M, so that the steam is not allowed to escape in an uninterrupted way, but is caused, by means of a bent piece of metal, to strike against the sides of the mouth-piece. The box, B, is filled with cold water, which partially condenses the steam before it issues. When the steam is allowed to issue in this way from the jets, it will be found to be highly charged with positive electricity, which may be collected by a number of points or a bundle of wires, P, supported on an insulating stand and connected with a prime conductor, D.

The boiler itself is supported on stout glass legs, and becomes very highly charged with negative electricity—so much so that sparks nearly two feet in length have been obtained from a machine of this kind.

If acid or a salt be added to the water in the boiler, all evolution of electricity will cease; if oil be added, the boiler will become positively charged, and the steam negatively.

In this machine, as in the others we have considered, the real cause of the electricity is friction. The steam becomes partially condensed, and therefore contains a number of minute globules of water. These, being carried along with the steam, strike violently against the tongue, and, by their friction against it and the sides, evolve the electricity. If perfectly dry steam be used, or if the jets allow a free passage, no electricity will be produced.

READINGS IN LATIN.—V.

LIVY.

TITUS LIVIUS, the greatest of the Roman historians, was born at Patavium, the modern Padua, about 60 B.C., and died in the year 20 A.D. From the name of his birthplace he is called *Patavinus*, and the occasional provincial expressions which some critics have affected to detect in his style have been called, from the same cause, *Patavinitas*. He is said, in his earlier years, to have published some works on rhetoric, but the recollection of these has been eclipsed by the magnificence and colossal proportions of his history of Rome from the earliest period down to his own days. Of this work comparatively a small portion has reached us. It is believed that he intended completing it in 150 books, divided into fifteen *decads* or sets of ten books each, and of these he wrote 142. All that are extant in their entirety are the first, third, and fourth decads—in other words, Books I.—X. and XX.—XL. The only other remains are abstracts of the contents of all the 142 books, with the exception of Books CXXXVI. and CXXXVII., and a few isolated fragments. Though containing occasional obscurities, the style of Livy's writing is, as a whole, remarkably pure and elegant, and his descriptions are always forcible and picturesque. As a statement of facts his account of the early period of Roman history is not to be depended upon, though for a long time it was accepted as true; and it was reserved for Niebuhr, one of the greatest of German scholars, to show that Livy had, in the absence of more reliable authorities, merely taken for granted and repeated the stories of the old annalists, which were in point of fact little better than fabulous, without taking the trouble to examine them critically; but as the work proceeds it increases in historical value. Niebuhr says of him, "Few authors have exercised an influence like that of Livy; he forms an era in Roman literature; and after him, no attempt was made to write Roman annals. His reputation was extraordinary. It is well known that one man came from Cadiz to Rome merely to see Livy; and this reputation was not ephemeral; it lasted and became firmly established. Livy was regarded as *the* historian, and Roman history was learned and studied from him alone. He threw all his predecessors into the shade, and nearly all subsequent historians confined themselves to abridging his work."

According to the early legends, the original inhabitants of Rome were almost entirely men, and being mostly criminals and runaway slaves, they found it impossible to obtain any of the women of the neighbouring states in marriage. In this difficulty, Romulus, the king and founder of the city, had recourse to an artifice. He invited the Sabines to a festival at Rome, and they came without suspicion, bringing their wives and daughters; but in the midst of the festivities the Romans rushed on them with drawn swords, and carried off a great number of the women (the rape of the Sabines). War ensued, and a battle was fought which seemed likely to have ended in the total destruction of the Sabine army. At this crisis our first extract comes in:—

LIVY, I. 13.

Tum Sabinæ mulieres, quarum ex injuria[1] bellum ortum erat, crinibus passis, scissaque veste, victo[2] malis muliebri pavore, ausæ se inter tela volantia inferre, ex transverso impetu facto[3] dirimere infestas acies, dirimere iras, hinc patres, hinc viros[4] orantes, ne sanguine se[5] nefando soceri generique respergerent, ne parricidio macularent partus suos, nepotum illi, hi liberum[6] progeniem. "Si affinitatis[7] inter vos, si connubii piget, in nos vertite iras: nos causa belli, nos vulnerum ac cædium viris ac parentibus sumus, melius[8] peribimus quam sine alteris vestrum viduæ aut orbæ vivemus." Movet res quum multitudinem, tum[9] duces; silentium et repentina fit quies: inde ad fœdus faciendum duces prodeunt, nec pacem modo sed civitatem unam ex duabus faciunt, regnum consociant, imperium omne conferunt Romam.[10] Ita geminata urbe ut Sabinis tamen aliquid daretur, Quirites a Curibus appellati.

NOTES.

1. Quarum ex injuria. The genitive of the object: *from the injury done to whom.*
2. Victo, abl. absolute, agreeing with pavore: *the fear natural to their sex being overcome by the horrors of the scene.*
3. Impetu facto, *rushing across*, between the combatants.
4. Patres—viros, their fathers, who were Sabines; their husbands, the Romans, who had forcibly married them.
5. Ne sanguine, etc., *not to stain themselves with impious blood; these of their fathers-in-law, the others of their sons-in-law.*
6. Nepotum—liberum, grandsons to their fathers, the Sabines; sons to their husbands, the Romans.
7. Si affinitatis, "*If*," *they say.* The construction changes from the *oratio obliqua* to the *oratio recta*, in which the actual words of the speakers are reported.
8. Melius, *it will be better for us to die.*
9. Quum—tum, first one, then the other, and so *both, and.*
10. Conferunt Romam, lit., *they bring together to Rome; they concentrate at Rome.* Romam, accusative of motion to a place.

Our second extract is part of the account of a deed of bravery that is no doubt well known to most of our readers, the defence of the bridge by Horatius Cocles, which forms the subject of the best of Macaulay's "Lays of Ancient Rome." The last of the kings of Rome, Tarquinius Superbus, who had been driven from the state for his great cruelties, made several vigorous efforts to regain the crown he had lost. He summoned to his aid Porsenna, lord of the neighbouring state of Clusium, who came with a strong army to attack Rome. The only hope for the Romans lay in breaking down the bridge over the Tiber, and so preventing the entrance of Porsenna's army, but the enemy were close upon them before they accomplished their object. In this juncture a brave Roman, named Horatius, volunteered to keep the passage of the bridge, with two of his friends, until the Romans should be able to cut it down:—

LIVY, II. 10, 5.

Vadit inde (Horatius) in primum aditum pontis, insignisque inter conspecta cedentium pugnæ[1] terga obversis comminus ad ineundum prœlium armis ipso miraculo audaciæ obstupefecit hostes. Duos tamen cum eo pudor tenuit Sp. Lartium ac T. Herminium ambos claros genere factisque. Cum his primam periculi procellam, et quod[2] tumultuosissimum pugnæ erat, parumper sustinuit: deinde eos quoque ipsos exigua parte pontis relicta, revocantibus[3] qui rescindebant, cedere in tutum coegit. Circumferens inde truces minaciter oculos ad proceres Etruscorum,[4] nunc singulos provocare, nunc increpare[5] omnes, servitia[6] regum superborum suæ libertatis[7] immemores, alienam oppugnatum[8] venire. Cunctati aliquamdiu sunt, dum alius alium, ut prœlium incipiant, circumspectant. Pudor deinde commovit aciem, et clamore sublato indigne in unum hostem[9] tela conjiciunt. Qua quum in objecto cuncta scuto hæsissent, neque ille minus obstinatus ingenti pontem obtineret gradu, jam impetu conabantur[10] detrudere virum, quum simul fragor rupti pontis, simul clamor Romanorum alacritate perfecti operis sublatus, pavore subito impetum sustinuit. Tum Cocles, "Tiberine pater," inquit, "te sancte precor, hæc arma et hunc militem propitio flumine accipias." Ita sic armatus in Tiberim desiluit, multisque super incidentibus telis incolumis ad suos tranavit, rem ausus plus famæ[11] habituram ad posteros quam fidei. Grata erga tantam virtutem civitas fuit; statua in comitio[12] posita, agri quantum uno die circumaravit datum.

NOTES.

1. Cedentium pugnæ, *retreating;* lit., *yielding to the battle.*
2. Et quod, etc., *the most tumultuous part of the fray.*
3. Revocantibusc, etc., *while they who were cutting down the bridge were calling them to come back.*
4. Etruscorum. Clusium, from whence Porsenna came, was a city of Etruria.
5. Provocare—increpare, historical infinitives.
6. Servitia, put for servos, the abstract for the concrete. So we find *militia* for *milites; juventus* for *juvenes.* To agree with it Livy puts immemores, a constructio κατα σύνεσιν (according to the sense).
7. Suæ libertatis, etc. The infin. venire depends upon the verb increpare; *taunting them for coming, slaves of a proud king as they were, and careless of their own freedom, to attack the freedom of others.*
8. Oppugnatum; supine in um; after venire, a verb of motion.
9. In unum hostem, *on their solitary foe.*
10. Conabantur, etc., hostes, *when the darts had stuck fast the enemy* (who had thrown them) *endeavoured.*
11. Plus famæ, etc., *destined to gain among posterity more fame than credit.*
12. Comitio. The comitium, the place of meeting of the comitia, or public assemblage, was a part of the Forum.

In the course of a war (B.C. 319) with the Samnites, a people who inhabited the country north of Campania, the Roman army were entrapped in a narrow defile called the Furculæ Caudinæ, or Caudine Forks, and were obliged to surrender. The following extract is remarkable as being one of the few descriptions of scenery found in the Latin authors:—

LIVY, IX. 2, 4.

Duæ ad Luceriam ferebant viæ altera præter oram superi maris[1] patens apertaque sed quanto tutior[2] tanto fere longior, altera per Furculas Caudinas brevior. Sed ita natus[3] locus est: saltus duo alti angusti silvosique sunt montibus circa perpetuis inter se juncti: jacet inter eos satis patens[4] clausus in medio campus herbidus aquosusque, per quem medium iter est: sed ante quam venias[5] ad eum, intrandæ primæ angustiæ sunt, et aut eadem, qua te insinuaveris, retro via repetenda, aut si ire porro pergas, per alium saltum arctiorem impeditioremque evadendum. In eum campum via alia per cavam rupem[6] Romani remisso agmine, quoniam ad alias angustias protinus pergerent,[7] septas dejectu arborum[8] saxorumque ingentium objacentem molem invenere. Quum fraus hostilis apparuisset, præsidium etiam in summo saltu conspicitur:[9] citati inde retro, qua venerant, pergunt repetere viam: eam quoque clausam sua[10] obice armisque inveniunt.

NOTES.

1. Superi maris, the Adriatic, which lies to the north-east of Italy, and so above it, as opposed to the mare inferum, or Tyrrhenum, which lies to the south-west.
2. Quanto tutior, etc. In a comparison of two qualities which are found in the same thing in an unequal degree, the one varying with the other, the Latins use two comparatives; we use the positive. Lit., *as long as it was secure, its length being proportionate to its security.*
3. Ita natus, *the nature of the spot is as follows.*
4. Satis patens, *of tolerably wide extent.*
5. Venias—*i.e.*, you, the reader.
6. Cavam rupem, *through a rocky gorge.*
7. Protinus pergerent, *had got right through to the defile at the other end.*
8. Dejectu arborum, put for dejectis arboribus.
9. Conspicitur, the change to the present adds vividness and force to the description.
10. Sua, *with its barrier*, just like the other.

Poetical Translation of HORACE, "ODES," I. v., *in last Reading.*

What slender youth, bedewed with liquid odours,
Courts thee on roses in some pleasant cave.
Pyrrha? For whom bind'st thou
In wreaths thy golden hair,
Plain in thy neatness? Oh how oft shall he
On faith and changèd gods complain, and seas
Rough with black winds and storms
Unwonted shall admire.

Who now enjoys thee credulous, all gold,
Who always vacant, always amiable
Hopes thee, of flattering gales
Unmindful. Hapless they

To whom thou untried seem'st fair. Me in my vowed
Picture the sacred wall declares to have hung
My dank and dropping weeds
To the stern god of sea.—*Milton.*

LESSONS IN ASTRONOMY.—IV.

RESULTS OF NEWTON'S LAWS—FOUNDATION OF THE ROYAL OBSERVATORY—FLAMSTEED—HALLEY—CALCULATION OF ORBIT OF COMET—BRADLEY—BODE'S LAW—DISCOVERIES OF HERSCHEL.

THE grand discovery of Newton seems to have completed our knowledge of the fundamental laws of motion of the worlds around us, and has afforded to us another most convincing proof of the wisdom and power of Him who created all things. To make and sustain these bodies requires the power of Omnipotence; but when we find that all their motions depend on the two simple laws of *inertia* and *mutual attraction*, and that all their variations and movements can be fully explained by these; and further, when deeper investigation shows us that though all the stars are in ceaseless motion, yet these motions run through fixed and certain cycles, so that their very fluctuations ensure the stability of the entire system, we are lost in admiration at the wisdom of the great and omnipotent Architect of the Universe.

Great as Newton's work was, he did not live to complete all his task. He discovered the mutual attractions of the heavenly bodies for one another, but left it to succeeding astronomers to calculate the effects this attraction would produce on the movements of each. That this was a work involving no slight difficulty will easily be seen if we consider the case of only a single planet. For illustration, we will take Venus. Suppose now for an instant that only this planet and the Sun existed, we could then easily mark out the exact position of the planet for every moment if we knew its mean distance and the eccentricity of its orbit. Now add the Earth to the system, and we shall find that a disturbing influence is at once introduced by its attraction. As Venus comes in the part of its course nearest the Earth, it is attracted by it, and thus drawn out of its path; its motion is likewise accelerated as it approaches the Earth, and retarded as it recedes from it; and the calculation of the amount of this disturbance is rendered more difficult by the fact that the Earth is itself moving at a rate different from that of Venus.

When we have made allowance for this disturbance, we have to consider the effects produced by each of the other planets in turn, remembering that they too are all in motion. We thus get some idea of the complication of the problem. It has, however, been completely worked out by modern astronomers, the due allowance being made for each of these disturbing forces; and, as we shall learn by and by, this has been done with such astounding accuracy that when certain minute irregularities were discovered in the motions of one of the planets which could not be accounted for by the influence of any of the known ones, it was conjectured that another planet must exist beyond them. Two astronomers, accordingly, quite independently of each other, set about the calculation, and determined the very spot in which such a planet ought to be, if it existed at all; and on turning a telescope to that spot, the planet (Neptune) was found, though at no portion of its orbit could it come within 130,000,000 miles of the planet whose course had been disturbed by its attraction.

One fact we particularly notice as the result of these investigations, and that is the absolute stability of the system, it being so beautifully balanced that all these perturbations exactly compensate one for another, and after an infinite cycle all return to their original places.

Flamsteed was another celebrated astronomer, almost contemporary with Newton, and was the first Astronomer Royal.

The origin of the Royal Observatory and of this post was in the year 1675. Great inconvenience had been experienced in long voyages from the want of some method of determining the longitude in which a vessel was at any time, but at length a plan was proposed which was substantially the same as one in use at the present time. This consisted in noticing very accurately the position of the moon with respect to neighbouring fixed stars. As the earth moves in its path, this position seems to vary. If then we have an accurate list of these "lunar distances," as they are termed, calculated for any given meridian of longitude, we shall be able to tell by observation what the time is at that meridian. We can then compare this with the local time of the place where we are, and in this way ascertain the longitude; for since 15° of longitude make a difference of one hour in the time, we have only to allow 15° for every hour of difference in the times, and we shall at once tell the longitude.

The method of solving this problem usually employed now is merely to compare a good chronometer, set to Greenwich time, with the local time; but it was not till a comparatively recent period that chronometers were made accurate enough for this purpose, and even now it is a great advantage to be able occasionally to check them by means of lunar observations.

When this plan of ascertaining longitudes was proposed, an objection was taken to it on the ground that the tables of the positions of the moon and fixed stars which then existed were not sufficiently accurate to be of any practical use for this purpose.

It was decided, therefore, that an observatory should be built and sustained with this especial end in view, and Flamsteed was appointed Astronomer Royal. An elevated position in Greenwich Park was accordingly selected as a suitable site for this observatory, and here it was erected in 1675, and from that time to the present some of the greatest astronomers have resided in it, and an almost uninterrupted series of observations has been maintained. These have constantly proved in many different ways to be of the greatest practical utility. One main duty connected with the Observatory is the preparation of the "Nautical Almanack." This is an almanack published three or four years in advance, and containing a large number of important astronomical tables. The position of the moon with respect to many of the fixed stars is shown for every third hour throughout the year. The position of the various planets is also shown, as well as the eclipses and occultations of Jupiter's satellites, and many similar tables, which are useful to the mariner in ascertaining his position, as well as to the astronomer. The reason of its early publication is in order that captains about to set sail on long voyages may take it with them.

Though the Observatory was thus founded by Government, it was some time before it was provided with instruments worthy of the place, Flamsteed having to use his own for a considerable period. No very important discoveries are associated with the name of this astronomer, but he was a very careful observer; and it appears that it was to his accurate observations that Newton was greatly indebted in many of his inquiries.

Halley succeeded Flamsteed in his duties at the Observatory. He was for some time an intimate friend of Newton, and made several long journeys in the interests of science. An expedition was fitted out under his charge to observe and catalogue those stars in the southern hemisphere which are invisible in this country, and a list of nearly 400 was compiled. This, however, was by no means a complete one, as the station chosen for observation (St. Helena) was in many respects unfavourable.

After the discovery which Newton had made, that bodies under the joint influence of an original impulse, and the attraction of a central body, might revolve in an hyperbola or parabola as well as in an ellipse, the appearance of a comet was anxiously awaited, in order that if possible it might be ascertained whether these bodies moved in fixed orbits of either of these forms, or whether they were merely stray wanderers dashing swiftly past our system, and then for ever lost in the deep abysses of space.

In the year 1680 this desire was gratified by the appearance of a very large and remarkable comet, which attracted great attention both by its brilliancy and the rapidity with which it travelled. Halley devoted his earnest attention to the study of this body; its motion was accurately noticed and recorded by him, and he discovered that a parabolic orbit could be constructed which would account for all its movements. Its eccentricity, however, was so great that a period of about 600 years must elapse before it could again return to the sun.

After this comet had passed away, Halley still devoted his attention to the subject, carefully inquiring into the recorded appearances of different comets, with the view of ascertaining whether the intervals between the appearances of any of the most noticeable ones appeared in any way uniform. Shortly after this, in the year 1682, a second large comet appeared, and now, with the information he had already acquired, Halley was in a better position to inquire into its motion. He accordingly did this, and after a time announced that he had calculated its orbit, and found that it moved in an ellipse, its aphelion distance being nearly 3,500,000,000 miles; also, that its period was about seventy-five years. He then looked back through his list of comets, and found that he could distinctly trace it back for a considerable period. This so far confirmed his former calculations that he distinctly foretold its reappearance about the close of the year 1758; and so convinced was he of the truth of this prediction that he requested, since he could not live to witness its return, that, when it was fulfilled, people might remember it was an Englishman who had first traced the path and prophesied the return of a comet.

Long before the date assigned for the return of this comet, which was known as Halley's, he himself had passed away. Astronomers were, however, on the watch, and some French astronomers in particular investigated most carefully and industriously the retarding effect which would be produced on the comet by the attraction of the planets, and as a result of their inquiries, announced that it would be slightly delayed by the action of Saturn and Jupiter, so that its passage round the sun might be expected on the 13th of April, 1759. Just at the close of the previous year a wanderer was detected by an amateur, and as it came nearer it proved to be the very one whose return had been for so long a time foretold; and though its period of revolution was upwards of three-quarters of a century, yet the observations and calculations were so accurate that it actually passed the sun within less than three weeks of the predicted day.

On the occasion of the next return of this comet, which was in 1835, not only was the date, but the place of its appearance, pointed out; and on turning a large telescope to that spot, the comet was seen as a faint cloudy object. We see thus that Halley's comet may now be reckoned as one of the members of our system whose motions are fully understood. Its next return may be expected in the year 1912.

Bradley was the next Astronomer Royal. The great discovery which has rendered his name memorable is that of the aberration of light, a phenomenon the explanation of which must be deferred for the present. He also took an active part in the reform of the calendar, which had by this time varied considerably from the true seasons, and in order to rectify the error, joined in recommending that eleven days should be struck out of the month of September, 1752, so that the day following the 3rd of that month was called the 14th. This measure was very unpopular at the time, and Bradley came in for a large share of the popular dislike on this account; and his death, which occurred a few years afterwards, was by many of the ignorant regarded as a mark of Divine displeasure at his presumption in thus daring to interfere with the regular order of the calendar.

This alteration has since been made in nearly all countries except Russia, where dates are still reckoned according to the old style, and are now thirteen days behind those used in the rest of Europe.

In the year 1778 Professor Bode, of Berlin, published a very remarkable law relating to the distances of the planets from the sun, which, though it is said to have been discovered by Titius, is always known as "Bode's Law." It was at first merely a bold conjecture, but has since attracted much attention, as it partly led to the discovery of the first of the minor planets or asteroids.

He observed that if we take the numbers

0 3 6 12 24 48 96

each of which (after the second) is double that which precedes it, and add the number 4 to each of them, we obtain the following list, which represents approximately the distances of the planets named under them:—

4	7	10	16	28	52	100
Mercury.	Venus.	Earth.	Mars.	——	Jupiter.	Saturn.

Thus, if we take 10 to represent the distance of the Earth, we shall find that 4 represents that of Mercury, 7 that of Venus, and so on. No planet was, however, known to occupy the space between Mars and Jupiter, corresponding to the figure 28. There was thus a gap left in the system, and Bode stated his conviction that, as the sky was more carefully watched, and better telescopes were employed, such a body would be discovered. Nor was his prediction long unfulfilled, for on the 1st of January, 1801, a planet, afterwards named Ceres, was discovered by Piazzi, moving at a distance corresponding very closely with that assigned to it by the law. This planet is, however, very small, and soon afterwards three more were discovered moving almost at the same distance. These were named Pallas, Juno, and Vesta. Up to the present time (July, 1869), 108 of these minute bodies have been detected thus revolving around the sun, their distances and periods closely resembling one another; and thus in the place of one planet, we have a large group of small ones. The other planets, namely, Uranus and Neptune, which have been discovered subsequently to the announcement of this law, are found not to differ very greatly from it, though the difference in the case of Neptune is much greater than in any of the others.

We must now just look at the services which have been rendered to the science of astronomy by another of those men whose names will ever stand foremost in its annals—Sir William Herschel. He was a man of somewhat humble origin, and unable to procure a telescope sufficiently powerful to enable him to understand some of the mysteries of the heavens. He had, however, an intense desire to do so, and having acquired a knowledge of the principles of the telescope, set himself to the task of constructing one. In this he succeeded well; and altogether he is said to have ground upwards of 500 specula for reflecting telescopes. In March, 1781, aided with one of these instruments, he was examining the sky, when he came upon a small star, which, as he examined it with higher powers, seemed to exhibit a disc. He, accordingly, took an accurate note of its position, so as to watch it again on another evening. When he again examined it, it was at once clear that it had changed its position. The idea, however, that it was a new planet did not appear to enter at all into his mind, so accustomed had every one been to regard Saturn as the extreme member of our system. Accordingly, he set it down as a new and strange comet which he had discovered, and announced it as such. Its motions, however, soon showed that, unlike the comets, it moved in an orbit of but small eccentricity, and it was then found to be a planet revolving outside Saturn. This planet Herschel named Georgium Sidus, in honour of the king who had been his patron, but the name was afterwards altered to Herschel, and finally to Uranus, by which name it is now known.

Soon after this he constructed a much larger instrument, the speculum of which was four feet in diameter, and the tube forty feet long. The penetrating power of this instrument was reckoned at 194; that is, it would penetrate into space to a depth 194 times as great as could the unassisted eye. With this he discovered two more satellites of the planet Saturn. Six out of the eight which revolve around Uranus were also detected by him; so that he made a very large addition to the number of the heavenly bodies then known. But his most important discoveries were made about the nebulæ and stars. A large number of double and triple stars were first observed by him, and carefully noted, with a view of determining, if possible, whether any of them exhibited any sensible parallax. The Milky Way was also resolved by the power of his magnificent telescope, and thus some estimate was formed of the size of the clnster of which our complete system forms but an insignificant fraction.

Sir John Herschel, the son of this great man, displayed a similar love for astronomy; but so many names now occur, and so many fresh discoveries have been made, that we must leave them to be noticed in their special places. There is, however, one instrument which we must refer to before closing this historical sketch of the science, as having been of the utmost service in the determination of many difficult points. This is a reflecting telescope, erected by the late Earl of Rosse at Parsonstown, the speculum of which is six feet in diameter, and its focal length fifty-four feet. The whole of the work of this was carried out under the personal superintendence of Lord Rosse, and the instrument may fairly be ranked as one of the wonders of the age.

LESSONS IN ALGEBRA.—XIX.

EXERCISE 30.—MISCELLANEOUS PROBLEMS IN SIMPLE EQUATIONS (*continued.*)

45. Divide the number 68 into two such parts, that the difference between the greater and 84 shall be equal to three times the difference between the less and 40.

46. Four places are sitnated in the order of the letters A, B, C, D. The distance from A to D is 34 miles. The distance from A to B is to the distance from C to D as 2 to 3; and $\frac{1}{4}$ of the distance from A to B, added to half the distance from C to D, is three times the distance from B to C. What are the respective distances?

47. Divide the number 36 into three snch parts, that $\frac{1}{2}$ of the first, $\frac{1}{3}$ of the second, and $\frac{1}{4}$ of the third, shall be equal to each other.

48. A merchant supported himself 3 years for £50 a year, and at the end of each year added to that part of his stock which was not thus expended a sum equal to $\frac{1}{3}$ of this part. At the end of the third year his original stock was doubled. What was that stock?

49. A general having lost a battle, fonnd that he had only half of his army + 3,600 men left fit for action; $\frac{1}{8}$ of the army + 600 men being wounded; and the rest, who were $\frac{1}{5}$ of the whole, either slain, taken prisoners, or missing. Of how many men did his army consist?

50. To find a number to the snm of whose digits if 7 be added, the result will be 3 times the left-hand digit; and if from the number itself 18 be taken, the digits will be inverted.

51. To find a nnmber consisting of two digits, the sum of which is 5; and if 9 be added to the number itself, the digits will be inverted.

52. There is a certain fraction such, that if you add 1 to its numerator it becomes $\frac{1}{2}$; but if you add 3 to its denominator, it becomes $\frac{1}{3}$. Required the fraction.

53. It is required to find two numbers whose difference is 7, and their sum 33.

54. At a town meeting, 375 votes were cast, and the person elected to office had a majority of 91. How many votes had each candidate?

55. A post stands $\frac{1}{4}$ in the ground, $\frac{1}{3}$ in the watcr, and 10 feet above the water. What is the whole length of it?

56. A young man, the first day after his arrival in London, spent $\frac{1}{3}$ of his money, the second day $\frac{1}{4}$, the third day $\frac{1}{5}$, and he then had only 26 pence left. How much did he have at first?

57. A person being asked his age, answered that $\frac{3}{4}$ of his age multiplied by $\frac{1}{12}$ of his age, wonld give a product equal to his age. How many years old was he?

58. A man leased a house for 99 years; and being asked how much of the time had expired, replied that $\frac{2}{3}$ of the time past was equal to $\frac{4}{5}$ of the time to come. How many years had expired?

59. On commencing the stndy of his profession, a man found that $\frac{1}{7}$ of his life had been spent before he learned his letters, $\frac{1}{3}$ at a public school, $\frac{1}{3}$ at an academy, and 4 years at college. How old was he?

60. It is requircd to find a number such, that whether it be divided into two equal parts, or three equal parts, the product of its parts will be equal.

61. Two persons, 154 miles apart, set ont at the same time to meet each other, one travelling at the rate of 3 miles in 2 hours, the other 5 miles in 4 hours. How long will it be before they meet?

62. A man and his wife usually drank a cask of beer in 12 days, but when the man was absent it lasted the wife 30 days. How long would it last the man if his wife were absent?

63. A shepherd being asked how many sheep he had, replied, if he had as many more, half as many more, and $7\frac{1}{2}$ sheep, he would then have 500. How many had he?

64. A farmer hired two men to do a job of work for him; one could do the work in 10 days, the other in 15. How long would it take both together to do the same job?

65. A and B together can build a boat in 20 days; with the assistance of C they can do it in 12 days. How long would it take C to build the boat?

66. There is a cistern with two aqueducts; one will fill it in 30 minutes, the other will empty it in 40. How long will it take to fill it if both run together?

67. Required to divide 1 shilling into pence and farthings in such a proportion that there may be 39 pieces.

68. A man divided a small sum of money among his children in the following manner: viz., to the first he gave $\frac{1}{6}$ of the whole + 4 pence, to the second $\frac{1}{6}$ of the remainder + 8 pence, to the third $\frac{1}{6}$ of the remainder + 12 pence, and so on, giving to all an equal sum till he had distributed the whole. Required the number of shares and the sum distribnted.

69. A hare has 50 leaps the start of a hound, and takes 4 leaps while the hound takes 3; but 2 leaps of the hound are equal to 3 of the hare. How many leaps will the hound take in catching the hare?

70. A and B start at the same time and place to go round an island 600 miles in circumference. A goes 30 miles a day, and B 20. How long before they will both be at the starting-point together, and how far will each have travelled?

71. A has £100, B £48. A robber takes twice as mnch from A as from B. A now has 3 times as much as B. What was taken from each?

72. It is required to divide £1,200 between A, B, and C; B has £256 + $\frac{1}{2}$ of A's share; C has £270 + $\frac{1}{2}$ of B's. What was the share of each?

73. There are three pieces of cloth of different value. The average price of the first and second is 7s. per yard, that of the second and third is 9s., and the average price of all is $\frac{5}{8}$ of the third. What are the several prices?

74. A pipe will fill a cistern in 11 hours. After running 5 hours another is opened, and then the two fill it in 2 hours. In what time would the last fill it?

75. A man bonght a cask of wine, and $\frac{1}{5}$ of it leaking out, he sold the rest at 25s. per gallon, and neither gained nor lost by his bargain. What did he give per gallon for his wine?

76. A and B start at the same time and in the same direction, bnt directly opposite each other, to go ronnd a circular pond 536 yards in circumference; A goes 11 yards a minute, and B 34 in 3 minutes. In what time will B overtake A?

77. A cask contains a certain number of gallons of rum, and an mth part of that quantity of water: but if a gallons of rum and b of water be added to the mixture, the water in the whole compound will be an nth part of the rum. Required the quantity of each contained in the cask at first. Examine also and explain the case, in which m being equal to n, a is equal to $n\,b$, and the one in which it is not equal to it; and also the case in which x and y come out negative, x denoting the original number of gallons of the rum, and y those of the water.

78. Find a fraction, such that if its denominator be increased by 1, the valne becomes $\frac{1}{2}$; while if the numerator be increased by 1, the valne is $\frac{2}{3}$.

79. Reqnired a fraction, such that if the numerator and denominator be each increased by 1, the value is changed into $\frac{1}{2}$; but if they be each diminished by 1, the value becomes $\frac{1}{3}$.

80. One person says to another: "If you give me half your money, I shall have a hundred pounds." The other replies: "I shall have a hundred pounds if you give me a third of your money." How mnch had each?

81. At what time between 10 and 11 o'clock are the hour and minute hands of a common clock exactly together?

82. Find two numbers, such that $\frac{1}{3}$ of the first exceeds $\frac{1}{4}$ of the second by 3, and that $\frac{1}{4}$ of the first and $\frac{1}{3}$ of the second are together equal to 10.

83. Required two numbers, such that the sum of $\frac{1}{2}$ of the first and $\frac{1}{3}$ of the second may be 29, and that $\frac{1}{3}$ of the first and $\frac{1}{4}$ of the second may amount to 21.

84. A number expressed by three digits, whose sum is 22, is less by 297 than the number expressed by the same digits in a reversed order, and its first digit is less by 1 than its second. What is the number?

85. A bill of £100 may be paid by 50 bank notes of one value each, and by 38 of another; or it may be paid by means of 75 of the former kind, and 17 of the latter. What are the values of the notes?

86. Two persons set out from a certain place on the same day, and proceed in the same direction, the one travelling 30 miles the first day, and going each day a mile less than he did on the preceding; while the other travels at the constant rate of 20 miles a day. When will they next be together?

87. How many lines are contained in a page of a book, and how many letters at an average in each line of that page, if it be found that by adding one line to each page, and making each line contain an additional letter, the page will be increased by 96 letters; while, by adding two lines to the original page, and making each line contain four additional letters, the number of letters will be increased by 286?

88. Two persons get each a legacy of £300, and one of them is then found to be worth three times as much as the other; but had the legacy to each been £800, the one would have been worth only twice as much as the other. How much had each originally?

89. A cistern can be filled by three pipes; by the first in 80 minntes, by the second in 200 minutes, and by the third in 300 minutes. In what time will the cistern be filled when all three pipes are open at once?

90. Two gentlemen play at billiards; A, before he began to play, had £42, and B £24. Each lost and won in turn, when A found he had five times as much as B had remaining. How much did A win?

91. What capital is that which, with five years' interest at 4 per cent., will amonnt to £8,208?

92. A capital was put out for one year at $4\frac{1}{2}$ per cent. per annum; at the expiration of the year there was received back, as capital and interest, £13,167. What was the amount of the capital?

93. A fortress has a garrison of 2,600 men, among whom are 9 times as many foot soldiers and 3 times as many artillery as cavalry. How many are there in each corps?

94. Divide the number 46 into two parts, so that when the one is divided by 7, and the other by 3, the qnotients together may amount to 10. What are the parts?

95. From the first of two mortars in a battery 36 shells are thrown before the second is ready for firing. Shells are then thrown from both in the proportion of 8 from the first to 7 of the second; the second mortar requiring as much powder for 3 charges as the first does for 4. It is required to determine after how many discharges of the second mortar the quantity of powder consumed by it is equal to the quantity consnmed by the first.

96. Suppose the crown of Hiero of Syracuse weighed 100 onnces; suppose the two crowns, one gold and the other silver, weighed the same, 100 ounces each; and snpposing, what would be very nearly the case, that the gold crown, weighed in water, lost 5 onnces, the silver one lost 9 ounces; and supposing the compound or mixed crown lost 6 ounces, it is required to find the proportion of gold and silver in the crown of Hiero.

97. A footman agreed to serve his master for £8 a year and a livery, but was turned away at the end of 7 months, and received only £2 13s. 4d. and his livery. What was its value?

98. A fish was caught whose tail weighed 9lbs.; his head weighed as much as his tail and half his body; and his body weighed as much as his head and tail. What is the weight of the whole fish?

99. If A and B together can perform a piece of work in 8 days, A and C together in 9 days, and B and C together in 10 days, how long will each person take to perform it alone?

100. The fore-wheel of a carriage makes 6 revolutions more than the hind-wheel in going 120 yards; but if the circumference of each wheel be increased by 3 feet, the fore-wheel makes only 4 revolutions more than the hind-wheel. What is the circumference of each wheel?

RECREATIVE SCIENCE.—III.

THE NATURE AND MEASUREMENT OF LIGHT—PHOTOMETRY.

The sources of light and the principles which regulate the production of artificial light having been discussed in the previous papers, it seems quite in the natnral order of things to go further and attempt to solve the nature of light—in fact, to try to understand its relation to non-luminous bodies, and the nses of various optical instruments. In determining the nature of light, it may be asked why it can travel so fast from the sun, and although the distance of that luminary from the earth is about 91,000,000 miles, how it is that light can achieve this enormous interspace in eight and a-half minutes, when a railway train, going at a speed of thirty miles per hour and starting on the 1st of July, 1869, would not reach the sun until the end of the year 2207.

The velocity of light is, according to Mons. Foucault, 185,177 miles per second; but his experiments were tried through distances on the earth. Römer, by astronomical observations, gives a greater rate of speed, viz., 192,500 miles per second; and this is very nearly the same as that determined subsequently by Bradley, who calculated the velocity to be 191,515 miles per second.

Fig. 1.

The immortal Newton explained the manner in which light travelled through space by supposing, firstly, that it consisted of material particles or corpuscles, so rare and subtile that no balance, however exquisitely devised, could be made to appreciate them; and, secondly, that these corpuscles were shot out from the sun and all luminous bodies with amazing velocity, and in consequence of their rarity passed bodily through solids, liquids, or gases, and caused the sensation of vision by ultimately finding their way to and impinging on the expanded nerve or retina of the eye. This theory is called the corpuscular or emissive theory of light, and when applied even to explain the reflection or refraction of light it fails to do so, and with the more complicated phenomena—such as the colours of thin plates, and especially with polarised light—the difficulty of reconciling the theory with the facts increases. Thus it has come to pass that the hypothesis of Newton is now rejected and that another one is deservedly substituted for it.

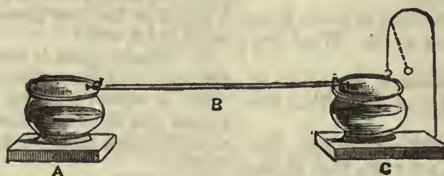

Fig. 2.

It was probably in consequence of the great musical knowledge of Huygens that this celebrated astronomer was led to oppose the Newtonian theory, and to insist that the mechanism of sound and light was identical, and that it was in both cases an undulating or wave motion. Euler, like Huygens, was perfectly acquainted with the philosophy of sound, and he also, being a great mathematician, opposed the emissive theory. The arguments of these great men, however weighty, would have had but little effect if they had not been succeeded by the practical experiments and mathematical powers of Dr. Thomas Young, who reasserted and revived the theory of undulations about the beginning of the present century. The wave theory of light starts with the assumption that there is an infinitely rare medium filling space, and contained in all solid, fluid, and gaseous bodies, which is called *ether*. The latter is not light, air is not sound, water is not necessarily a wave; but light is produced in the ether by the setting up of an undulating or wave motion by the vibration or trembling of the particles of the luminous body. The sun, or rather the molecules of which its photosphere or source of light is composed, is supposed to be in a vibratory condition; these vibrations are communicated to the ether, and transmitted in the form of waves, which may ultimately dash or gently impinge against the retina. If they strike violently—as, for instance, when the astronomer forgets to use the coloured glass or tank of diluted ink whilst viewing the sun through his telescope—then great damage, even blindness, may be caused. If the waves move softly, as in diffused daylight, the gentle ripple of the ether dies away harmlessly on the nerve of vision.

Fig. 3.

The ether is not only the incarnation of levity, but of elasticity, and just as sound travels more quickly through an elastic substance, so the waves of light are propagated from the sun at the enormous velocity already stated.

A rod of wood is infinitely less dense and lighter than a bar of cast-iron, but in consequence of its elasticity being greater than that of the metal, the vibrations of sound travel more quickly through its particles than they do through the cast-iron. The luminiferous ether is supposed to possess a spring or elasticity greater than that of any other created matter, and thus the first question, "Why does light travel so fast?" is answered by the wave theory. Some acoustic experiments may assist the learner to appreciate the idea of an undulating medium.

If the wetted finger is drawn around the edge of an ordinary finger-glass a loud sound is emitted, and the vibration of the glass is easily shown by suspending a bit of cork with a thread, and allowing it to touch the trembling glass. As long as the sound lasts, the cork will be driven away by the constant succession of blows or impulses it receives. (Fig. 1.) Substitute ideally the sun or any other self-luminous body for the trembling glass, and the analogy between the two is at once established, only instead of air being set in motion it is the hypothetical ether which is affected by the vibrating molecules of the luminous body.

Ether conveys the vibrations like a solid substance; such a conveyance or travelling of vibrations may be shown by placing the ear at one end of a long piece of timber, and scratching with a nail at the other, or by placing a watch at the extremity of a light wooden rod and listening at the other. The vibrations set up in a finger-glass may soon be communicated to another, by connecting the two together with a wooden rod, which may be of any convenient length. In this experiment the luminous body is represented by the glass A, the ether by the rod B, and the body upon which the luminiferous ether impinges by the glass C. (Fig. 2.)

A musical note is produced when the impulses in the air are sufficiently frequent, and its pitch depends upon the number of aërial waves which recur in a second. If the undulations follow each other very rapidly, an acute sound is heard; or the reverse, a grave one, when the recurrences of the waves are less rapid. Tyndall says, "Colour is to light what pitch is to sound; the colour of light depends on the number of ethereal waves which strike the eye in a second. Thus the sensation of red is produced by imparting to the optic nerve four hundred and seventy-four millions of millions of impulses per second, while the sensation of violet is produced by imparting to the nerve six hundred and ninety-nine millions of millions of impulses per second. In the 'emissive theory' numbers not less immense occur." "Now," remarks Herschel, "is there any mode of conceiving the subject which does not call upon us to admit the exertion of mechanical forces which may well be called infinite?"

It is convenient to regard a sunbeam as an assemblage of waves, one only of which may be called a *ray*. Light distributes itself on all sides from a self-luminous body, like radii drawn from the centre of a circle; it must therefore follow that each ray pursues a straight line, although diverging from the one by the side of it. As all the single rays forming a beam of light diverge from each other, unless altered by special optical contrivances, they may be represented by a fountain jet in which the streams of water are forced out in straight lines, not parallel but diverging from each other. (Fig. 3.)

If the hand be held across the fountain at A, all the water issuing from the jet may be directed or thrown off to the side; at B only a certain number of the streams of water impinge upon the hand; and at C the number would be still less. By analogy, the metal jet may represent a luminous point; the streams of water the rays of light issuing from it. At A all the rays strike upon the object, which would be highly illuminated; at B the object could not look so bright, because a smaller number of rays illumine it; and at C the light would be still more feeble. In consequence of this divergence of the rays from each other, light decreases in intensity as the distance from the luminous point is increased; and this fact is called the law of inverse squares—the greater the distance, the less light, and *vice versâ*. The law is proved by observing the shadow cast by an opaque body held in the beam of light; the more intense the light, the darker will be the shadow. A board, one foot square, held at a certain distance from a bright light, will completely throw into shadow another board, 4 feet square, held at twice the distance from the luminous source; and this, again, a third board, 9 feet square, placed at three times the distance from the source of light. The law is easily reduced to figures: the first distance is taken as unity, or 1; at the second distance, the square of 2 being 4, the shadow is spread over four times the area, and is four times less intense on each square foot; at the third distance, the square of 3 being 9, the shadow is spread over 9 square feet, and is nine times less intense on each square foot, and so on to any required distance. The law is demonstrated in a most amusing manner by placing a very bright point of light, such as that obtainable from the lime-light, on the floor, and at a certain distance, say 10 feet, from a transparent screen. Place a boy at 2 feet distance from the lime-light, when his body, intercepting all the rays, will cast a shadow as high as the screen. Now request him to walk double the distance, or 4 feet from the light: and the shadow will be reduced considerably in height, and, if measured, would be found in accordance with the law of inverse squares; and so on, as the boy walks away to a distance of 6, 8, or 10 feet, until he touches the screen. At this position the shadow of his body dwindles down to a very small one, again increasing in height as he returns to his original station, close to and in front of the light. If three persons are stationed at unequal distances from the light, three shadows are cast upon the screen, C, and the shadow of the one nearest the sheet may be so small that it is easily seen below the Brobdingnagian stride of the shadow of the figure nearest the light, who may place the shadow of his arm apparently on that of the intermediate figure. (Fig. 4.)

Fig. 4.

The shadow effect is still more ludicrous when the figures jump over the light; and they appear to spring up to the ceiling if they jump away from the screen and over the light, or to come down from the ceiling to the floor when they spring from the back of the light towards the screen. (Fig. 5.) Wherever these opaque bodies cut the rays of light, an equivalent to a solar eclipse is the result; the dark shadow moves across the screen as that of the moon does upon the earth; and this is called the path of the shadow—a direction always known, and to which astronomers go when they wish to observe a total eclipse of the sun. It is on this principle that photometers, or light-measurers, are used.

Two unequal lights will have the effect of casting two different shadows, one of which will be stronger than the other, if the lights are placed at the same distance from the wall. A lighted candle and the flame of a moderator argand lamp will cast two shadows of a stick held in front of them. One will be darker than the other, but if the candle is gradually brought nearer to the wall or sheet of paper on which the two shadows are thrown, the distances of the lights may be so adapted that the two shadows of the stick shall be equally dark. It is now only necessary to measure the distances of the two lights from the wall, and after squaring the two measurements, the greater may be divided by the lesser one, when the quotient will give approximately the illuminating power of the lamp as compared with that of the candle. Thus, suppose the lamp to be twelve feet away from the screen and the candle four, then $12 \times 12 = 144$, $4 \times 4 = 16$, and $144 \div 16 = 9$. The lamp gives nine times more light than the candle.

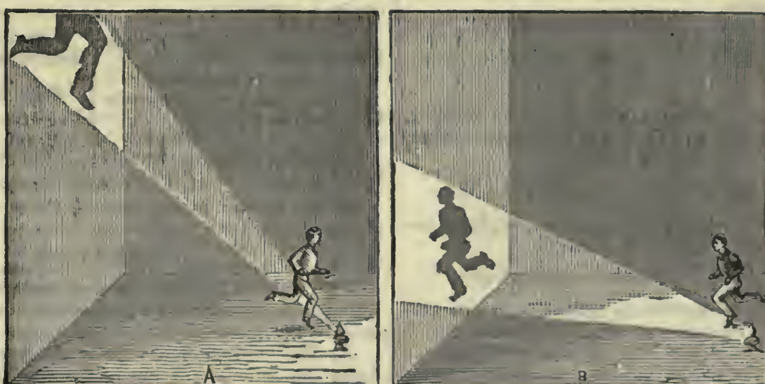

Fig. 5.—A. Springing up to the Ceiling. B. Jumping down from the Ceiling.

When bodies are illuminated they scatter or reflect the rays of light from every part of their surface. If we draw straight lines from each part of an arrow, and imagine these straight lines to be reflected rays of light entering the pupil and lenses of the eye, they necessarily form a cone, the point of which will impinge upon the retina. This fact will be considered more fully in the next paper, and especially in connection with the laws of reflection.

LESSONS IN FRENCH.—LVIII.

§ 42.—Remarks on the Indefinite Pronouns (*cont.*).

(7.) **Personne** also means *anybody*, in which case it does not admit of **ne** being placed before the verb :—

Personne l'a-t-il vu?	*Has anybody seen it?*

(8.) Although the pronoun **personne** is masculine, yet the adjective or past participle referring to it may be used in the feminine when it relates distinctly to a feminine noun or pronoun :—

Personne n'était plus **belle** que Cléopâtre. JULLIEN.	*No one (no woman) was more beautiful than Cleopatra.*

Note.—The word **personne**, used as a *noun*, and meaning a particular person, is of the feminine gender.

(9.) **Quelqu'un**, *somebody, some one, any one, anybody*, used absolutely, is invariable :—

Envier **quelqu'un** c'est s'avouer son inférieur. MLLE. DE L'ESPINASSE.	*To envy any one is confessing one's self his inferior.*
Quelqu'un a-t-il jamais douté sérieusement de l'existence de Dieu? GIRAULT-DUVIVIER.	*Has any one ever had serious doubts on the existence of God?*

(10.) **Quelqu'un**, used relatively, changes for gender and number. It has then the sense of *some of, some one of a few* :—

Connaissez-vous **quelqu'une** de ces dames, **quelques uns** de ces messieurs? GIRAULT-DUVIVIER.	*Do you know any one of those ladies, any of those gentlemen?*
Prenez **quelques-unes** de ces poires.	*Take a few of these pears.*

(11.) **Quiconque**, *whoever, whosoever*, though generally masculine, may be used in reference to feminine nouns or pronouns. It has no plural, and is only said of persons :—

Quiconque flatte ses maîtres, les trahit. MASSILLON.	*Whoever flatters his masters betrays them.*
Quiconque est capable de mentir, est indigne d'être compté au nombre des hommes. FÉNELON.	*Whoever is capable of falsehood is unworthy to be counted among the number of men.*
Quiconque est soupçonneux, invite la trahison. VOLTAIRE.	*Whoever is suspicious, invites treachery.*
Mesdemoiselles, **quiconque** de vous sortira sera punie.	*Young ladies, whoever of you goes out shall be punished.*

(12.) **L'un l'autre**, *one another, each other*. This pronoun has for feminine **l'une l'autre**, and for plural **les uns les autres, les unes les autres** :—

Vous vous flattiez **l'un l'autre.**	*You used to flatter one another.*

Note.—The preposition used with this pronoun is placed between **l'un** and **l'autre**, and not as in English :—

Elles se nuisent l'une **à** l'autre.	*They do harm to each other.*

L'un l'autre is used in the singular in reference to two persons, and in the plural in reference to more than two.

(13.) **L'un . . . l'autre, les uns . . . les autres; l'une . . . l'autre, les unes . . . les autres,** *the one . . . the other; the ones . . . the others; some* :—

Les uns nous suivaient par curiosité, **les autres** par intérêt.	*Some followed us out of curiosity, others out of interest.*

(14.) **L'un et l'autre, les uns et les autres, l'une et l'autre, les unes et les autres** (*both*). This expression may be used of persons and of things in the singular in reference to two persons or things, or in the plural, in the case of more than two. The preposition should be placed before **l'un**, and repeated before **l'autre** :—

L'un et l'autre sont honnêtes.	*Both are honest.*
Votre frère blâme **les uns et les autres.**	*Your brother blames the ones and the others.*
Il parle mal **des unes et des autres.**	*He speaks ill of the ones and of the others.*
Je le ferai **pour l'un et pour l'autre.**	*I will do it for both.*

Note.—**L'un et l'autre,** etc., may be used adjectively :—

La Condamine a parcouru **l'un et l'autre** hémisphère.* BUFFON.	*La Condamine travelled over both hemispheres.*
L'un et l'autre consul suivaient ses étendards. CORNEILLE.	*Both consuls followed his standards.*
À l'une et l'autre époque, il périt un très grand nombre de citoyens. BARTHÉLEMY.	*At both epochs a large number of citizens perished.*

(15.) **Rien**, *nothing*, is masculine singular, requires **ne** before the verb, and may be used as subject and as object. **Rien** means also *anything*, in which case it does not admit of **ne** before the verb :—

Rien n'est plus utile.	*Nothing is more useful.*
Il **n'a rien** entendu.	*He has heard nothing.*
Est-il **rien** de plus beau que la vertu?	*Is there anything more beautiful than virtue?*
Je doute que **rien** lui réussisse.	*I doubt whether he will be successful in anything.*

(16.) **Tel, telle,** feminine, *such, many a person, many*, is an indefinite pronoun in the following and in similar sentences :—

Tel donne à pleines mains, qui n'oblige personne. CORNEILLE.	*Many a one may give bountifully without obliging any one.*
Tel brille au second rang, qui s'éclipse au premier. VOLTAIRE.	*Many a person may shine in the second rank, who is eclipsed in the first.*
Tel est pris qui croyait prendre. LA FONTAINE.	*Many are caught while attempting to catch others.*
Telle, sans aucun attrait pour la retraite, se consacre au Seigneur par pure fierté. MASSILLON.	*Many [a nun] for whom retreat has no attractions, consecrates herself to the Lord through mere pride.*
Tels que l'on croit d'inutiles amis, dans le besoin rendent de bons services. BOURSAULT.	*Many friends whom we think useless render us, in our need, valuable services.*

(17.) **Tel**, in connection with **Monsieur, Madame,** etc., as **Monsieur un tel, Madame une telle,** *Mr., Mrs. such-a-one*, is used substantively. **Tel** may be used adjectively in the sense of *such* :—

un **tel** homme,	*such a man.*
de **tels** actes,	*such deeds.*

(18.) **Tout**, *every one, everything*. This word, employed absolutely, is invariable :—

À la seule vertu, sois sûr que **tout** prospère. F. DE NEUFCHATEAU.	*Be assured that it is with virtue alone that everything prospers.*
Tout n'est pas Caumartin, Bignon, ni d'Aguesseau. BOILEAU.	*Every one is not Caumartin, Bignon, or d'Aguesseau.*
Son grand génie embrassait **tout.** BOSSUET.	*His great genius embraced everything.*

Note.—In the acceptation of *every one*, **tout** is getting obsolete.

§ 43.—Verbs.

(1.) The verb is that part of speech which expresses an action done or suffered by the subject; or simply indicates the condition of the subject.

(2.) The subject of a verb is the person, animal, or thing doing the action, or being in the condition expressed by the verb. It replies to the question **qui est-ce qui?** *who?* for persons; and **qu'est-ce qui?** *which? what?* for things.

(3.) Verbs admit two kinds of objects, the *direct object* and the *indirect object*.

(4.) The *direct object* is that which suffers the action expressed by a verb. It answers to the question **qui?** *whom?* for persons; and **quoi?** *what?* for things.

(5.) The *indirect object* is that which completes the signification of the verb by means of an intermediate word, such as the prepositions **à, de, pour, avec, dans,** etc. It answers to the questions **à qui?** *to whom?* **de qui?** *of* or *from whom?* **pour qui?** *from whom?* **avec qui?** etc., for persons; and **à quoi?** *to what?* **de quoi?** *of* or *from what?* etc., for things.

(6.) Verbs are regular, irregular, or defective. [§ 45 (3).]

* The noun is in the singular, because the word **hémisphère** is understood after the word **l'un.** This rule is observed by the best French authors.

§ 44.—Different Sorts of Verbs.

(1.) There are five sorts of verbs: active, passive, neuter, reflective or pronominal, and impersonal.

(2.) The active verb is that which expresses an action performed by the subject, and suffered by a direct object.

(3.) Every French verb after which **quelqu'un**, *some one*, **quelque chose**, *something*, may be placed, is an active verb. Thus, in the following sentences, **protéger**, **changer**, **chanter**, etc., are active verbs, because we may say **protéger quelqu'un**, *to protect some one;* **changer quelque chose**, *to change something:*—

Dieu **protège** l'innocence. RACINE.	*God protects innocence.*
L'habit **change** les mœurs. VOLTAIRE.	*Dress changes the manners.*
Les cygnes ne **chantent** pas leur mort. BUFFON.	*Swans do not sing their death.*

(4.) The passive verb is the contrary of the active verb. The active verb presents the subject as performing an action immediately directed towards an object; whereas the passive verb presents the subject as suffering or receiving an action performed by the object. The passive verb is composed of the past participle of an active verb and the auxiliary *être*, to be. (See § 55.)

Nos campagnes **sont fertilisées** par la pluie. L'ACADÉMIE.	*Our fields are fertilized by the rain.*
Il **était guidé** par la force de son génie. MASSILLON.	*He was guided by the force of his genius.*
Les petits esprits **sont** trop **blessés** des petites choses. LA ROCHEFOUCAULD.	*Little minds are too much vexed with trifles.*

(5.) The neuter verb marks, like the active verb, an action performed by the subject; but this action is confined to the subject. Hence, a neuter verb never has a direct object, and the words *quelqu'un* and *quelque chose* cannot be placed after it. A neuter verb can never be used in the *passive voice:*—

Socrate passa le dernier jour de sa vie à **discourir sur** l'immortalité de l'âme. L'ACADÉMIE.	*Socrates spent the last day of his life in discoursing upon the immortality of the soul.*
Le feu qui semble éteint, **dort** souvent **sous** sa cendre. CORNEILLE.	*The fire which seems extinct sleeps often under its ashes.*
Les Platéens citèrent les Lacédémoniens à **comparaître devant** les Amphyctions. LE GENDRE.	*The Plateans summoned the Lacedemonians to appear before the Amphyctions.*

(6.) The reflective or pronominal verb is conjugated with two pronouns of the same person; *je me, tu te, il se, nous nous, vous vous, ils se.* (See § 57.) It expresses: 1st. An action performed and suffered by the subject, and is then called *pronominal reflective* verb:—

Je me flatte, *I flatter myself.*	**Vous vous** félicitez, *you congratulate yourselves.*
Il ne faut pas permettre à l'homme de **se mépriser** entièrement. BOSSUET.	*We should not allow men to despise themselves entirely.*

2ndly. An action reciprocated between two or more subjects, and is then called *pronominal reciprocal* verb:—

Ils se sont nui.	*They have done harm to each other.*
Ces **enfants se** détestent.	*These children hate one another.*

3rdly. An action strictly confined to the subject; this is called a *naturally pronominal* verb, and is expressed in English by a transitive or intransitive verb, as the case may be:—

Nous nous souvenons de ce fait.	*We remember that fact.*
Les **ennemis** s'enfuirent.	*The enemy fled.*

(7.) The impersonal verb can only be used in the third person singular: **Il pleut**, *it rains;* **il gèle**, *it freezes;* **il tonne**, *it thunders:*—

Pour bien juger les grands, **il faut** les approcher. AUBERT.	*To judge properly of the great, it is necessary to approach them.*
Il faut rendre meilleur le pauvre qu'on soulage. SAINT-LAMBERT.	*We should (it is necessary to) improve the poor whom we relieve.*

(8.) There are two verbs called auxiliary, because they serve to conjugate all others. They are—**avoir**, *to have:* and **être**, *to be.*

§ 45.—Conjugations.

(1.) The French verbs are divided into four classes or conjugations, which are chiefly distinguished by the *ending* of the present infinitive:—

1st. The first conjugation comprises all verbs of which the present of the infinitive ends in **er**; as, **parler**, *to speak;* **aimer**, *to love, etc.*

2nd. The second conjugation embraces all those of which the infinitive ends in **ir**; as, **chérir**, *to cherish;* **punir**, *to punish, etc.*

3rd. The third conjugation contains all the verbs which, in the infinitive, end in **oir**; as, **recevoir**, *to receive;* **pouvoir**, *to be able, etc.*

4th. The fourth conjugation comprises all the verbs terminating with **re** in the infinitive; as, **rendre**, *to render;* **prendre**, *to take, etc.*

(2.) Considered as words, French verbs present two distinct parts, viz., a *root* or *stem*, and an *ending* or *termination*. The root points out the meaning of the verb; the ending, the tense and the person. Thus, *e.g.*, in **parler**, **parl**, the root, has the force of *speak;* and **er**, the ending, points out the present tense of the infinitive.

(3.) The verbs are again divided into regular, irregular, and defective:—

1st. The regular verbs are those which, in all their tenses, preserve their *stem* or *root unaltered.*

2nd. The irregular verbs are those which *alter their root*, or have not the endings peculiar to their conjugation.

3rd. The defective verbs are those which want certain tenses or persons.

§ 46.—Moods and Tenses.

(1.) There are five moods: the infinitive, the indicative, the conditional, the imperative, and the subjunctive:—

1st. The infinitive presents the signification of the verb in an unlimited manner: **abandonner ses enfants**, *to abandon one's children.*

2nd. The indicative, whatever may be the tense, indicates or declares in a positive, absolute manner: **j'abandonne**, *I abandon;* **j'ai abandonné**, *I have abandoned;* **j'abandonnerai**, *I will abandon.*

3rd. The conditional indicates a condition or a supposition: **j'abandonnerais si** . . . *I would abandon if* . . .

4th. The imperative is used to express a command, prayer, or exhortation: **abandonnez cet enfant**, *abandon that child.*

5th. The subjunctive is used after clauses expressing doubt, contingency, or necessity: **il est douteux que je l'abandonne**, *it is not certain that I may abandon him.*

(2.) The infinitive has five tenses:—

1st. The present:	**parler,**	*to speak.*
2nd. The past:	**avoir parlé,**	*to have spoken.*
3rd. The present participle:	**parlant,**	*speaking.*
4th. The compound present participle:	**ayant parlé,**	*having spoken.*
5th. The past participle:	**parlé,**	*spoken.*

(3.) The indicative has eight tenses:—

1st. The present:	**je parle,** **je donne,**	*I speak;* *I give.*
2nd. The simultaneous past, or imperfect:	**je parlais,**	*I was speaking.*
3rd. The past definite:	**je parlai,**	*I spoke, I did speak.*
4th. The past indefinite:	**j'ai parlé,**	*I have spoken.*
5th. The pluperfect:	**j'avais parlé,**	*I had been speaking.*
6th. The past anterior:	**j'eus parlé,**	*I had spoken.*
7th. The future absolute:	**je parlerai,**	*I shall, will speak.*
8th. The future anterior, or future perfect:	**j'aurai parlé,**	*I shall have spoken.*

(4.) The conditional has two tenses:—

1st. The present or future:	**je parlerais,**	*I should, would speak.*
2nd. The past:	**j'aurais parlé,**	*I should have spoken.*

(5.) The imperative has one tense:—

The present:	**parle,**	*speak.*

(6.) The subjunctive has four tenses:—

1st. The present or future:	**que je parle,**	*that I may speak.*
2nd. The imperfect:	**que je parlasse,**	*that I might speak.*
3rd. The past:	**que j'aie parlé,**	*that I may have spoken.*
4th. The pluperfect:	**que j'eusse parlé,**	*that I might have spoken.*

(7.) Tenses are simple or compound:—

1st. Simple, when they are expressed in a single word: **je parle**, *I speak.*

2ndly. Compound, when they require the assistance of the verb **avoir** or **être**: **j'ai parlé**, *I have spoken;* **je suis arrivé**, *I am arrived.*

§ 47.—Use of the Auxiliary Verbs Avoir and Être.

(1.) The verb **avoir** is nsed:—

1st. As a leading verb, to express possession, obligation, duty: J'ai une maison, *I have* (*I possess*) *a house;* nous **avons*** à travailler, *we have to* (*must*) *work.*

2ndly. As an anxiliary verb to form—

Its own compound tenses: **j'ai eu,** *I have had.*

The compound tenses of the verb **être**: **j'ai été,** *I have been.*

The compond tenses of the active verbs: **j'ai aimé,** *I have loved.*

The componnd tenses of most neuter verbs expressing an action: **j'ai marché,** *I have walked.* [See exceptions to this rule (3) below.]

The compound tenses of impersonal verbs: **il a plu,** *it has rained;* **il a grêlé,** *it has hailed,* etc.

(2.) The verb **être** is used:—

1st. As a leading verb, to express existence, condition: **Être,** on ne pas **être,** *To be or not to be,* i.e., *to exist or not to exist;* elle **est** malade, *she is ill;* ils **sont,*** à plaindre, *they are to be pitied.*

2ndly. As an auxiliary verb, to form—

All the tenses of passive verbs: **Je suis aimé,** *I am loved.*

The compound tenses of all pronominal verbs: **Je me suis flatté,** *I have flattered myself;* **je me suis promené,** *I have walked.*

The compound tenses of a few neuter verbs, though the same express action:—

aller,	*to go*	naître,	*to be born*
arriver,	*to arrive*	tomber,	*to fall*
choir,	*to fall*	venir,	*to come*
décéder,	*to decease*	parvenir,	*to succeed*
mourir,	*to die*	devenir,	*to become*
revenir,	*to return, etc.*		

Note.—Some neuter verbs which take **être** in their compound tenses, preserve the same auxiliary when they are used impersonally: Il lui **est** arrivé un malheur, *A misfortune has happened to him.*

(3.) A certain number of neuter verbs, as—

accourir,	*to run towards*	entrer,	*to enter*
disparaître,	*to disappear*	sortir,	*to go out*
croître,	*to grow*	passer,	*to pass*
cesser,	*to cease*	partir,	*to depart*
monter,	*to mount, to ascend*	vieillir,	*to grow old*
descendre,	*to go down*	grandir,	*to grow*
rester,	*to remain, to dwell*		

take sometimes **avoir,** and sometimes **être.**

1. They take **avoir** when we have in view the action expressed by the verb;

2. And **être** when situation or condition is the principal idea which we wish to express:—

Examples.

With avoir.	*With* être.
Elle **a** disparu subitement.	Elle **est** disparue depuis quinze jours.
She disappeared suddenly.	*She has been gone a fortnight.*
La fièvre **a** cessé hier.	La fièvre **est** cessée, depuis quelque temps.
The fever ceased yesterday.	*It is some time since the fever ceased.*
Le baromètre **a** descendu de plusieurs degrés en peu d'heures.	Il **est** descendu depuis une heure.
The barometer went down several degrees in a few hours.	*He has been down one hour.*
Il **a** passé en Amérique à telle époque.	Les chaleurs **sont** passées.
He went to America at such a time.	*The heat is past.*
Le trait **a** parti avec impétuosité. L'Académie.	Les troupes **sont** parties depuis six mois. L'Académie.
The dart went off with impetuosity.	*The troops have been gone six months.*

Le sang **avait** cessé de couler. Boiste.	Ce grand bruit **est** cessé. Mme. de Sévigné.
The blood had ceased to flow.	*That great noise is over* (*has ceased*).

(4.) **Rester** and **demeurer,** meaning *to stay, to dwell, to reside,* take the anxiliary verb **avoir**; when they mean *to remain, to be left,* they take **être**:—

avoir.	être.
J'**ai** resté plus d'un an en Italie . . . Montesquieu.	Elle donnerait pour vous sa vie, le seul bien qui lui **soit** resté. Marmontel.
I resided more than a year in Italy . . .	*She would give, for you, her life, the only possession which remains to her.*
Il **a** demeuré deux ans à la campagne. L'Académie.	Deux cents hommes **sont** demeurés sur le champ de bataille. L'Académie.
He lived (*dwelt*) *two years in the country.*	*Two hundred men remained on the field of battle.*

(5.) **Échapper,** *to escape, to pass unnoticed, to be forgotten,* takes the auxiliary **avoir.** In the sense of *to say inadvertently,* it takes **être**:—

avoir.	être.
Cette différence ne m'**a** pas échappé. Rousseau.	Ce mot m'**est** échappé; pardonnez ma franchise. Voltaire.
That difference has not escaped me.	*That word escaped my lips; excuse my frankness.*
J'ai retenu le chant, les vers m'**ont** échappé. Voltaire.	Excusez les fautes qui pourront m'**être** échappées. Boileau.
I retained the tune, but the verses have escaped my memory.	*Excuse the faults which I may have committed inadvertently.*

(6.) **Convenir,** *to become, to suit,* takes **avoir.** When it is used in the sense of *agreeing,* it takes **être**:—

Cette maison m'**a** convenu.	Nous **sommes** convenus du prix. L'Académie.
That house suited me.	*We agreed upon the price.*

* Neither **avoir** nor **être** can be immediately followed by an infinitive; the preposition **à** must be placed before the latter:—Il est **à** travailler, *He is working;* j'ai **à** sortir, *I have to go out.*

MECHANICS.—XXIII.

COLLISION OR IMPACT.

We said that any force is measured by the velocity generated in a second. There is one class of forces, however, which cannot be so measured, because they do not act for any appreciable length of time. These we call impulses or impulsive forces; any force which is of the nature of a blow is placed in this class.

When one body strikes against another different results will ensue, according to the nature of the bodies. If an ivory ball be allowed to fall on a stone slab, it rebounds or rises from its surface, but the height to which it rises is less than that from which it fell. Were the ball perfectly elastic, it would rise to the same height. This, however, is not all that has occurred; the changes have been more complicated. On striking the slab, the ball is first flattened in a slight degree. In proof of this we may smear the slab with oil, and we shall find the ball marked, not in a minute point as it would be if merely laid on it, but over a space increasing in size with the violence of the blow. The particles are thus compressed, but their own elasticity causes them at once to recover their original position, and in so doing the ball flies up from the slab.

The effect, then, varies with the degree of elasticity of the body. We can, however, only consider the cases of elastic and inelastic bodies, not that any substances are perfectly so, but by examining these we shall get at general principles, which can then be applied or modified as may be required.

We will first consider the case of inelastic bodies, and well-kneaded clay or putty may be chosen as suitable substances to experiment with. Wax, softened with oil, will also answer well.

In making experiments on impact, the best plan is to procure balls of the substances chosen, and, having fastened them to strings, suspend them in such a way that they may just touch one another.

Let us take two such balls, C and D (Fig. 102), of equal weight, and having raised them to the same height, in opposite directions, leave them free to fall together and strike each other. Since both fall from the same height, their velocities are equal, and they each have the same mass; their momenta are therefore equal, and being in opposite directions neutralise each other. Both balls will therefore, after impact, remain at rest.

In order to measure the distance through which the balls fall, we must draw the arcs which they describe and divide them. We do not, however, make the divisions equal, but draw a series of parallel lines at the same distance apart, the lowest being even with the top of the balls, and make our divisions at the points where these cut the arcs. The reason of this is, that the velocity is proportional, not to the length of arc, but to the vertical height, and thus these divisions indicate the velocity.

Now raise C to the fourth division, and let it fall against D. No momentum will be destroyed; it will merely be shared between the two balls, as much being gained by the one as is lost by the other; and, since both balls have the same weight, each will move with half the velocity that C had on striking D. They will therefore rise together to the first division of the arc D F, for C takes twice as long to fall from 4 as it does from 1, and the velocity is proportional to the time, therefore it acquires a double velocity in falling. Now whatever velocity a body acquires in falling from any height, it must start with that velocity to rise to that height. A velocity, then, half as great as that acquired by C will raise the two balls to 1.

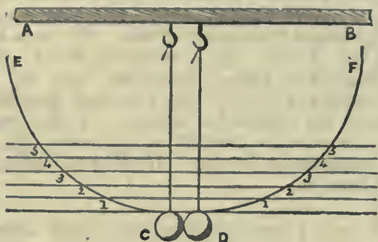

Fig. 102.

In the same way, if we make C half as heavy as D, and raising it to the 9th division let it fall, the two will, as before, rise to 1. The mass moved after impact is three times that of C, the velocity will therefore be only one-third as great; they will therefore rise $\frac{1}{9}$ the height. We see thus that when one body strikes against another, the momentum will be divided between them, and hence the resulting velocity will be as much less than that of the moving body as the mass of the two is greater than its mass.

For example, suppose a ball weighing 1 lb. and moving with a velocity of 60, to impinge against a larger ball weighing 14 lbs. The mass after impact will be 15 lbs., or fifteen times that of the ball; the velocity will therefore be $\frac{1}{15}$, or 4 feet per second. No momentum is lost. The original momentum was 1×60; after impact it is 15×4, which is also equal to 60.

This principle supplies us with a means of measuring very great velocities, as that of a cannon-ball or other missile.

A large block of wood or metal is suspended by a rod so as to swing to and fro with as little friction as possible. This is called a ballistic pendulum. Against this the ball is caused to strike, and by its impact it sets it in motion. A graduated arc is fixed under the block on which the distance to which it swings can be noted, and from this we can calculate the velocity it had immediately after the ball struck it. We have only to measure the vertical height to which it rose, and ascertain the velocity it would attain in falling from that height, and thus we have the velocity with which it started.

The weight of the bullet and the pendulum being also known, we can at once determine the proportion they bear to each other, and thus we can ascertain the velocity of the ball from that of the pendulum.

Suppose, for example, that the pendulum weighs half a ton, and being struck by a ball weighing 24 lbs. is raised to a height of 16 feet. In falling from this height it would acquire a velocity of 32; this, therefore, is that which it had immediately after the ball struck it. But the mass of the ball is to that of the two together as 24 to 1144, or 1 to 48 nearly. The velocity of the ball was therefore 48×32, or 1536 feet per second.

Hence we see why, if one body strikes against another, the heavier it is as compared with that against which it strikes, the greater the effect produced. If we want to drive a large nail or to strike a violent blow, we use a heavy hammer, for by it we obtain a much greater momentum, and thus accomplish the work with greater ease. So, too, when we are driving a nail into a plank, we place a support behind or hold a heavy hammer against it. Unless we do this the momentum is shared by the board, which yields to the blow, and thus destroys much of the effect. But when a heavy inelastic body is held behind, this, too, has to share the momentum, and thus the plank yields much less, and the nail is driven more easily.

In the same way some of the feats of strength sometimes exhibited may be explained. A man will lie with his shoulders supported on one chair and his feet on a second. A heavy anvil is then placed on his body, and on this he allows stones to be broken or blows to be struck, which, but for the anvil, must certainly kill him. The reason is, that the momentum of the hammer imparts but a very slight velocity to the anvil, on account of the greatly superior weight of the latter. This small velocity is easily overcome by the muscles, which being stretched, act, to a certain extent, like a spring, and thus the blow is scarcely felt.

We must now pass on to consider the impact of elastic bodies, and for this we may take balls of ivory suspended in the same way as those of clay were. We shall find that, though the effects produced by these are different, the same general laws apply. The bodies, however, instead of moving on together, will, after impact, rebound and fly apart.

Let us raise one of the balls C (Fig. 102) and allow it to fall against the other. The first effect will be that the momentum will be shared between the two, but, being elastic, they will be compressed, and the reaction in regaining their shape, being equal and opposite to the action, will destroy the motion of C and double that of D. The former will therefore remain at rest, and D will move on with a velocity equal to that which C had. If a series of several balls be thus suspended so as just to touch one another, and the end one raised and allowed to fall against the others, the motion of the first will be imparted to the second, and by that to the third, and so on throughout the entire series, the motion of each being destroyed by the reaction of the next. The result will thus be that the end ball only will rise, all the others remaining at rest. So, if two balls be allowed to fall, two will be raised at the other end. We see, then, that no momentum is lost here, any more than it was in the case of inelastic bodies; but it is not shared between all the balls, as it was in the other case. These experiments can, of course, be varied to almost any extent, and you are recommended to try them for yourselves, for more is always learnt by seeing or trying a few experiments than by reading about many. As, however, there is difficulty in procuring and suspending ivory balls, the experiments can be tried in a simpler way with common glass marbles. Lay two thin strips of wood along a smooth surface, like the top of a table, and adjust their distance so that a marble may just roll along between them; or, better still, cut a small groove in which the marbles may run. One marble may then be laid in the groove, and another made to strike it gently. The latter will come almost to rest, while the other will move. The reason why it does not come absolutely to rest is, that glass is not perfectly elastic, and thus the reaction is not quite sufficient to destroy the motion. If several marbles be laid so as to touch one another, and one made to strike the end, the same results will ensue as with the ivory balls.

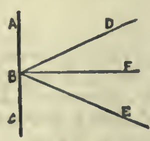

Fig. 103.

There is one other law relating to impact. It is, that "the angle of incidence is equal to the angle of reflection." The meaning of this will be clear from the annexed figure. Let any body strike against a surface A C, in the direction D B, it will rebound from it in the direction B E, making the same angle with the perpendicular B F that B D does. The angle D B F, or that at which it strikes A C, is called the angle of incidence, while F B E is the angle of reflection, and the law asserts that these are always equal. As we pass to optics and other branches of physics, we shall find further illustrations of this law.

ANSWERS TO EXAMPLES IN LESSON XXII.

1. It will rise a little over 156 feet, and will reach the earth again in 6¼ seconds.
2. The elevation is $5\frac{1}{2}^2 \times 16$, which equals $30\frac{1}{4} \times 16$, or 484 feet.
3. It will strike the earth with a velocity of 160.
4. It will take 7 seconds, in the last of which it will fall 208 feet.
5. 16×33, or 528 feet.
6. It would require 6 seconds, and pass over 576 feet.

LESSONS IN GREEK.—XXIX.

THE PRESENT AND IMPERFECT TENSES, ACTIVE VOICE.

To illustrate what we have been saying in the previous lesson, suppose that we have to construe *βουλευουσι*. This is the third person plural indicative present, formed by adding the termination *ουσι* to the stem of the present, *βουλευ*, which comes from *βουλευω*, *I advise;* and consequently *βουλευουσι* signifies *they advise.* Suppose, also, that we are requested to put into Greek the English *he has*, and that we have given us for the purpose the verb *εχω*, *I have.* Εχω is the first person singular indicative active. To get the stem of the present, we cut off the *ω*, and to *εχ*, thus obtained, we affix *ει*, the personal-ending of the third person singular indicative active, and so we obtain *εχει* as the Greek for *he has.*

Again, suppose that we have the form *εβουλευον*, and wish to ascertain what the form is. We find that this form is made up thus: *ε* is the syllabic augment, *βουλευ* the root, *εβουλευ* the tense-stem of the imperfect, and *ον* the person-ending of the first person singular; consequently the form means *I was advising*, since *βουλευω* signifies *I advise.* Accordingly, to put into Greek the imperfect *ye were advising*, we take *βουλευω*, and cutting off *ω*, the termination of the first person singular, we prefix to the root thus obtained the augment *ε*, and so form *εβουλευ*, the stem of the imperfect; to this stem we add, as the termination of the second person plural, the letters *ετε*, thus forming *εβουλευετε*, which means *ye were advising.* In order, then, to form the imperfect, take the present as given in the vocabulary, cut off the person-ending of the present, prefix the augment, and subjoin the person-ending (that one of the person-endings which you want) to the tense-stem. Care should be taken in all cases to get the tense-stem before attempting to add the person-endings, or the mood-vowel, or indeed to form any required part of the verb.

VOCABULARY.

Αγορευω, I harangue, I say.
Απειρος, -ον (adverb απειιως), unskilful; απειρως εχειν, to be ignorant of.
Αποτρεπω, I turn away, turn from.
Αποφευγω, I flee.
Αροτρον, -ου, το (*Latin* aratrum), a plough
Γενναιως, generously, nobly, bravely.
Δεινος, -η, -ον, fearful; το δεινον, peril.
ʽΕτερος, -α, -ον (Latin, *alter*), another.
Εχω, I have, possess.
ʽΙνα, in order that (with subjunctive after a principal tense; with optative after an historical tense).
Καλλος, -ους, το, beauty.
Κευθω, I conceal.
Μουσικη, -ης, ἡ, art, music.
ʽΟταν, when (with subjunctive).
ʽΟτε, when (with indicative).
Οὑτως (before consonants, οὑτω), thus.
Πλησιαζω, I draw near, approach.
Προνοια, -ας, ἡ, forethought; προν. εχειν, to care for.
Προσπιπτω, I fall to, happen, befall.
Στασιαζω, I live in uproar, I disagree.
Τε — και, both, as well as, and — and.

EXERCISE 80.—GREEK-ENGLISH.

1. Δυο δδω προς την πολιν αγετον. 2. Βοε το αροτρον αγετον. 3. Χαιρωμεν, ω παιδες. 4. ʽΩς ἡδυ (sc. εστι) καλλος, δταν εχῃ νοῦν σωφρονα. 5. Οἱ πολιται τους νομους φυλαττοντων. 6. ʽΕταιρος ἑταιρου φροντιζετω. 7. Πατηρ τε καὶ μητηρ προνοιαν εχετων της των τεκνων παιδειας. 8. ʽΟ γραμματων απειρος ου βλεπει βλεπων. 9. Τας προσπιπτουσας τυχας γενναιως φερε. 10. ʽΟ παις τῳ πατρι ῥοδον φερει, ἱνα χαιρῃ. 11. ʽΟ παις τῳ πατρι ῥοδον εφερεν, ἱνα χαιροι. 12. Σωκρατης ὡσπερ εγιγνωσκεν οὑτως ελεγεν. 13. ʽΟτε οἱ ʽΕλληνες επλησιαζον, οἱ βαρβαροι απεφευγον. 14. Θεμιστοκλης και Αριστειδης ποτε εστασιαζετην. 15. Λακεδαιμονιοι μουσικης απειρως εχουσιν. 16. Αποτρεποιτε, ω θεοι, το δεινον αφ᾽ ἡμων. 17. Μη ἑτερον κευθοις καρδιᾳ νουν, αλλα αγορευων.

REMARKS ON THIS EXERCISE.

The subjunctive of the first person plural holds the place of the imperative; thus, *χαιρωμεν, ω παιδες*, is to be rendered, *let us rejoice, O boys.*

The imperfect often denotes a repeated act, and may sometimes be rendered, with the aid of the verb *to accustom*, thus—*Σωκρατης*, etc., *was accustomed to speak.* The optative, as expressive of a wish, may be used as a softened imperative, as *Αποτρεποιτε*, etc., *O that you would turn away;* that is, *turn away.* *Μη ἑτερον*, etc., literally, do not conceal in your heart another thought, speaking different things—that is, *do not say one thing and think another.*

EXERCISE 81.—ENGLISH-GREEK.

1. This road leads to the city. 2. Two roads lead to the city. 3. Two horses drive the plough. 4. These roads led to the city. 5. Women are beautiful when they have good sense (*a sound mind*). 6. The citizens keep (*guard*) the laws. 7. The citizens were keeping the laws. 8. The citizen keeps the laws. 9. You, O citizens, keep the laws. 10. My father takes care of my education. 11. My mother and my sisters took care of my education. 12. The citizens nobly bear the chances that befall. 13. The mother brings a rose to the father, that he may rejoice. 14. The sister brought a rose to her brother, that he might rejoice. 15. The daughter, the mother, and the father disagreed. 16. Do not (*O that ye would not*, *μη* with opt.) disagree, O parents! 17. The boys were rejoicing. 18. I rejoice. 19. You rejoice. 20. We rejoice. 21. Thou rejoicest. 22. They rejoice. 23. You were rejoicing. 24. I was rejoicing. 25. My sister was rejoicing. 26. The young man is ignorant of music. 27. These girls are ignorant of music. 28. I am ignorant of music. 29. We, O boys, are ignorant of music. 30. Those who are unskilled in letters, seeing see not. 31. Those women are unskilled in letters. 32. I am not unskilled in letters. 33. We are not unskilled in letters. 34. Two men are fleeing. 35. He conceals his thought in his heart. 36. When the barbarians approached, he fled. 37. May the gods (opt.) turn the danger from us.

THE FUTURE TENSE, THE FIRST AORIST—ACTIVE VOICE.

The stem of the future is formed from the stem of the present by the addition of *σ* to the stem of the present; *e.g.*, *λυ-*, *λυσ-*. *Λυσ-* is the stem of the future: subjoin the person-endings, and you have the tense in full.

The first aorist active stem is formed from the stem of the future by prefixing to that stem the augment; by affixing the person-endings, as given in the paradigm, we obtain the tense in full. The future and the first aorist of *αγορευω* are thus formed:—

αγορευ-, Future, *αγορευσ-*, *αγορευσω*, *-εις*, *-ει*, etc.
αγορευσ-, Aorist First, *ηγορευσ-*, *ηγορευσα*, *-ας*, *-ε*, etc.

Observe in this last instance that the augment is not the syllabic but the temporal, namely, *ε* is changed into *η*.

VOCABULARY.

Αβλαβεια, innocence, innocuousness (α, not; βλαβη, injury).
Αγαμεμνων, -ονος, ὁ, Agamemnon.
Αμφω, both.
Απολυω, I free from (απο and λυω).
Δακρυον, -ου, το, a tear.
Διαλυω, I put an end to (δια and λυω).
Δικαζω, I judge (δικη, justice, judgment).
Δικαστης, -ου, ὁ, a judge.
Εκγονος, -ου, ὁ and ἡ, a descendant, offspring.
ʽΕκτωρ, -ορος, ὁ, Hector.
Επαγγελλω, I announce, report (αγγελος, a messenger; hence our *angel*).
Επιβουλευω, I plot against.
Εσχατος, -η, -ον, the last, extreme.
ʽΙκετευω, I implore.
Και, even, also (in Latin, *etiam*).
Καταλυω, I destroy (κατα and λυω).
Κινδυνευω, I am in danger, I incur danger.
Μηνιω, I owe a grudge, I am angry with.
ʽΟτι, that.
Πλατειαι, -ων, ἡ, Platæa.
Στρατια, -ας, ἡ, an army.
Φυτευω, I plant.

EXERCISE 82.—GREEK-ENGLISH.

1. Οἱ στρατιωται την πολιν απο των πολεμιων απολυσουσιν. 2. ʽΟ χρηστος ανθρωπος και τοις εκγονοις φυτευσει. 3. ʽΟ αγγελος επηγγελλε τοις πολιταις, δτι οἱ πολεμιοι τῳ στρατευματι επιβουλευσοιεν. 4. Αχιλλευς Αγαμεμνονι εμηνῑσεν. 5. Οἱ ʽΕλληνες ανδρειᾳ πολλα ισχῡσαν. 6. Σωκρατης ουχ ἱκετευσε τους δικαστας, μετα πολλων δακρυων, αλλα πιστευσας τῃ ἑαυτου αβλαβειᾳ εκινδυνευσε τον εσχατον κινδῡνον. 7. Πριν αν αμφοιν μυθον ακουσῃς, μη δικαζε. 8. Οἱ Λακεδαιμονιοι Πλαταιας κατελῡσαν. 9. Τίς αι πιστευσαι (πιστευσειε) ψευστῃ; 10. Ακουσαις (ακουσειας) μου, ω φιλε. 11. ʽΟ αγγελος επηγγελλεν, οτι οἱ πολεμιοι τῃ στρατιᾳ επιβουλευσαιεν (επιβουλευσειαν). 12. Ακουσον μου, ω φιλε. 13. ʽΕταιρος ἑταιρῳ πιστευσατω. 14. Την πολιν λεγουσι μεγαν κινδῡνον κινδυνευσαι.

REMARKS ON THIS EXERCISE.

Πριν αν, *before* (with subjunctive or optative); *αν* refers to a condition expressed or understood, and so requires a dependent mood.

In the exercise επηγγελλε is the third person singular of the imperfect indicative; the η between επ (επι) and the verb is the temporal augment formed by lengthening the α, the first letter in the verb αγγελλω. In ισχυω and ἱκετευω the augment is formed by simply lengthening the ι. The optative form in επιβουλευσαιεν is occasioned by ὁτι in a sentence in what is called the *obliqua oratio*, that is, a dependent sentence. A direct independent sentence is called *oratio recta*. In other words, the optative is required because the fact is represented as dependent on the report of the messenger; in English the indicative must be used. The force of the aorist in the imperative πιστευσατω cannot be given in English by any one word. The student must wait for the explanations to be given in the Syntax.

EXERCISE 83.—ENGLISH-GREEK.

1. The general will free the city from the enemy (plural). 2. Good men plant for their offspring also. 3. Good men will plant for their children (παις). 4. The messengers report many things. 5. The enemy plot against the king. 6. The enemy will plot against me. 7. I announce many things to the citizens. 8. Achilles is angry with Agamemnon. 9. Achilles will be angry with Agamemnon. 10. Thou art angry with thy brother. 11. I was angry (first aorist) with the enemy. 12. I will entreat my judges. 13. Socrates will not entreat his judges. 14. The good citizens will not entreat their judges. 15. The enemy are destroying Platæa. 16. The soldiers will destroy Platæa. 17. The soldiers destroyed the city. 18. Hear (aorist) me, O my offspring (plural). 19. One friend believes another (ἑταιρος ἑταιρῳ). 20. One friend will believe another. 21. One friend did believe another. 22. They believed. 23. They did believe. 24. They believe. 25. They will believe. 26. Thou wilt believe. 27. They two believed. 28. We shall believe. 29. We believe. 30. The soldier prevails much by his valour. 31. I prevailed much by my valour.

HISTORIC SKETCHES.—XLIII.

THE THIRTY YEARS' WAR.

THIRTY years of war! Thirty years of battle, murder, and sudden death; thirty years of anarchy and bad-blood-making; thirty years in which two strenuously opposed hosts did their utmost to mar so much of God's image in one another as thirty such years had left remaining in them. Why all this bloodshed? The conquerors and the conquered called themselves Christians, professed to be guided by the teaching of Him who bade his follower put up his sword into its sheath, and ordered the smitten on one cheek to turn the other cheek also to the smiter. It is true that he said so, true also that he warned his followers that he was come not to bring peace upon the earth but a sword—that is to say, that though he himself taught his disciples, by his own precept and example, not to resist evil, he knew that what he taught would so divide men as for a time, and even, perhaps, at recurring times, to put the sword of strife between them. The parents were to be divided against their children, the wife against her husband; and a man's foes were to be they of his own household.

This state of things had been seen in Christendom on more than one occasion, but not accompanied by any great convulsion. It had been rather local than general, showing itself in the form of heresies with their attendant persecutions, rather than in any universal outbreak. In early days the circumstances of the Christian Church were such, that union amongst its members was indispensable to its existence, surrounded as it was on all sides with implacable foes, and overlooked from its midst by an irresistible pagan master, who looked contemptuously on its practices, and derided its principles as unmanly. When, in the course of time, the Christian Gospel made its splendid but bloodless victories, and the master who, erewhile oppressed, became its champion and supporter, while all the nations of Europe heard its message gladly, the Church was too much occupied in consolidating its power, the people were too ignorant in the newness of their conversion, for any serious disturbances to take place. Occasionally, indeed, as time grew older, and corruptions which had crept in began to be seen and spoken about, there was agitation and trouble, as when John Huss raised his voice in Bohemia against spiritual wrongdoing, and having brought down the wrath of ignorant rulers upon him, perished a witness for truth; as when John Wycliffe, in our own country, undertook to withstand the traditions of the elders, where those conflicted with the revelations written for man's instruction in God's Bible; as when Savonarola, in 1497, preached to the people of Florence, and was, for their sins or his own, put to death in the market-place.

But it was not till the year 1517, when Martin Luther trod under foot and burned the Pope's Bull of Indulgences at Wittenberg, that Christendom saw the fulfilment, on a large scale, of the words which the Redeemer had addressed to his apostles. In the flame that burned the Papal Bull to ashes was kindled the scorching fire of a so-called religious war, which raged furiously for the space of thirty years, involved nearly every European nation in its toils, and at its finish left Europe purified, though exhausted; purged from many sins and many follies which perhaps actually required so great a remedy for their removal.

The Thirty Years' War was in effect the war between Roman Catholicism and Protestantism, between the old order which was changing, and the new which forced change upon it. It sprang from a number of causes, but the immediate outburst was on this wise.

Since the Reformation till the year 1612, the German Protestants had enjoyed the free exercise of their religion. Their numbers and the importance of their leaders, including as they did some of the more powerful among the lesser princes, had won this for them, and they lived peaceably enough with their Roman Catholic countrymen. The rights of the Protestants were under the protection of the emperor, as head of the empire. All went smoothly enough, in spite of the efforts of the men of the older Church, till the advent of Rudolph II. to the throne. He neglected many of his duties for pleasures harmless enough in themselves, such as clock-making, chemistry, and mechanics, but not only useless but pernicious in a king. Whatever statesmanship he had in him led him to join the princes of the empire in a league against the Turks, who were at that time threatening seriously the western nations of Europe. The Jesuits, who abounded at his court, managed to work the emperor's organisation to their own ends, and the Protestants getting wind of this, banded themselves together into what they called "The Evangelical Union," at the head of which they placed the Elector Palatine of the Rhine, son-in-law to James I. of England. When Rudolph died, in 1612, the election fell, to the great horror of the Protestants, upon Matthias, the approved pupil and close ally of the Jesuits and extremists in the Roman Church.

Matthias wilfully failed to protect his Protestant subjects in the enjoyment of their simple right to worship God according to the dictates of their own consciences; the Romanists understood that a nod was as good as a wink from an emperor whose eyes were intentionally fast shut, and the result was that the Protestants of Germany were evil intreated in many places. Churches in which the Protestants worshipped were pulled down, and a large amount of social persecution went on, though, as yet, the law professed to protect equally all who were under it. Then the League arose, a combination of Roman Catholic princes throughout Europe, not in Germany only, of which the avowed object was to root out the hated Protestant faith wherever it might be. The League had the special blessing of the Pope, and included among its members many of the most powerful persons in Christendom, lay princes as well as ecclesiastical dignitaries; it was rich in wealth and influence, and in bitter hatred for all who were opposed to it.

When the Bohemian nobles complained to the Imperial Council at Prague that their churches had been pulled down, and their rites and those who administered them had been insulted, their complaints were received with so much contempt and so little consideration, that the heady Bohemians treated the matter as a personal affront to themselves, hot words followed, and some of the contemptuous councillors got thrown out of window for their pains. To make the situation more difficult, Matthias procured that his cousin Ferdinand, a bigot of bigots on the Roman side, should be King of Bohemia, and his acts and government speedily drove his subjects into revolt. Anarchy was prevailing, civil war was going on in

Bohemia, when the emperor died (1619), and to the distress of the whole Protestant party, Ferdinand was chosen to succeed him. The Bohemians elected Count Frederick, Elector Palatine of the Rhine, to be their king, as he was also head of the "Evangelical Union," and in an evil hour for him he accepted the dignity. The Thirty Years' War now began in earnest.

Frederick's dominions were quickly invaded by a host of Imperialists, whom he was quite unable to withstand; and, unassisted by those from whom he had every natural right to expect help, the unfortunate elector had to put up not only with the loss of Bohemia, but of the Rhenish palatinate also, a province which was his by hereditary descent.

Shocked, but not stunned, by this blow, the Protestants of Germany saw that they must at once make a stand, or be for ever kept under the yoke. A new union was formed, and King Christian of Denmark was placed at the head of it. Under him were the Dukes of Mecklenburg, Count Mansfeldt, an able commander though an adventurer, the Marquis of Brandenburg, and some of the lesser princes on the western side of the empire. War burst forth instantly. The Danish king was all unready to embark in such a war, and those who relied upon him for leadership and for material help as well, were unable to bring much to the advancement of the cause, except themselves, their swords, and enormous appetites. On the Imperial side were wealth, the best soldiers in Europe, leaders of consummate ability, and with a belief in the righteousness of their cause, which was worth half an army to them. Counts Tilly and Wallenstein—the latter was in the course of this campaign made Duke of Friedland—commanded for the emperor, and against their skill and the discipline of the troops all Mansfeldt's bravery was in vain. The Protestant provinces were overrun, fire and sword laid waste the whole of that part of the empire, King Christian was beaten again and again, and finally made peace with the emperor on condition of renouncing for ever all right to interfere in the affairs of Germany, and of leaving his allies in the war to their fate. The Dukes of Mecklenburg were dispossessed, Wallenstein obtained a grant of the duchies for himself, and the Protestant cause in 1629 looked blank indeed.

Help came from a very unexpected quarter. Louis XIII. of France came to the throne a minor, and Cardinal Richelieu was appointed to govern in his name. The cardinal had two grand ideas of State policy: one was to humble the nobility of France to a minimum of power, so that the king might be all in all in his kingdom; the other was not to allow any foreign State to become so powerful as to make it impossible or even dangerous for France to cope with it. With his home policy, which he carried out bloodily and mercilessly, we have not now any concern, but his foreign policy led him to see, in what was going on in Germany, the certainty of Austria becoming, if not checked, an overmatch for any other European nation whatever. The cardinal disliked heretics, not so much as such, but because they were necessarily troublesome people to the Government. In France, he crushed the Huguenots with a relentless hand, but he did not object to Huguenots in other people's dominions, especially if, as in the present case, they helped on his policy. If he hated Protestants at all, he hated the Imperial power still more, and he did not scruple to employ and to support the former when they promised to come in conflict with the latter.

A decree of the Emperor Ferdinand published in 1630, and requiring the Protestants to give up all church property of any kind in their use or possession, was entrusted to Wallenstein to carry out, and that despot did his work so cruelly and shamefully, that even the Roman Catholics cried out. The deadly rage of the Protestants was once more excited, and, fed by the agents of Richelieu, looked for the "still strong man" with "heart, head, hand," who should concentrate their anger, and then discharge it like a shell upon the Imperialists.

Such a man was Gustavus Adolphus, King of Sweden, the most important, both for position and resources, among all the Protestant princes of Europe. When asked to take the place to which Christian of Denmark had shown himself unequal, and from which many a bold man might have shrunk, he hesitated; but having accepted the post, he knew no shirking or shrinking from the work. He devoted himself and all his resources to the undertaking, and having captured the important island of Rugen, landed in Pomerania, June 24th, 1630.

Jealousy kept asunder those who should have hurried to meet him. The Saxon princes even refused him permission to march his army through their territories—a foolish, even criminal act, which caused the strong city of Magdeburg to fall into the hands of Count Tilly, who knew not the meaning of the word mercy, but caused 30,000 of the inhabitants to perish miserably, and the entire city, excepting the cathedral, to be razed to the ground. This awful cruelty of the Imperialists taught German Protestants what they had to expect, and the immediate result was to bind the wavering Protestant princes in a firm bond with Gustavus. The rulers of Pomerania, Brandenburg (now the kingdom of Prussia), Hesse, and after some delay, Saxony, united to support the King of Sweden, who brought men and ability to fight their battles. At Wittenberg they joined their armies with his, and at Leipsic, on the 7th of September, 1631, battle was joined with the Imperial army under Count Tilly, who was defeated with tremendous loss. The ghosts of Magdeburg sat heavily on his sword, and diverted his talents from their usual successful channel. His valour and his counsel were alike set at nought, and at length, in the early part of 1632, when trying to stop the progress of the victorious Swedes into Bavaria, he was killed by a cannon-shot, from which all the relics he carried about with him, all the saints to whom he paid his homage, could not save him. The Protestant allies occupied the whole country between the Elbe and the Rhine, and after Tilly's death, overran Bavaria.

Wallenstein, whose boundless ambition, enormous wealth, and intolerable insolence had fixed a great gulf between him and the emperor, was the only man who could save the empire. An appeal was made to him, and he took command of the Imperial armies, unshackled by a single condition. At Nuremberg, where he was entrenched, he had the satisfaction of beating off the army of Gustavus, who, burning under the desire to wipe off the disgrace of even partial defeat, attacked him at Lutzen, on the 16th November, 1632. The battle was one of the most bloody on record. For nine hours it was fought with obstinate fury on both sides, Gustavus Adolphus fell mortally wounded in the middle of it, and the Swedes fought for revenge as well as for victory. Prince Bernhard of Saxe Weimar took the command after the king's death, and the result was that the Imperialists were totally routed, while the field was literally covered with their slain.

Happily, there remained, in spite of the grievous loss sustained in the death of Gustavus, good men and true among the Swedes, who resolved to carry out the policy of their beloved king. Chancellor Oxenstiern, Gustavus' friend and counsellor, was chosen to manage the war, and he gathered up in his strong hand the reins which threatened to float loosely and disordered. He linked the German Protestants in a new union, gave Prince Bernhard, and Gustavus' trusted generals, Banier, Horn, and Torstensohn, the chief commands of the armies, and with Richelieu's help prosecuted the war vigorously. At the end of 1634 another event conspired to help him. The Emperor Ferdinand, jealous of his mighty subject, the Duke of Friedland, and suspicious of his intentions to snatch the crown for himself, procured his assassination, and the loss of Gustavus was more than counterbalanced. But the King of Hungary, son to the emperor, took Wallenstein's place, and at Nordlingen defeated the confederates with so severe a loss, that all but the French and Swedes and the Landgraf of Hesse were fain to make peace with the emperor. This was done by the Treaty of Prague, in 1635.

During the whole of Richelieu's life the war went on, bringing out generals like the Great Condé, Turenne, and Torstensohn, and winning, on the whole, fresh laurels for the French and Swedish arms; and when Richelieu and his master died in 1643, it was found that Cardinal Mazarin, who governed for the inor Louis XIV., was prepared to carry out their plan for humbling the House of Austria.

Under the conduct of Condé and Turenne, and the Swedish generals, the Thirty Years' War continued to ruin and desolate the face of Germany, till in 1648, the Emperor Ferdinand III., weary of continuous defeat, exhausted as to his resources, and unable to cope with the powers against him, sued for peace, and the Peace of Westphalia, which secured civil and religious liberty to the Protestant subjects of the empire, was signed at Munster, and brought the long succession of years of war to a close.

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NATURAL HISTORY OF COMMERCE.

CHAPTER III.

THE EFFECT OF GEOLOGY ON THE INDUSTRY OF THE BRITISH PEOPLE.

Introduction—General Physical Geography of England as dependent on its Geology—Geological Distribution of Mineral Products.

THE soils of a country necessarily vary with the varying nature of the subjacent strata; and to appreciate the influence of the former on the industry of the inhabitants of any particular district, its geology must be carefully studied; for, apart from climatic effects, the constituents of different soils determine, to a great extent, the distribution of plants. The attachment of some species of these to certain kinds of rock is illustrative of the statement. *Arenaria Norwegica*, *Cerastium alpinum*, and *Arabis petræa* are confined, in the Shetlands, to serpentine rock; *Orobanche rubra*, in Ireland, to the basalt; *Erica vagans* marks, in Cornwall, the course of many metalliferous veins; and the prevalence of other species on sandy, clayey, chalky, or calcareous beds is well known.

Great Britain presents in its rock-groups an epitome of the geological structure of Europe, if not of the known world, and offers, accordingly, material for the most fruitful and interesting study. Nowhere can better be seen the connection between geological influences and mining, manufacturing, or agricultural industry. At the first glance, a map of England shows that west of a line drawn from the mouth of the Tees on the north-east, to Lyme Regis on the south-west, the chief occupations are mining and manufactures, while east of the same line agriculture is the staple. The people of the north, too, are distinct from those of the south.

The intelligent reader will naturally inquire into the causes of these phenomena. We will at once direct attention to them, and offer some generalisations on the geological distribution of the minerals, plants, and animals most useful to man.

I. *General Physical Geography of England as dependent on its Geology.*

The rocks of Great Britain are divided, according to the origin of their present condition, into two great classes and one sub-class—viz., *aqueous* rocks, formed by the action of water; *igneous* rocks, formed by the action of heat; and *metamorphic* rocks, which, originally stratified or aqueous, have since been changed in their texture by igneous action.

Igneous and metamorphic rocks comprise only a small proportion of the rocks of England and Wales. In North Wales they appear largely in the counties of Merioneth, Carnarvon, and Anglesea; and for twenty miles eastward of St. David's Head igneous rocks are variously distributed. Rocks of these groups constitute the Grampians, the South Highlands of Scotland, the Cheviots, and the Malverns; they occur too in Derbyshire, Worcestershire, Charnwood Forest, Devon, and Cornwall, whilst the midland, southern, and eastern parts of England are devoid of them.

Aqueous rocks, constituting by far the greater proportion of the rocks of the entire world, form in our island a number of beds arranged in succession one upon the other, each set of beds, or *formations*, presenting peculiarities which enable the geologist to recognise and place them in a serial order, which order is irreversible. The following table exhibits the series of formations composing the stratified rocks of England:—

Epochs or Periods.	*Systems.*	*Formations.*
TERTIARY or CAINOZOIC.	*Pliocene* . . .	Post-Pliocene. Newer Pliocene. Older Pliocene.
TERTIARY or CAINOZOIC.	*Miocene.*	
	Eocene . . .	Upper Eocene. Middle Eocene. Lower Eocene.
SECONDARY or MESOZOIC.	*Cretaceous* . . .	Chalk. Upper Greensand. Gault. Neocomian. Wealden.
	Jurassic . . .	Purbeck. Portlandian. Kimmeridge Clay. Coral Rag. Oxford Clay. Cornbrash. Great Oolite. Inferior Oolite. Lias.
	Triassic or New Red Sandstone . .	Keuper. Muschelkalk (absent in England). Bunter.
PRIMARY or PALÆOZOIC.	*Permian.*	
	Carboniferous . .	Coal Measures. Millstone Grit. Mountain Limestone.
	Devonian and Old Red Sandstone.	
	Silurian . . .	Upper Silurian. Middle Silurian. Lower Silurian. Primordial Silurian.
	Cambrian.	
	Laurentian.	

In the west, in Devon, Cornwall, and in Wales; in the north-west, in Cumberland; and in the Pennine chain, which stretches from Northumberland to Derbyshire, we have what form the mountain and hilly tracts of England and Wales; all of which are composed of palæozoic rocks, elevated by the disturbances to which they have been subjected.

If we pass from the older rocks of South Wales and the border counties in an easterly direction, as from the neighbourhood of Gloucester to London, to the newer and less disturbed rocks, we find that they present low undulating grounds and plains of new red sandstone and lias, succeeded by two great escarpments, the edges of table-lands, of not more than 1,000 feet above the sea, sloping toward the east. The western escarpment, as seen in the Cotswold Hills, is formed by the oolitic, and the eastern by the cretaceous or chalk strata; the tertiary, comprising on the east the London, and on the south the Hampshire basins, overlies the chalk.

This physical structure of England is represented in the following generalised section:—

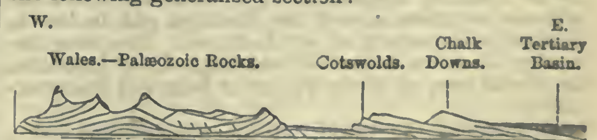


Fig. 1.

If we examine the country farther north, say from Snowdon to Flamborough Head, the arrangement of strata will be found very similar to that observed in the line of the southern sections. Thus in the west rise the disturbed palæozoic strata which form the mountain region of North Wales; in Flint and Denbigh carboniferous rocks appear; then in Cheshire, lies the great plain of new red sandstone, from underneath which rise, in Derbyshire, the carboniferous strata, forming the high grounds in that country; these are succeeded by the low escarpment of the magnesian limestone of the Permian system; and then come plains of new red sandstone again, crowned by the escarpment of the narrow strip of oolite, and by that of the cretaceous rocks.

This structure explains the course of the larger rivers. The principal watershed of the country is the tract of high ground extending from the north of Scotland far into England; it is nearer to the west coast than to the east, and therefore a much larger area of country is drained towards the east than towards the west. All the larger rivers—with the exception of the Severn and its tributaries—run into the German Ocean. The plains which occupy much of the middle and east of England are traversed by many tidal rivers; and from the nature of the country, the construction of canals has been a comparatively easy task.

II. *Geological Distribution of Mineral Products.*

The modes of occurrence of minerals are in veins or lodes, in regular or irregular beds, and in connection with detrital matters. The consideration of the distribution of minerals will be treated of under these heads.

1. *Minerals in Veins.*

Though it is difficult, in the present state of our knowledge, to ascertain the laws regulating the deposit of metalliferous matter, yet we are able, from general observation of the geological structure of the earth, to say that *here* search may be made for minerals with some hope of success, and that *there* exploration will be futile. Hundreds of thousands of pounds have been expended in the opening up of mineral districts; a large proportion of the sum utterly without profit.

Great Britain possesses a rich supply of minerals; we have gold, silver, copper, lead, tin, zinc, antimony, nickel, cobalt, bismuth, uranium, chromium, and other of the rare metals, besides vast stores of iron; our coal beds are enormous, and earthy minerals are in great variety and value. Statistics show that in Great Britain 350,000 persons are actually engaged in mining operations, exclusive of quarries of all kinds, and that the produce is of the minimum annual value of £40,000,000.

The lodes from which we derive our chief supply of metals are almost wholly confined to palæozoic rocks. Their occurrence may be sketched as follows:—

The Silurian formation in North Wales, in the Isle of Man, in Cumberland, in the lead hills of the south of Scotland, in parts of the Highlands, and in parts of Ireland, contains metalliferous veins which yield gold, ores of copper, lead, silver, antimony, arsenic, and zinc.

The rocks of the Devonian formation in Devon and Cornwall contain rich tin, copper, and lead lodes.

The carboniferous limestone in Derbyshire, ranging up to the north of England through Cumberland and the adjacent counties, also of the Mendips, and in Devon, is the chief depository of our lead ores. The same formation contains large and rich deposits of hæmatite, an ore of iron, as in the Forest of Dean and Somersetshire.

Throughout the world, all the metalliferous lodes, with some peculiar exceptions hereafter to be mentioned, occur in stratified or the associated igneous rocks, not newer than the Permian. It is thus that one generalisation in the inquiry is arrived at, viz., that of the *period* during which the lodes carrying our richer metals were filled. Geology, like the more exact sciences, is capable of advancing philosophical inductions to very important results. Sir Roderick Murchison was enabled in 1844, from the study of the gold-bearing tracts in Russia, to predict the discovery of gold in Australia. "Having," writes Sir R. Murchison, "in the year 1844, recently returned from the auriferous Ural Mountains, I had the advantage of examining the numerous specimens collected by Count Strzelecki, along the eastern chain of Australia. Seeing the great similarity of the rocks of those two distant countries, I could have little difficulty in drawing a parallel between them; in doing which, I was naturally struck by the circumstance, that no gold 'had *yet* been found' in the Australian ridge, which I termed in anticipation the 'Cordillera.' Impressed with the conviction that gold would, sooner or later, be found in the great British colony, I learned in 1846 that a specimen of the ore had been discovered. I thereupon encouraged the unemployed miners of Cornwall to emigrate and dig for gold, as they dug for tin in the gravel of their own district. These notices were, as far as I know, the first published documents relating to Australian gold." ("Siluria.")

Influence of Igneous Rocks in the Development of Minerals in Veins.

Mineral veins occur in igneous rocks as well as in aqueous rocks; but the intrusion of an igneous mass among stratified deposits appears to have rendered their lodes richer than when conditions otherwise similar obtain.

Gold is usually found in a quartz matrix, traversing palæozoic shales, chiefly those of the lower Silurian epoch; and the auriferous lodes are frequently richest in the vicinity of eruptive rocks. But the precious metal is found also in secondary rocks, such as those of California, Peru, etc., yet under circumstances exceptional to the *usual mode of association of gold.* It appears that where certain igneous eruptions, diorite especially, have penetrated the secondary strata, the latter have been rendered auriferous for a limited distance only beyond the junction of the two rocks; and it is concluded that all secondary and tertiary deposits (except the auriferous detritus of the latter), not so specially affected, never contain gold.

The lodes carrying copper and tin in Cornwall and Devon are richest about the junction of the *killas* (local name for the slaty rocks of the Devonian formation in this district), and the bosses of granite, and where they are intersected by granitic dykes, termed *elvans.* It is worthy of remark that these metalliferous veins have a course or strike nearly east and west, and that these phenomena are not confined to this area, but are exhibited in Saxony and elsewhere.

Other examples might be adduced, but these will suffice to show that *intrusive rocks influence the metalliferous richness of veins.*

2. *Bedded Mineral Deposits.*

These include coal and iron ore of primary importance; and salt, gypsum, cement-stones, coprolites, iron-pyrites, bituminous shales, etc., of secondary value.

(*a.*) *Coal* occurs in many formations; it has been mined for upwards of a hundred years at Brora, in Sutherlandshire, in rocks of the oolitic epoch, and is worked at Bovey Tracey, Devonshire, in Miocene beds. An anthracite occurs in the Devonian rocks in Spain; there are good workable coals of the age of the trias in Virginia and Hindostan, and of that of the lias in Hungary; and less valuable coals, chiefly brown coals, occur in tertiary strata in Austria and other parts of Germany. But by far the richest and largest supplies are drawn from the carboniferous system in Great Britain, Belgium, United States, Nova Scotia, Australia, etc.

In Great Britain no coal is found below carboniferous strata, but it does occur in newer strata. In the midland and south-western counties of England, and in South Wales, it is confined to the true coal measures underlain by the millstone grit, locally called the "farewell rock," because, in the language of the miner, when that rock is reached, one bids farewell to the coal. But in the north of England and in Scotland workable coal seams occur in the inferior formations of the carboniferous system, as well as in the coal measures.

The right understanding of the law of superposition of rocks in relation to our coal-bearing strata, is of value not only to the man of science, but to every speculator in mines, and to every landed proprictor who cares to understand the mineral value of his property. Not long ago considerable funds were spent at Tullygirvan, Co. Down, in a useless search for coal. The adventurer had set to work in black Silurian shales, their mineral aspect resembling that of certain coaly strata, with which he was, perhaps, familiar; but had he possessed even a slight acquaintance with organic remains, he would have abandoned his experiment at the commencement, for the shales were charged with graptolites. Now the scientific miner knows that rocks containing graptolites, trilobites, etc., existed untold ages before the epoch of the coal strata; so that when he meets with those remains, he concludes that money spent in search of coal beneath them will be turned into irredeemable dust, for they occupy, in the irreversible order of deposits, a position thousands of feet beneath the coal measures.

Lord Londonderry bored in the old red sandstone, at Mount Stewart, Co. Down, in search of coal: here, though no fossils occurred, yet the position of the sandstone strata above the previously mentioned Silurian shales, and overlaid as they are by mountain limestone, proved the impossibility of coal being found.

In the neighbourhood of Carrickfergus are two silent witnesses of the folly of sinking for coal where the geological structure of the country precludes the possibility of its presence, or of its occurrence at reasonable depths. Trial shafts had been sunk in new red sandstone, which was pierced to a depth of about 1,000 feet, when the adventures were abandoned. Before coal could be reached, the Permian strata would have to be passed through; and from the unconformability of the new red sandstone to the Permian, and of that set of strata to underlying formations in this district, it was even doubtful if coal could be reached at all.

But coal has been successfully reached by the penetration of newer unconformable strata; thus in the Somersetshire coal field, the coal shafts pass through new red sandstone, the Permian strata being absent. The famous Monkwearmouth pit passes through 330 feet of overlying Permian rocks.

In these and other instances that might be adduced the undertakings had been commenced at the suggestions of those who were perfectly satisfied, from an examination of the surrounding country, of the feasibility of the venture. Yet, on the other hand, attempts have been made to reach coal from below secondary rocks, when, with but a broad knowledge of the geological structure of the country, the trials should have been at the outset abandoned. Thus, at Kingsthorpe, near Northampton, a shaft was sunk through the lower oolite and lias, at an expenditure of nearly £30,000; the adventurers desisted when they reached the new red sandstone. A similar trial took place near Lyme Regis, the lias being bored for coal at an expense of several thousand pounds; the deception was fostered by the accident of passing through a *piece* of lignite.

(*b.*) *Iron Ores.*

Certain ores of iron occur in lodes in primary strata, but others, especially the spathic and brown hæmatite ores, are intercalated as bands among shales and limestones of the carboniferous, liassic, oolitic, wealden, and cretaceous strata; but by far the largest supply is obtained from the carboniferous system, the one shaft often communicating with both coal and iron-stone workings, and the same group of rocks furnishing limestone

CORRESPONDENCE IN FRENCH.—V.

17.—Form of Advice of a Traveller's Visit.

Lyons, March 28th, 1882.

Messrs. Smith, Cook & Hyde, London.

Gentlemen,—We beg to inform you that our Mr. Robert Roche will wait upon you to submit to your inspection samples of our latest manufactures in Dresses and Shawls, Waistcoatings, Cravats and Handkerchiefs.

Trusting soon to be favoured with a large order,

We remain, Gentlemen,

Your obedient Servants,

Lecouteur, Gaspard & Co.

Lyon, le 28 *Mars* 1882.

Messieurs Smith, Cook & Hyde, à Londres.

Messieurs,—Nous avons l'honneur de vous annoncer que notre M. Robert Roche se présentera chez vous pour vous soumettre les échantillons de toutes nos nouveautés pour robes, châles, étoffes pour gilets, cravates et foulards.

Dans l'espoir de recevoir bientôt une bonne commande,

Nous vous présentons, Messieurs,

nos salutations empressées,

Lecouteur, Gaspard & Cie.

18.—Letter advising despatch of Goods, and enclosing Invoice

London, April 10th, 1882.

Phillip Teesdale, Esq., Dublin.

Dear Sir,—Enclosed please find invoice of Cotton Goods forwarded to-day in a case marked P T No. 5.

The amount of this invoice

£450 please place to my credit.

Awaiting your further orders, to which my best attention shall always be given. I remain, dear Sir,

Yours truly,

A. Lonsdale.

Londres, le 10 *Avril* 1882.

Monsieur Phillip Teesdale, à Dublin.

Cher Monsieur,—Ci-joint j'ai le plaisir de vous remettre facture à des Cotonnades qui vous ont été expédiées ce jour dans une caisse marquée P T No 5.

Pour le montant de cette facture veuillez me reconnaître de £450.

Dans l'attente de vos ordres ultérieurs qui auront tous mes soins, Je vous présente, cher Monsieur,

Mes salutations sincères,

A. Lonsdale.

19.—Letter requesting Further Orders.

Lyons, Dec. 30th, 1881.

Messrs. Dufour & Co., Paris.

Gentlemen,—It is now more than three months since we had any orders from your firm; nevertheless, we are persuaded that the fault does not lie with us, or the manner in which we have executed your last.

We are more vexed than you at the rise in velvet, and we know that your sale must in consequence be hampered. If you, however, realise that throughout France and Italy cocoons have fetched from 6 fr. to 6 fr. 90 c. per kilogram—that is to say, 18% more than last year, and that consequently silk costs us more than 18% above last year's prices—you will see the necessity of our raising the price of our velvet in proportion.

You will find in our parcel some samples of what we have in stock, and we subjoin our price list.

Our Mr. Marchand will be in Paris next Tuesday, and will have great pleasure in giving you further details.

We are, Gentlemen,

Truly yours,

James Marchand, Brigaud & Co.

Lyon, le 30 *Décembre,* 1881.

Messieurs Dufour & Cie, à Paris.

Messieurs,—Il y a plus de trois mois que nous n'avons reçu d'ordres de votre maison; nous ne pouvons, pourtant, imaginer que la manière dont nous vous avons traités dans le dernier envoi, ait pu diminuer la confiance que vous nous avez accordée.

Nous sommes plus fâchés que vous de l'élévation de prix que vont subir nos velours, et nous sentons bien que cela vous gênera pour la vente. Figurez-vous que les cocons se sont payés partout en France et en Italie de 6 fr. à 6 fr. 90 le kilogramme—c'est-à-dire, 18 % plus cher que l'an dernier—les soieries de toute cette campagne vont donc nous coûter 18 % de plus que l'an dernier, et il faut que nous augmentions nos velours en proportion.

Vous trouverez dans notre envoi quelques échantillons de ce que nous avons de disponible en magasin, et ci-joint notre note de prix.

Notre M. Marchand sera à Paris Mardi prochain, et aura le plaisir de vous entretenir plus longuement de tous ces détails.

Agréez, Messieurs,
Nos saluts empressés,
JACQUES MARCHAND, BRIGAUD & C^{IE}.

20.—CIRCULAR LETTER OF CREDIT, ETC.

London, March 4th, 1882.

Gentlemen,—This circular letter of recommendation and credit will be remitted to you by James Muirhead, Esq., of Edinburgh, a gentleman for whom we claim from you a friendly reception, and we beg you to give him an opportunity of entering into business relations with the large landholders of your country. Mr. Muirhead belongs to one of the richest families in Scotland, and himself superintends his extensive and flourishing estates. As he intends looking over the land in the neighbourhood of your metropolis, you will oblige us by paying every attention in your power to his family, who, having accompanied him thus far, will remain a few weeks in your city during his short absence.

As to the funds which Mr. Muirhead will require, we beg to open a credit with you in his favour for the sum of £5,000 (five thousand pounds sterling), which you will please to pay, indorsing on this letter each of the sums he will have received to the full amount of his credit. Please add to the amount your commission and all other expenses, and draw on us for the whole sum at the best possible rate of exchange, and at the date customary in your town.

Assuring you that due honour will always meet the drafts for the payments you will make to James Muirhead, Esq., the receipts for which you will be kind enough to send us, we beg to thank you beforehand for the attentions you will show to this gentleman and his family.

We shall always have the greatest pleasure in rendering you similar or other services, and begging you to command the same at any time,

We are, Gentlemen,
Your obedient servants,
SPIELMAN & Co.

Messrs. N. N. at Berlin, Vienna, Trieste,
Venice, Rome, Naples.

Londres, le 4 Mars, 1882.

Messieurs,

La présente lettre circulaire de recommandation et de crédit vous sera remise par James Muirhead, Esq., d'Edimbourg, auquel nous vous prions de vouloir bien faire un accueil obligeant, et lui procurer en même temps la possibilité de se mettre en relation d'affaires avec les grands propriétaires de votre pays. Mr. Muirhead appartient à une des plus riches familles de l'Écosse, dont les terres prospèrent sous sa direction. Vous nous obligerez infiniment, Messieurs, si vous pouvez aussi contribuer aux agréments d'un séjour de quelques semaines que la famille de notre recommandé fera dans votre capitale, tandis que Mr. Muirhead lui-même visitera les terres voisines de la métropole.

Quant aux fonds dont Mr. Muirhead aura besoin, nous l'accréditons chez vous pour une somme totale de £5,000 st. (nous disons cinq mille livres sterling), qu'il vous plaira de lui payer, en marquant sur le dos de cette lettre chacune des sommes qu'il aura touchées jusqu'à épuisement de son crédit. Vous voudrez bien chaque fois ajouter à ces paiements votre commission de banque et tous les autres frais, en vous remboursant sur nous au meilleur cours possible et à l'échéance qui conviendra aux usages de votre place.

En vous assurant, Messieurs, que le meilleur accueil sera toujours préparé à vos traites pour les paiements que vous ferez à Mr. J. Muirhead, et dont vous nous enverrez les reçus, permettez-nous de vous exprimer d'avance nos plus vifs remerciements des attentions que vous aurez pour notre recommandé et sa famille.

Nous éprouverons toujours le plus grand plaisir à vous rendre le réciproque, ainsi que tout autre service qui dépendra de nous, et vous prions de disposer librement de notre ministère.

Agréez, Messieurs, l'assurance de la plus haute considération de

Vos obéissants serviteurs,
SPIELMAN & C^{IE}

Messieurs N. N. à Berlin, Vienne, Trieste,
Venise, Rome, Naples.

21.—LETTER OF INTRODUCTION.

Stuttgard, Jan., 4th, 1882.

Gentlemen (Sir),—We beg to introduce to you the bearer, Mr. ——, whom we recommend to your kindness.

We at the same time open in your account a credit of £1,000, to which amount please furnish Mr. —— with the sums he requires upon his receipts, which please send us, when debiting our account for your payments.

Accept beforehand our best thanks for the services you will render Mr. ——, and believe us to be, Gentlemen (Sir),

Faithfully yours,
J. WEBER & Co.

Mr. ——, London.
Valid for —— months.

Stuttgard, le 4 Janvier, 1882.

Messieurs (Monsieur),—Nous prenons la liberté d'introduire chez vous par ces lignes, et de vous recommander à un accueil obligeant, M. ——.

Nous l'accréditons chez vous pour la somme de £1,000 (nous disons mille livres sterling). Veuillez bien payer jusqu'à cette concurrence l'argent dont M. —— aura besoin, et nous en débiter sous envoi de ses quittances.

Nous vous remercions d'avance, de ce que vous voudrez faire en faveur de M. ——, et vous prions d'agréer l'assurance de notre parfaite considération,

J. WEBER & C^{IE}.

M. ——, à Londres.
Valable pour —— mois.

CIVIL SERVICE PAPERS.—IV.

GROUP III. (*continued*).

7.—ECCLESIASTICAL COMMISSION. (*Open Competition.*)

THE office is at 10, Whitehall Place, and its duties are to carry out the detail of business imposed upon the Commissioners by the Act of Parliament which created them. This act authorised certain persons, including all the prelates of England and Wales and some disinterested laymen, to arrange, due regard being had for existing interests, for the better distribution of ecclesiastical property for church purposes throughout the country. The Commissioners are receivers, equalisers, and distributors of church revenues. Establishment as follows:—Twelve first-class clerks, £400 to £600; 24 second-class ditto, £100 to £350.

8.—EMIGRATION OFFICE. (*Open Competition.*)

Office at Park Street, Westminster. Staff small, comprising first-class, second-class, and supplementary clerks. Duties consist in aiding, on behalf of the Government, the efforts of persons desirous of emigrating from this country. This is done subject to conditions imposed by the Government. The commissioners have also a general control over all emigration, and by their agents at the ports take care that emigrant ships are properly manned. Salaries—Second-class, £100 to £300; first-class, £300 to £500.

9.—THE LUNACY COMMISSION. (*Open Competition.*)

Office at 19, Whitehall Place. The duty consists in doing the clerical business incidental to the commission, of which the function is to inquire into allegations of lunacy, and generally to exercise care and control over lunatics and their custodians. The office staff is small, comprising one clerk at

£300 to £500, by increments of £15 a year; five clerks at £100 to £400; one clerk at £80 to £200; and three clerks (Lower Division) at £80 to £200.

10.—THE MINT (*Open Competition*)

Is on Tower Hill. The professional officers belonging to the establishment are many, inclnding assayers, engravers, modellers, and chemists; but the office staff is small. Salaries—Junior clerks, £100 to £250, by £10 annually; senior clerks, £300 to £400, by £15; chief clerk, £500 to £700, by £20.

In this department there are various situations reqniring special technical knowledge on the part of those who occupy them, and these appointments are made nnder the provisions of Clause VII. of the Order in Council of June, 1870, and, on the recommendation of the head of the department, the person selected by him is not compelled to submit to the ordinary examination, bnt the Civil Service Commissioners may grant the certificate of qnalification upon evidence satisfactory to them that the candidate possesses the reqnisite knowledge and ability, and is duly qualified in respect of age, health, and character. The age of foremen in the operative department mnst be between 25 and 45, and they have to pass an examination in handwriting and orthography; arithmetic (including vnlgar and decimal fractions), and English composition. Balance mechanics must be between 25 and 50, and, of conrse, possessed of special technical knowledge.

11.—NATIONAL DEBT OFFICE (*Open Competition*)

Is at 19, Old Jewry. Discharges dnties in connection with proposals for reducing the National Debt, and is the office for calculating and arranging life annuities secnred upon the guarantee of the Government. There are seven commissioners for the office, but the secretary and comptroller-general is the practical head and manager. In addition to sundry professional assistants, there is a considerable office staff. One chief clerk, £800; 4 principal clerks, £600 to £700; 6 assistant principal clerks, £400 to £500; 2 senior clerks (redundant), £340 to £480; 7 assistant clerks (redundant), £200 to £320; junior clerk (rednndant), £140 to £180; 13 clerks (Lower Division), £80 to £200.

12.—PATENT OFFICE (*Open Competition*)

Is at 25, Sonthampton Buildings. Through it pass all docnments reqniring the patent of the Great Seal, and in it are recorded all specifications of inventions with protective patent rights. The commissioners are the Lord Chancellor, the Master of the Rolls, the Attorney-General, and Solicitor-General. The clerk of the commissioners is head of the office.

13.—THE PAYMASTER-GENERAL'S. (*Open Competition.*)

Office at Whitehall. The Paymaster-General pays all anthorised demands on the pnblic purse. Except for small amounts, no department of the state is allowed itself to pay, in cash, liabilities which it has incurred. Public payments are, as a rule, paid only by the Paymaster-General, npon whom the other departments draw bills at three days. These bills are paid at maturity, either in cash, if nnder £50 and the payee so wishes it, or, if for amonnts over £50, by cheque on the Bank of England. The office staff for this duty is necessarily large, and costs over £20,000 a year. Establishment as follows:—One chief clerk, £800 to £1,000; 3 principal clerks, £700 to £800; 18 first-class clerks £400 to £600; 18 second-class clerks, £100 to £375; and 17 clerks (Lower Division), £80 to £200.

14.—THE RECORD OFFICE. (*Open Competition for Clerkships.*)

In the Rolls House, Chancery Lane. There are kept the archives of the kingdoms, and all the pnblic papers of importance enongh to be preserved. The duties of the office are manifold, some of them consisting in ordinary official routine, some in translating, deciphering, transcribing, or arranging documents in the possession of the Keeper of the Records; these duties are performed by specially qualified attendant keepers.

The patronage is in the Master of the Rolls, who is Keeper of the Records. Candidates for Clerkships are, in addition to the ordinary first-class examination, examined in translations from the Latin and French languages.

15.—REGISTRAR-GENERAL'S OFFICE (*Open Competition*)

Is at Somerset House. The duties of the office are to arrange and tabulate the information which is collected by district registrars as to the increase and diminution of the population.

Births, marriages, and deaths are recorded there, and copies of certificates can be obtained under certain conditions. The year's statistics are gathered np into the Registrar-General's report, which is pnblished annually.

16.—SCIENCE AND ART DEPARTMENT. (*Open Competition.*)

Office in Cromwell Road, Sonth Kensington. Carries out the detail of administration of the departments connected with the Museum. Salaries:—1 chief clerk, £500 to £650; 9 first-class clerks, £100 to £400; 2 second-class clerks, £100 to £250; 32 clerks (Lower Division), £95 to £250. There are assistant naturalists, cnrators, and geologists, bnt special scientific knowledge being reqnired, additional examination mnst be passed. The appointments are open to competition.

GROUP IV.

The departments in this group are those connected with the collection of the revenue rather than with execntive administration. The offices we have previonsly considered are those which direct the spending of the money; those we shall now describe are very large establishments, which collect immense sums, and necessarily employ very large staffs. Appointments in the Customs and Inland Revenue Departments are now entirely open to competition; and in the Post Office the principle is applied to some of the offices. We shall treat of these important departments *seriatim*, and begin with—

1.—THE CUSTOMS. (*Open Competition.*)

It is the bnsiness of the Customs Department to collect at all the ports in the kingdom the taxes on imports which the wisdom of Parliament has chosen to impose, to see that nothing goes from the warehouses in which the articles are lying "in bond," as it is called, without payment of the accustomed dnty; and generally to see that the revenue is not defrauded by smngglers. There are custom-house officers at every port of arrival, but the head-qnarters to which all agents report, and where the customs business for the metropolis is carried on, is in Thames Street, London. The office staff, in addition to the regular "officers" of the department, is necessarily large. The department, which is under the control of the Treasnry, is under the immediate direction of commissioners who act as a board, and are assisted by a secretary, assistant secretary, and a number of principal officers. The pay of the last-named varies considerably, some having no more than £500, others as much as £1,000 a year. These appointments constitute the prizes of the office. Salaries:—These vary a little, according as the appointments are in the Secretary's, Solicitor's, or Acconntant's offices; in the Statistical department, in the Long Room, or in the other offices into which the establishment is subdivided. But it may be stated generally that second-class clerks enter at £80, and may rise to £250; first-class clerks rise from £100 to £400; and principal clerks from £520 to £700. Committee clerks have from £600 to £700, by annual increment of £50. Special qnalifications are required for clerkships in the Solicitor's office, and in addition to the ordinary subjects the candidate mnst pass an examination in criminal law, law of evidence, or in law procedure and practice and elements of conveyancing. If to these legal subjects he can add equity and bankruptcy, so mnch the better, but those subjects are optional. Besides the appointments here mentioned, there are examining officers (£100 to £300, according to grade); surveyors (£100 to £400); inspectors (£350 to £650); and a large staff of ont-door officers, with salaries from £60 to £100. Candidates for appointment as outdoor officers mnst be from 19 to 25 years of age, and pass an examination in handwriting, orthography, arithmetic (as far as vulgar and decimal fractions), and English composition. The fee for the examination is 2s. 6d. These officers are eligible for promotion to the higher ranks of the service.

2.—INLAND REVENUE. (*Open Competition.*)

Somerset House. This is a very large department, doing with regard to internal taxation what the Customs does with regard to duties on articles coming from without the kingdom. It has outposts in all parts of the country, and its head-quarters in London. To the central office all reports are made from the out stations, and all orders are issned from thence. Generally

*

speaking, the Inland Revenue department is charged with the collection of all internal taxes, as income tax, legacy duty, and assessed taxes. It regulates the administration of the excise laws, provides stamps of all kinds, licences, public conveyances, collects legacy duty, and discharges the detailed duties of a great fiscal department. There are several departments in which a large number of clerks are employed—the offices of the secretary, the solicitor, the accountant and controller-general, the statistical department, and the long room, being the most important. Altogether nearly 500 clerks are employed in the office of the Inland Revenue. Salaries vary according to the department in which the clerk is placed; but may be generally stated as Lower Division clerks, £80 to £250; Upper Division clerks, £100 to £550; principal clerks, £520 to £700.

Candidates for the appointment of assistant of excise must be between the ages of 19 and 22, unmarried. They will be examined in handwriting, orthography, arithmetic (to vulgar and decimal fractions), and English composition. Failing in any of these subjects, the candidates will not be eligible. The following are optional subjects, namely:—higher arithmetic, including mensuration, sqnare and cnbe root; and geography, especially that of the British Isles. Each candidate mnst pay an entrance fee of £1.

3.—POST OFFICE. (*Open Competition.*)

The chief office is in St. Martin's-le-Grand, in the City. The functions of this office need not be described, for the daily and hourly discharge of them must have made them familiar to all. It is sufficient to say, generally, that the duties of the office include the carrying on the vast detail of postal administration, both for home and foreign service, in making all necessary arrangements for the transport of mails, and in seeing that mail contracts are properly carried out. To these important duties are added the management of the telegraphs and a large amount of money order and savings bank business. Clerks in the secretary's office must pass the first-class examination, as described by us in a previous paper.

It scarcely comes within the scope of these papers to give information respecting the employment of boys as clerks and newspaper and telegraph messengers in the Post Office; but we may say that they must be between 13 and 16 years of age; that boy clerks, of whom there are a considerable number in the Savings Bank and other departments, must pass an examination in copying and writing from dictation, geography, and arithmetic as far as practice. They receive from £30 to £50 a year. Boy newspaper sorters and telegraph messengers must be between the ages of 13 and 16, and pass an elementary examination; they are paid from 6s. to 12s. per week. Fnll information respecting these situations can be obtained at the office of the Civil Service Commissioners, Cannon Row, Westminster.

Telegraph Clerks.—Since the management of the telegraphs has been undertaken by the Post Office, a great number of appointments, both of male and female operators, have been made. This department offers interesting and fairly remunerative employment to well-educated and intelligent young men and women. The age for appointment is between 14 and 20; and candidates should address applications, accompanied by testimonials as to character and ability, to the private secretary of the Postmaster-General, at the chief office, St. Martin's-le-Grand. When vacancies occur, candidates who appear to be eligible receive notice to attend for the purpose of undergoing a test examination in elementary knowledge. Having passed this—and it is of a very easy character—the applicants are sent to the School of Telegraphy, where they are instructed in the management of the telegraphic apparatus. They remain there two or three months, but receive no remuneration until appointed to clerkships. On the male staff there are 262 first-class telegraphists, from £110 to £140, and 904 second-class telegraphists, 12s. a week to £100. On the female staff there are 196 first-class telegraphists, 21s. to 34s. a week, and 474 second-class telegraphists, 10s. to 27s. We may add that acquaintance with French, German, or any other Enropean language, is a recommendation for promotion; and that in no department of the service is general intelligence more valuable.

4.—FRIENDLY SOCIETIES' REGISTRY. (*Nomination.*)

This was called into existence by the 18 and 19 Victoria, c. 63, which provided for the regnlation of benefit clubs and other friendly societies. The office staff includes 1 chief clerk, £400 to £500; 2 clerks, £180 to £300; 4 copying clerks, £80 to £200; 2 ditto (Lower Division). £80 to £200. The patronage rests with the Home Secretary.

LESSONS IN GEOLOGY.—XIII.

THE METAMORPHIC SYSTEM.

THE lowest of the systems enumerated in the eleventh lesson was the "Metamorphic System." That classification arranged the stratified rocks, but this system has many material differences from the rest of the strata which owe their existence to aqueous action. In the first place, the appearance of the members of this system is eminently crystalline. In many of them the lines of stratification have been almost or altogether obliterated, and this has been the result of some action which permitted a re-arrangement of particles, and completely metamorphosed the rocks which were submitted to its power. Hence they are termed "metamorphic rocks." No signs of organic remains have as yet been discovered, nor can this be a matter of surprise, for a re-arrangement of particles would readily obliterate any fossil remains.

Of course, it is quite possible that these rocks never contained fossils, that the epoch of their deposition was previous to the creation of animal or vegetable life on the earth. By those who hold this belief the metamorphic period is said to be *azoic* (destitute of life). Others, who think that the signs of life have been obliterated or perhaps not yet discovered, prefer the term *hypozoic* (below life). Such a term does not commit them to any conclnsion, but simply asserts that as yet these rocks have not afforded evidences of life existing at the time of their deposition, but that it is quite possible that such life may have existed.

As might be anticipated, the metamorphic action has not been carried to the same extent in all rocks, just as in the case of fossilisation the whole of the original matter of the organic body may have been replaced, or the process may only have partially proceeded. Hence Professor Jukes divided metamorphic rocks into two classes:—(1.) Those in which the original structure is still apparent. (2.) Those in which it is obscured, or quite obliterated.

In this, as in every system, the three great kinds of rock are represented—

Arenaceous . .	Quartzite or Quartz rock.
Argillaceous . .	Clay Slate.
Calcareous . . .	Crystalline Limestone, Marble, etc.

These rocks belong to the first of the above divisions, while *schists* and *gneiss* form the other class, in some specimens of which there is no appearance of stratification whatever.

In speaking of various kinds of rocks, it is quite impossible to describe them so accurately as to give the reader the power of at once pronouncing upon a specimen he has never seen before. Geological mnseums are now so numerous, and so readily accessible, that well-nigh every one can see specimens of the various rocks whose main characteristics we touch upon, and such practical examination will do more for the young geologist than chapters of description.

Gneiss is the most prominent of the metamorphic group. It contains the constituents of granite—qnartz, feldspar, and mica. But these minerals are not congregated in gneiss as they are in granite. In the latter rock they appear distinct and in good-sized crystals, but thoroughly mixed; whereas in gneiss they are in small particles, and are arranged in layers, the mica being separated from the quartz and the feldspar from each. These layers are very thin, and the rock readily separates—or *foliates*—along the juncture of the layers. This naturally led to the supposition that gneiss was degraded granite: the action of water had worn down the granite, and its particles had been redistributed; falling according to their gravities, the same mineral would arrive at the bottom at the same time, whereas any alteration in the strength of the current would alter this, and cause to be deposited another of the three constituents of the original rock, so forming several layers of quartz, feldspar, and mica. In process of time, this stratified rock became subject to the influence of heat, which aided the crystallisation of the minerals, and gave to the rock that indurated appearance which gneiss frequently exhibits. But the layers in gneiss are too perfectly parallel to admit of their origin being due to the deposition from water. Besides, we have an instance when gneiss has evidently been produced from clay-slate. There is, in the neighbourhood of Dublin Bay, a range of granite hills, some 70 miles long. This vast mass of granite was erupted through a series of clay-slates. These slates have a dull, earthy texture, and are dark-coloured. According to Professor Jukes, "Whenever the granite comes to the surface, a belt of slates surrounding it is converted into *mica-schist*, with, in some few places, beds of *perfect gneiss*. Crystals of garnet, schorl, andalusite, etc., make their appearance in these altered slates in greater and greater abundance as they approach the granite."

At a distance as much as two miles from the outcrop of the granite, the slates acquire a glaze, or a micaceous lustre, which does not desert the particles even when the rock is crushed. This micaceous tendency becomes more definite as the granite is approached, until folia and plates of mica are apparent.

Here, then, we have a plain case in which clay-slates have become metamorphosed into mica-schist and gneiss.

A similar instance—and, in one sense, more instructive—is quoted by Sir Charles Lyell, as being exhibited on the west side of the fiord of Christiania, in Norway. Here the granite protrudes into fossiliferous strata; at a distance of 400 yards from the outcrop of the igneous rock the stratified rocks are "altered," and begin to exhibit all the appearances of metamorphic rocks, and to contain crystals in their mass of minerals usually classed with igneous rocks. The fossils can "rarely be detected," and in those places where the crystallising force has proceeded to any extent, all traces of organic remains are quite obliterated.

In Shetland the same fact is illustrated. There, clay-slates which are in contact with granite become gradually more siliceous, and finally merge into hornblende-schist.

From these and similar facts we conclude that gneiss, and its kindred rocks, are "altered" stratified rocks, altered by the agency of heat. The greatest amount of metamorphism would be effected where the heat was so intense as to completely fuse the rock; in this case an igneous rock would be the result, and therefore it is possible that some igneous rocks, and even granite, may have been once stratified rocks which had undergone fusion. This opinion is received by many geologists, who argue that the presence of phosphates in minerals found in these igneous rocks may be due to organic remains which have been utterly obliterated, and yet the phosphate of lime found in their bony structures mingled itself with the composition of the molten matter, and there produced such minerals as apatite, which contain phosphorus in a state of combination.

Gneiss may be said to be schistose granite; that is, a rock containing the constituents of granite, and yet exhibiting a degree of foliation and a disposition to split up into lamina. When this facility of division increases, the term "schist" is always applied to the rock, and the most prominent constituent of the rock placed before the word, so as to render the name descriptive. Thus *mica-schist* is a fissile mass of mica and quartz, frequently containing garnets and crystals of hornblende. If *talc* be in the place of the mica, it is then termed *talc-schist;* if the material be composed of chlorite and quartz, a *chlorite-schist* is the result; and thus the schistose rocks are a large class, all probably dependent for their different composition to the circumstances under which they were formed.

Metamorphosed Calcareous Rocks.—This class presents unusual interest, for to this action we owe the existence of that beautiful stone which has been used in every civilised age for ornament and sculpture. Marble is an "altered" or "metamorphosed" limestone. In a preceding lesson, we entered into the formation of limestone and chalk rocks in general, showing that their origin was most probably due to the agency of life; in fact, they were built up by the united effort of an inconceivable number of minute polyps, and other animalcules. No wonder, then, that such rocks contain innumerable evidences of organic structure; and yet no trace of such structure has ever been discovered in marble. The very finest marble in the world, that of Carrara, offers the best illustration of this subject. It abounds in the Massa Carrara, or Apuan Alps, mountains some 6,000 feet high. In the neighbourhood, where the rocks are not altered by metamorphic action, they are composed of the ordinary Apennine limestone, which belongs to the oolite period, resting on argillaceous and siliceous sandstones. The limestones are full of fossils and flint nodules; between them and the sandstones, which are also fossiliferous, though not so plentifully as the limestones, is a band of shale. In the neighbourhood of the Massa Carrara these strata have been invaded by plutonic rocks, and consequently metamorphosed; the fossiliferous limestone has become Carrara marble, which does exhibit a trace of a fossil; the flint nodules are no longer found, but in their place crystals of quartz. In some places the lines of stratification can be traced, though this is the exception rather than the rule. The shales have been altered into talc-schists, jasper, and hornstone, whilst in the place of the underlying sandstones are quartzite and gneiss. This and other similar instances leave no room for doubt that marbles and crystallised limestones owe their characters to the action of heat. It seems not improbable that the black lines in marble are due to carbon in a very finely divided state, and that this carbon may be the remains of some vegetable or animal deposit.

The above results were approached by actual experiment by Sir James Hall, who found that chalk, when heated and so pressed as to prevent the escape of the carbonic acid gas, assumed a crystalline appearance.

Metamorphosed Argillaceous Rocks.—These rocks were originally deposited as clay or silt, which was probably derived from the further disintegration of gneiss, and which afterwards underwent metamorphic action. They are now known by the blue and purplish roofing-slates so much used, for which the series is very valuable. These rocks are of great thickness, and exhibit the phenomenon of "cleavage" very beautifully. The planes of cleavage do not run parallel to those of stratification, but almost at right angles to them. The origin of cleavage is not known. Some geologists ascribe it to the action of heat, others to pressure, others to electricity. Very probably all these causes have conspired to produce this curious effect.

Metamorphosed Arenaceous Rocks.—Quartzite or *Quartz Rock* is the sandstone of the group. As we have said, sandstone is an aggregation of particles of quartz. When such a rock is submitted to the action of great heat, these particles agglomerate, forming quartzite. This rock is not to be confounded with *vein-quartz*, which occurs as a white, flinty mass, often in large quantities. The matrix of the Australian gold is this species of quartz. The difference between the two kinds of quartz is this: quartzite is an altered bed of sandstone of the same age as the beds in which it is found; whereas vein-quartz is a deposition in a vein or fissure, which, of course, must have been made subsequent to the deposition and solidification of the rock.

The metamorphic systems, as we have seen, are very productive in a mercantile point of view. Marbles, slates, serpentines, quartz; rock which is used, when ground down, for pottery purposes; metallic veins of copper, lead, tin, frequently traverse the beds of the system. Gold and silver, and many precious stones, are among the valuables its beds contain.

But one of its products demands a longer notice. *Plumbago*, or *black lead*, as it is erroneously called, is only found in rocks which are members of this group. Plumbago is one of the forms of carbon. This element appears in three states: as coal, plumbago, and diamond. The latter is the purest, and is probably only carbon which has had, under peculiar circumstances, the opportunity of crystallising. Plumbago contains about four per cent. of iron, the rest of it is pure carbon. There is reason to believe that it is coal which has been metamorphosed. Sir Charles Lyell gives a typical example of this process.

At Worcester, in the State of Massachusetts, there occurs a bed of impure anthracite and plumbago, interstratified with mica-schist. Anthracite is heavier than common coal, and more completely mineralised. It has an iridescent lustre, and does not soil the fingers. From microscopical examination, and other means, there is no doubt that anthracite is coal which has been somewhat altered; a step further, and plumbago is the result. At the place indicated, the anthracite is dug out for fuel, and the plumbago for pencils. Sir Charles says:—"After traversing the country in various directions, I came to the conclusion that the carboniferous shales or slates, with anthracite and plants, which at Rhode Island often pass into mica-schist, have at Worcester assumed a perfectly crystalline and metamorphic texture, the anthracite having been nearly transmuted into that state of pure carbon which is called plumbago, or graphite."

LESSONS IN BOTANY.—XXXIX.

SECTION CXX.—CRYPTOGAMIC PLANTS.

These we have already glanced at in a former part of our lessons. Their organisation is very curious and exceedingly diverse; but in consequence of the absence of flowers, or at any rate recognisable flowers, their study is not so easy as that of the flowering plants. The most remarkable tribes belonging to this division of plants are the mosses, lichens, fungi, ferns, and sea-weeds, and to these we shall now direct the reader's attention.

SECTION CXXI.—MOSSES.

There is no season of the year in which we may not find interest and employment amid the mosses and lichens — no soil nor situation where some or other of one or both families may not be found. Scarcely any part of the world is destitute of them. On the coasts of the Icy Sea, where the soil never thaws for more than the depth of a few inches, plants of these kinds are said by travellers to be the chief forms of vegetation. In Spitzbergen, Greenland, and even in higher latitudes, they are abundant, as well as on the morasses and volcanic tracks of Iceland; and on the frozen deserts of Siberia, these little cryptogamous plants may still be found. Nor only there; for in the arid wastes of burning Africa, it is told us that the traveller Mungo Park was revived and rejoiced by the sight of one of the species of this lovely tribe.

278. Wall screw moss (Tortula muralis)—1, cluster of seed-vessels; 2, theca or fruit; 3, peristome; 4, calyptra. 279. Curved fruit-stalks of a moss. 280. Erect fruit-stalks of a moss. 281. Fruit-stalks of the hair-moss (Polytrichum).

The muscology of Britain, which contains about four hundred species, most nearly resembles that of North America, and is also closely allied to that of the northern and central parts of the continent of Europe. It is within less than a century that this interesting and widely extended class of plants has been made the subject of much study or research. The Germans seem to have taken the lead in this branch of botany, but they have been vigorously followed by many illustrious students of Nature among our own countrymen, and new discoveries are daily being made in this department of the vegetable kingdom.

The structure of mosses is of the simplest kind; fungi, sea-weeds, and lichens alone being below them in the scale of vegetation. With mosses commence the separation of root, stem, and leaves, with which parts every plant of this tribe is furnished, and in the place of a flower they have little vessels usually supported on a stalk, and containing the seed. The stems vary from the twelfth part of an inch to a foot in height; few of them, however, exceed four inches, and most are much less. The leaves differ in form, some being egg-shaped, others lance-shaped, and very many linear. If examined under a microscope, these will often be found beautifully veined and reticulated; they have generally a bright-green hue, which proves the activity of their breathing apparatus; yet there are species brown, purple, and even nearly black, as well as of the palest whitish-green. The edges of the leaves are often toothed, or notched like a saw. Mosses are said to be in fruit when the little seed-vessel of which we have spoken is formed.

The fructification of this tribe of plants is very peculiar, and by it, more frequently than by any other part, is the species determined. At certain seasons of the year we may observe a forest of thin stems, crowned with these little seed-vessels, rising above the general level of the clump of moss on which they grow; these stalks are called *setæ*, or fruit-stalks, and the vessels capsules. Let us take that species of moss which grows so commonly on almost every wall we see, the *Tortula muralis*, or wall screw-moss (Fig. 278-1), as our example, and examine it carefully. The *theca* (Fig. 278-2), or fruit of this, has a little cap, like that of a Norman peasant, with a high peak and long lappet (Fig. 278-4); this is the *calyptra*, or veil, and forms a sort of hood, which, when the fruit is young, is rolled round the theca, so as completely to cover it. As the fruit-stalks lengthen, this veil is torn from its support and carried up on the top of the seed-vessel, much as the calyx of the *Eschscholtzia* is borne up on the summit of the petals before the flower opens. Now if we place this seed-vessel under the microscope, we shall find that beneath the veil is a lid or covering, which closes the mouth of the capsule; this, when the spores or seeds are ripe and fit to be dispersed, is thrown off, and then new and wonderful objects are disclosed; underneath this lid (which is called the operculum) lies a kind of tuft of twisted hairs (Fig. 278-3), which arise from within the rim of the theca, and are called the teeth of the fringe, or *peristome*. These do not exist in all species of moss, and when they are found, differ in number; but it is an unvarying rule, that wherever they are seen at all, their number consists of *four*, or of some multiple of four, amounting occasionally to as many as sixty-four. Sometimes the fringe consists of two rows of teeth, differing in size, number, or arrangement; and this fringe acts in the most beautiful hygrometrical manner. A theca of this same *Tortula* will illustrate our meaning, and show this to be one of those beautiful and delicate arrangements which the wisdom and goodness of God provides for the protection of the young seed. Take a capsule which has been dried when the teeth were closed, and place it in water, or in a damp place, and you will see its teeth unclose with a graceful and steady motion which is beautiful to behold; or if you breathe on a capsule when its fringe is expanded in the sunshine, the slight moisture of your breath will make the little teeth instantly close over the mouth of the vessel wherein the seeds lie. In dry and sunny weather these teeth open, and the seeds, when ripe, are scattered by the wind, and wafted to situations where it is suitable for them to fix. The capsule being elevated on its footstalk, is freely exposed to the effects of sun and wind; thus the seed is first ripened, and then disseminated over the masses of recumbent moss below them, so keeping up and extending an active fresh vegetation, whilst the decaying plants form fresh soil whereon the new ones may grow. The capsule of the *Tortula* is oblong, the lid conical, the leaves expanded and of a very long oblong, their margins bent back, and the nerve protruded beyond the leaf into a white hair-like point. The seeds lie inside the theca, and are contained in a thin bag, open at the upper end, and surrounding a central column called the columella.

Such is the usual conformation of mosses, the organs of which we have spoken—root, stem, leaves, and capsule—being present in all, though they vary in form, arrangement, and other particulars, according to the different genera of which they are members. In some the root is longer and more creeping than in others; the stems differ in length and in other points, some being branched, others simple; some feathered with leaves from base to apex, others bare at the base. The shape and veining of the leaves also varies in different kinds, as do the fruit-stalks, some being curved, as in Fig. 279, others erect, as in Fig. 280. Some proceed from the ends of the stem and branches, as in Fig. 279, whilst others come off laterally, as in Fig. 280; and some kinds are devoid of them altogether, the capsule being sessile, and buried among the foliage.

The grand distinguishing features which mark the genera are chiefly found in the form and position of the theca, and the structure of the calyptra, or veil. Our space will only allow of our slightly touching on a few of these variations, and those who are disposed to study the subject of mosses to a greater length, are referred to the "Muscologia Britannica" of Drs. Hooker and Taylor, and other works which bear directly on the topic; but we may adduce a few instances of the distinctions to be found in some of the commonest genera.

282. SPHAGNUM. 283—1, 2, THECA OF SPHAGNUM. 284. ENCALYPTA OR EXTINGUISHER MOSS—1, THE PLANT; 2, THECA; 3, CALYPTRA. 285. CINCLIDOTUS FONTANALOIDES.

In the *Sphagnum* (Fig. 282), those pale whitish mosses which carpet the ground in bogs, the theca is sessile, that which looks like a fruit-stalk being in fact a continuation of the receptacle, and its form is that of a little cup, the mouth of which is uncovered. In the *Bartramia*, the theca is sub-globose, and seated on a terminal fruit-stalk—this has a double fringe, the outer of sixteen teeth; the inner a membrane divided into sixteen segments, each of which is cleft into two parts, and the calyptra is divided in half. The *Polytrichum*, or hair-moss (Fig. 281), has a double peristome, or fringe, the outer of thirty-two, or sixty-four incurved teeth, placed at equal distances; the inner a thick membrane connected with the outer teeth. The veil of this is also divided in half. The *Encalypta*, or extinguisher-moss (Fig. 284), has a terminal fruit-stalk, and its calyptra is so large, as wholly to cover and conceal the theca, looking like an extinguisher placed over a candle. This species grows on wall-tops, and appears with the screw wall-moss, and the pretty cushion-moss (*Grimmia pulvinata*), very early in the season. This latter is called by children "pincushion-moss," because, when covered with its fruit, it looks not unlike a cushion stuck with small pins. It has an oval theca, the fruit-stalk is rather short and curved, the lid conical, and the calyptra in the form of a mitre. The capsule of *Andrea* is provided with valves, and opens with longitudinal clefts, whilst *Phascum*, and others have persistent lids. In some of the genera the veil is irregularly rent, in others it is perfect; in some it has the form of a mitre, whilst others are beautifully plaited at the base. The differences in the leaves, growth, etc., of the various kinds are innumerable; yet, though the parts differ from each other, the general characteristics which distinguish mosses from plants of every other tribe are so marked and peculiar, that no one need be at a loss to know a moss from any other individual of the vegetable kingdom.

Mosses select very various, in some cases singular habitats; one species is found only on the highest Scotch mountains; another only in a bog near Cork. One very remarkable one grows on the perpendicular face of the white chalk cliffs in Kent and Sussex; others are confined to calcareous rocks, whilst some, as *Cinclidotus fontanaloides* (Fig. 285), will only live beneath the water, or where the spray and dash of the waterfall keeps them continually moistened. There is one kind almost sure to spring up where anything has been burnt on the ground, especially where charcoal has been made, whence its French name, *La Charbonière*.

Hooker tells us that most species of *Splachnum* are found only on the dung of animals, particularly of that of oxen or foxes. "One of these, *Splachnum angustatum*," he says, "which is commonly met with on dung, we once saw growing vigorously on the foot of an old stocking near the summit of Ingleborough, Yorkshire; the same was also found by a friend of ours covering the half-decayed hat of a traveller who had perished on Mount Saint Bernard; and the same was, if we mistake not, found by Captain Parry in Melville Island, vegetating on the bleached skull of a musk ox."

This is no doubt that species of moss which the old herbalist, Gerard, calls *Muscus ex Craneo Humano*, or moss from the human skull. "This kind of moss," says he, "is found upon the skulls or bare scalps of men and women lying long in charnel-houses, or other places, where the bones of men and women are kept together; it groweth very thicke, white like unto the short moss on the trunkes of old oakes; it is thought to be a singular remedy against the falling evil, and the chin cough in children, if it be powdered and given in sweet wine for certain daies together."

LESSONS IN LATIN.—XLI.

DEVIATIONS IN THE THIRD CONJUGATION (*continued*).

6. *Perfect in* -I; *Supine in* -SUM.

a. The stem ends in *d* or *t*.

i. Cando, found in compounds; as, accendo, accendĕre, accendi, accensum, *to kindle, to inflame.*

ii. Cūdo, cudere, cudi, cusum, *to forge.*

iii. Edo, ĕdere, ēdi, ēsum, *to eat.*

iv. Fendo, found in compounds; as, defendo, defendere, defendi, defensum, *to defend, protect.*

v. Fŏdio, fodere, fōdi, fossum, *to dig.*

vi. Fendo, fūdere, fūdi, fūsum, *to pour out.*

vii. Mando, mandere, mandi, mansum, *to chew.*

viii. Pando, pandere, pandi, pansum, and passum, *to spread out, to open.*

ix. Prehendo, prehendere, prehendi, prehensum, *to lay hold of.*

x. Scando, scandere, scandi, scansum, *to climb, mount.* Compounds are in scendo, scendi, scensum; as, ascendo, *to get up to.*

xi. Sīdo, sīdere, sēdi (no supine), *to sit down, to sink.* Compounds are in sido, sidere, sedi, sessum; as, consīdo, *to set one's self down.*

xii. Strīdo, stridere, strīdi (no supine), *to crack, hiss.*

xiii. Verto, vertere, verti, versum, *to turn.*

xiv. Fido, fidere, fisus sum, *to trust;* so confidere, *to confide;* diffidere, *to distrust.*

b. The stem ends in *l* or *r*.

xv. Vello, vellere, velli, vulsum, *to pluck.* Convello has in the perfect convelli; but avello and evello have avelli, evelli, and (seldom) avulsi, evulsi.

xvi. Psallo, psallere, psalli (no supine), *to play on the lyre.*

xvii. Sallo, sallere (no perfect), salsum, *to salt.*

xviii. Verro, verrere, verri, versum, *to sweep, clean.*

xix. Viso, visere, visi (visum, from video), *to visit.* In these verbs, the vowel of the stem, when short, becomes long in the perfect. Two verbs form apparent exceptions: Fi(n)do, findere, fĭdi, fissum, *to split* (so the compounds); sci(n)do, scindere, scĭdi, scissum, *to separate* (so the compounds). But these two verbs originally had the reduplication. It is the same with the compound percello, percellere, percŭli, perculsum, *to strike through.*

VOCABULARY.

Ægritudo (æger), -ĭnis, f., *sickness, grief.*
Antiquitus, *anciently.*
Colonia, -æ, f., *a colony.*
Comprehendere, *to take in, comprehend.*
Confodere, *to pierce.*
Conspectus, -ūs, m., *a view.*
Diffundere, *to spread abroad.*
Digerere, *to divide, digest.*
Epigramma, -ătis, *an epigram, something written on a tomb.*
Effodere, *to dig out.*
Effundere, *to pour out, to throw off (horse-back)* [compare the slang term *to spill*].
Exedere, *to eat away, gnaw.*
Furor, -ōris, m., *rage.*
Incendere, *to set on fire.*
Inscrībere (with dat.), *to inscribe, engrave.*
Lacerare, *to tear, mangle.*
Liquefacere, *to make into a liquid.*
Nuntius, -i, m., *a messenger.*
Offundere, *to pour against, spread.*
Pervĕhi, *to be carried through or to.*
Procudere, *to forge, coin.*
Proficere, *to benefit.*
Velis passis (ablative absolute), *in full sail.*
Velum, -i, n., *a sail.*
Vetustas, -ātis, f., *old age.*

EXERCISE 155.—LATIN-ENGLISH.

1. Constat Tyriorum colonias pæne toto orbe terrarum diffusas fuisse. 2. In morte portum nobis paratum esse et perfugium putemus (subjunctive for imperative). 3. Quo utĭnam velis passis pervehi liceat! 4. Hannĭbal patriam defensum ex Italia revocatus est. 5. Nihil proficiunt præcepta, quamdiu menti error offusus est. 6. Beate vivendi cupiditate incensi omnes sumus. 7. Ingens nummorum numerus hoc anno procusus est. 8. Ægritudo animum meum laceravit, exēdit, planeque confecit! 9. Epigrammătis, monumento inscripti, literæ vetustate exesæ erant. 10. Milites urbem, ab hostibus oppugnatam, acerrime defenderunt. 11. Antiquitus magna auri argentique vis in Hispaniâ est effossa. 12. Milites furore capti, ducem confoderunt. 13. Equus repente corruit, consulemque lapsum super caput effudit.

EXERCISE 156.—ENGLISH-LATIN.

1. Wilt thou turn thy skill in (*of*) speaking to the destruction of thy country? 2. I will turn my skill in speaking to the benefit of all. 3. He has turned his skill in speaking to the salvation and preservation of his country. 4. The traitor being taken will be put to death before the eyes of the citizens. 5. Take care thy horse do not fall and throw thee on thy head. 6. Will the soldiers run their general through? 7. This book is eaten by age. 8. The Queen will coin a large amount of money. 9. The messenger lacerated my mind. 10. My mind was torn by the view of my husband's death. 11. The old and the young will be inflamed with the love of life. 12. Thou canst not see truth so long as thy mind is covered with error. 13. He was carried into Italy. 14. They will be carried to those coasts. 15. The general bravely defended the city. 16. The city will be well defended by the citizens. 17. The colonies of Britain lay spread in all parts of the world.

7. *Perfect with Reduplication.*

The reduplication in the verbs, the first vowel of whose stem is *i*, *o*, or *u*, consists in the repetition of the first consonant of the stem, together with that vowel; in the rest, however, it consists in the repetition of the first consonant of the stem, together with *e*. The compounds have, in the perfect, no reduplication; except those from curro, *I run;* disco, *I learn;* and posco, *I demand.*

i. Cado, cadere, cecĭdi, casum, *to fall, happen.* Compounds are in cĭdo, cĭdere, cĭdi, cāsum, thus: occĭdo, *I go down, die;* incĭdo, *I fall on* (E. R. *incident*); recĭdo, *I fall back;* the rest want the supine; as, concĭdo, concĭdere, concĭdi, *to fall together.*

ii. Cædo, cædere, cecidi, cæsum, *to cut, to kill.* Compounds are in cīdo, cīdere, cīdi, cīsum; as, occīdo, *I put to death.*

iii. Cano, canere, cecĭni, cantum, *to sing.* Compounds in cĭno, cĭnere, cinui; so concĭno, *to sing together;* and occĭno, *to sing inauspiciously;* the rest are without perfect and supine.

iv. Curro, currere, cucurri, cursum, *to run.* Most of the compounds in the perfect have, but oftener have not, the reduplication.

v. Disco, discere, didici (no supine, but disciturus), *to learn;* so the compounds, as perdisco, perdiscere, perdidici, *to learn thoroughly.*

vi. Fallo, fallere, fefelli, falsum, *to deceive;* fallit me, *it escapes me, I am not aware, I am unconscious.* The participle falsus, *false,* is mostly employed as an adjective; compound, refello, refellere, refelli (no supine), *to refute.*

vii. (Pango) pangere, pepĭgi, pactum, *to conclude a treaty.* The present, with this meaning, is supplied by paciscor; but pango, in the sense *I strike, fasten,* has panxi (seldom pegi), panctum (pactum, E. R. *pact*). Compounds, pingo, pingere, pēgi, pactum; as, compingo, *I put together;* depango, *to fix in;* and repango, *to set into* (without the perfect).

viii. Parco, parcĕre, peperci, parsum (with dat.), *to spare.*

ix. Pario, părĕre, pepĕri, partum, *to bear, bring forth, to get, acquire;* P. F., pariturus; ova parere, *to lay eggs.*

x. Pello, pellere, pepŭli, pulsum, *to drive.* Compounds are in pello, pellere, puli, pulsum; as, expello, *I drive out.*

xi. Pendo, pendere, pependi, pensum, *to cause to hang, to weigh, to pay, to suffer.* Compounds are without reduplication; as, appendo, appendi, *I hang to,* or *fasten on.*

xii. Posco, poscere, poposci (no supine), *to ask, demand;* so the compounds, as, exposco, expoposci, *to get by asking.*

xiii. Pungo, pungere, pŭpŭgi, punctum, *to prick.* Compounds in perf., punxi; as, interpungo, *to place a point between.*

xiv. Tango, tangere, tetĭgi, tactum, *to touch.* Compounds are in tingo, tingere, tĭgi, tactum; as, attingo, *to touch upon.*

xv. Tendo, tendere, tetendi, tentum, and tensum, *to stretch;* tendere insidias, *to place in ambush.* Compounds are without reduplication, and with the supine in tentum; as, contendo, contendere, contendi, contentum, *to strive;* but retentum and retensum, extentum and extensum, are used; nevertheless, detendo and ostendo have only detensum and ostensum; ostentus is the same as obtentus, as, ostentus soli, *exposed to the sun.*

xvi. Tundo, tundere, tutŭdi, tunsum, *to pound, beat.* Compounds are in tundo, tudi; as, contundo, *to pound together, to beat in pieces, to weary.*

The two ensuing verbs have the reduplication in the present, and retain it throughout: bibo, bibĕre, bibi, bibĭtum, *to drink;* in the same way, the compounds; sisto, sistĕre, stiti, stătum (stătus, *set fast*), *to place.* Monosyllabic compounds of dare belong to this class; as, addo, addĭdi, addĭtum, *to add.*

VOCABULARY.

Concĭnĕre, *to sing together, to sound in harmony.*
Confirmare, *to confirm.*
Devolare, *to fly down.*
Emollire, *to soften.*
Epulæ, -arum, f., *a feast.*
Evertere, *to overturn, destroy.*
Excidere, *to cut out.*
Fides, -is, f., *a lyre.*
Fidĭbus canĕre, *to play on the lyre.*
Gallina, -æ, f., *a hen.*
Induciæ, -arum, f., *a truce.*
Inspicere, *to look into.*
Londinum, -i, n., *London.*
Noctu, *by night.*
Obtingere, *to obtain.*
Populari, dep., *to lay waste.*
Præsto, *present, quickly*
Recedere, *to go back.*
Restituere, *to restore.*
Tibia, -æ, f., *a pipe, flute.*
Tuba, -æ, f., *a trumpet.*

EXERCISE 157.—LATIN-ENGLISH.

1. Et discas oportet, et quod didicisti, agendo confirmes. 2. Male parta male dilabuntur. 3. Ut hirundines æstivo tempore præsto sunt, frigore pulsæ recedunt, ita falsi amici sereno vitæ tempore præsto sunt, simulatque hiĕmem fortunæ vidĕrint, devŏlant omnes. 4. Quid casurum sit, incertum est. 5. Quod cuique obtigit, id quisque teneat. 6. Clitum amicum senem et innoxium a se occisum esse Alexander dolebat. 7. Ingenuas didicisse fideliter artes emollit mores, nec sinit esse feros (eos). 8. Non tam utilitas, parta per amicum, quam amici amor ipse delectat. 9. Hannibălem non fefellit ferocius quam consultius rem hostes gesturos esse. 10. Ex quo (tempore) pecunia in honore fuit, verus rerum honor occĭdit. 11. Silva vetus cecĭdit, ferro quam nemo cecīdit. 12. Epaminondas fidĭbus præclare cecinisse dicitur. 13. Cato scribit priscos Romanos in epulis cecinisse ad tibiam clarorum virorum laudes atque virtutes. 14. Datur cohortibus signum, cornuaque ac tubæ concinuerunt.

EXERCISE 158.—ENGLISH-LATIN.

1. The hen has laid an egg. 2. The hens will lay eggs. 3. How many eggs a day (*in dies*) do your hens lay? 4. Thy mother has borne a son. 5. The general will not spare the public buildings. 6. The soldier, seized with fury, slew his general. 7. Dost thou think that the enemy will spare those who are worn down with age? 8. I know not whether the enemy will spare the women and children. 9. A truce has been made with the enemy for twenty days. 10. The voices sounded in harmony. 11. The sign having been given, thy brother sang to the lyre the praises of great men. 12. Twenty thousand of our soldiers were slain.

8. *Inchoatives.*

Those verbs are called *inchoatives* (from the Latin inchoo, *I begin*) which denote a commencement, or a transition from one state into another, with special reference to the idea conveyed by the roots from which they are severally formed: for example, vetus is *old;* accordingly the inchoative veterasco means, *I grow* or *become old.* Inchoatives are of the third conjugation, and follow the perfect and the supine of their radical verb.

i. Inveterasco (radical, invetĕrare), inveterascĕre, inveteravi, inveteratum, *to grow old.*

ii. Exardesco (R. ardēre), exardescĕre, exarsi, exarsum, *to burst into a flame, to burst into anger, break out.*

iii. Indolesco (R. dolēre), indolescĕre, indolui, indolĭtum, *to feel pain.*

iv. Revivisco (R. vivĕre), reviviscĕre, revixi, revictum, *to live again, to revive.*

v. Concupisco (R. cupĕre), concupiscĕre, concupivi, concupītum, *to desire* (E. R. *concupiscence*).

vi. Obdormisco (R. dormīre), obdormiscĕre, obdormivi, obdormitum, *to fall asleep.*

The inchoatives of the obsolete oleo, olēre, olui, *to grow,* are formed thus: adolesco, adolescĕre, adolēvi (adultus, as an adjective, *grown up, adult*), *to grow up;* exolesco, exolescĕre, exolēvi (exoletus, as an adj., *grown old, worn out, antiquated*), *to grow out, grow old, become obsolete;* inolesco, inolescĕre, inolevi (no supine), *to grow upon, to add to one's growth;* obsolesco, obsolescĕre, obsolēvi, obsoletum, *to grow down, become obsolete.* Very many inchoatives want the perfect and the supine, as augesco, *to increase,* from augeo, augēre, auxi, auctum. Here may be placed the inchoatives which are derived from substantives or adjectives, as repuerascĕre, *to become a boy again* (puer, *a boy*): only a small part of them form a perfect in -ui, as maturesco, maturescĕre, maturui, *to become ripe* (maturus).

VOCABULARY.

- Aborigines (ab and origo), *the original natives.*
- Adulterinus, -a, -um, *false, adulterate.*
- Advertĕre, *to turn to.*
- Auditor, -ōris, m., *a hearer.*
- Condemnāre, *to condemn,* with capitis, *to condemn to death.*
- Consanesco, -ui, *to become sound* (sanus) *or healthy.*
- Coalesco, coalescere, coalui, coalitum, *to grow together, unite, coalesce.*
- Convalesco, -ui, *to grow well or strong* (validus).
- Defervesco, -bui, *to cease fermenting, to cool down* (fervidus).
- Illucesco, illuxi, *to become bright, to shine forth (as the day).*
- Imprudens, -entis, *without knowing it.*
- Omnis, -e, *every.*
- Permanāre, *to flow through.*
- Recrudesco, -dui, *to grow raw (or sore) again, to break out again* (intransitive).
- Rescisco, *to come to know, find out.*
- Viscus, -ĕris, n. (commonly in the plural, viscera), *the bowels.*

EXERCISE 159.—LATIN-ENGLISH.

1. Crede omnem diem tibi illuxisse supremum. 2. Socratis responso sic judices exarserunt ut capitis hominem innocentissimum condemnarent. 3. Ratio, quum adolevit atque perfecta est, nominatur rite sapientia. 4. Quæritur si sapiens adulterinos nummos acceperit imprudens pro bonis, quum id rescierit, soluturusne sit eos pro bonis. 5. Incredibile memoratu est quam facile Romani et aborigines coaluerint. 6. Quum est concupita pecunia, nec adhibi a continuo ratio, quæ sanet eam cupiditatem, permanat in venas et inhæret in visceribus illud malum. 7. Endymio, nescio quando, in Latmo, Cariæ monte, obdormivit, necdum est experrectus. 8. Oratori abstinendum est verbis quæ propter vetustatem obsoleverunt. 9. Convaluistine tandem ex morbo, quo tamdiu laborasti? 10. Vulnus meum quod jam consanuisse videbatur, nunc recruduit.

EXERCISE 160.—ENGLISH-LATIN.

1. The last day has shone on thee. 2. Has the last day shone on my brother? 3. My father broke into anger at my foolish words. 4. Judges should not break into anger. 5. Between the Romans and the Carthaginians a terrible war broke out. 6. All things have grown old with our enemies. 7. Did you take that bad money for good? 8. I took it without knowing it. 9. I have now found it out, and shall not pay it for good. 10. The Romans and the aboriginal inhabitants soon coalesced. 11. Endymion will fall asleep on the mountain. 12. I have fallen asleep on the pillow. 13. Many words have grown old, many words will grow old. 14. My ardour will not cool down. 15. The wound has broken out afresh. 16. My wounds have not healed. 17. I do not know whether my father's wounds have healed.

KEY TO EXERCISES IN LESSONS IN LATIN.—XL.

EXERCISE 151.—LATIN-ENGLISH.

1. Men, when they have obtained the things which they eagerly desired, often disdain them. 2. Did you hear that the lions roared? 3. Let the war be so begun that nothing else save peace may seem sought after. 4. When in memory you have traced back all antiquity, you will scarcely find three pairs of friends who were ready to lay down their life for one another. 5. Take care you do not decide concerning the matter before you have carefully searched it out. 6. The daughters of Erechtheus eagerly desired death for the life of the citizens. 7. The whole philosophy of the Romans is borrowed from the Greeks. 8. We read that the Romans often sent for their consuls from the plough. 9. The Romans piously observed many sacred rites brought and adopted from foreign nations.

EXERCISE 152.—ENGLISH-LATIN.

1. Quis nescit Hannibalem Romanorum aliquando opes attrivisse? 2. Boni mala nunquam petunt. 3. Id quod adipiscar fastidiam nunquam. 4. Putasne te, pecuniâ acquisitâ, non eam fastiditurum esse. 5. Cave ne contemnas aut fastidias aliquem. 6. Arcesse duces ab aratro. 7. Ne facesse illi homini bono negotium. 8. Mali discipuli præceptoribus optimis negotium facessunt. 9. In bello pacem petimus. 10. In bello pax a nobis petitur. 11. Liberi mei cupide mortem expetiverunt pro vitâ meâ. 12. Constat nostros cives in hostem incessuros esse.

EXERCISE 153.—LATIN-ENGLISH.

1. Let us be disposed towards our friends in the same manner as they are towards us. 2. Completed labours are pleasant. 3. Virtue alone is in its own power; all things except it are subject to the rule of fortune. 4. One day spent well, and according to the precepts of philosophy, is to be preferred to a sinful immortality. 5. The consciousness of a well-spent life, and the remembrance of many good deeds, are most agreeable. 6. Xerxes was conquered more by the wisdom of Themistocles, than by the arms of Greece. 7. The enemies having broken the treaty which they had but just made, rushed suddenly into our camp. 8. Pliny read no book from which he did not make extracts. 9. The citizens subdued by the enemies, having every hope of recovering their liberty removed, passed a wretched life. 10. The soldiers broke through and scattered the enemies' line. 11. The treaties which were made have been broken by the enemies.

EXERCISE 154.—ENGLISH-LATIN.

1. Fœdus ictum milites vestri rumpent. 2. Hostes perfringentne aciem nostram? 3. Hostes nunquam copias nostras disjiciant. 4. Improbi miseram vitam transigunt. 5. Putasne improbos vitam miseram transigere? 6. Rex omnem pacis recuperandæ spem ademit. 7. Excerpe illum librum. 8. Milites nostri, captis armis, impetum faciunt in hostes. 9. Eodem modo erga senes affici volo, quo erga juvenes. 10. Religio sola in suâ potestate est. 11. Deo juvante, quicquid placet sibi ea facere potest.

Fable.—The She-goat and the Wolf.

A wolf, seeing a she-goat standing upon a lofty rock, said, "Why do you not leave those naked and barren places, and come down hither to the grassy plains which offer you pleasant pasture?" To which the she-goat answered, "I have no mind to prefer pleasantness to safety."

Fable.—The Dog and the Oxen.

A dog lay in a manger, and by his barking drove away the oxen from the fodder. To which one of the oxen said, "How great is that envy of yours, that you will not suffer us to eat that food which you yourself are neither willing nor able to take!"—This fable (*fabula*) shows the true character of envy.

HISTORIC SKETCHES.—XLIV.

THE SPANIARDS IN AMERICA.

"And there being among the Spaniards some who are not only cruel, but very cruel, when a man occasionally wishes to punish a slave, either for some crime that he had committed, or for not having done a good day's work, or for spite that he had towards him, or for not having extracted the usual quantity of silver or gold from the mine, when he came home at night, instead of giving him supper, he made him undress, if he happened to have a shirt on, and being thrown down on the ground, he had his hands and feet tied to a piece of wood laid across, so permitted under the rule called by the Spaniards the law of Baiona—a law suggested, I think, by some great demon; then with a thong or rope he was beaten, until his body streamed with blood; which done, they took a pound of pitch or a pipkin of boiling oil, and threw it gradually all over the unfortunate victim; then he was washed with some of the country pepper mixed with salt and water. He was thus left on a plank covered over with a cloth, until the master thought he was able again to work. Others dug a hole in the ground and put the man in, upright, leaving only his head out, and left him in all night; the Spanish saying that they have recourse to this cure because the earth absorbs the blood and preserves the flesh from forming any wound, so they get get well sooner. *And if any die (which sometimes happens) through great pain, there is no heavier punishment by law than that the master shall pay another slave to the king.*"

Thus wrote Girolamo Benzoni the Milanese, who, in the year 1541, "started from Milan in the name of God, the sustainer and governor of all the universe," to seek his fortune or whatever might present itself to him in the newly-discovered possessions of the Spaniards across the Atlantic. Benzoni was, to judge from his own account of his travels, a perfectly ingenuous man, who mentioned gravely and without aiming at effect whatever came under his notice, nothing extenuating nor setting down aught in malice. He was not particularly squeamish about what he did or what others did, though he appears to have had what was lacking in the Spanish composition—some of the feelings of the human heart. He is, therefore, a very fair, unprejudiced witness in respect of the Spanish treatment of the Indians, and his testimony is, moreover, abundantly confirmed by that of many others equally disinterested.

It is a sad and singular history, that of the conquest and possession of the West Indies and America by the Spaniards. However, it is proposed here simply to give a slight sketch of the Spanish doings in America and the Indies after obtaining possession of them, how they furiously raged together, imagined all sorts of vain things, and how in the end the power was reft from them.

The first permanent settlement made in the West was on Haiti, or, as Columbus called it, La Isla Española, of which Bartholomew Columbus was made governor on his brother Christopher's return to Spain. During his administration all went well with the colony, the Indians wondering at the bearded men who had come they knew not from whence with iron tubes from which they hurled lightnings, and by the aid of which they made noises like thunder; but discord sprung up before Christopher's return, the Spaniards ill-used the women, beat the men, and otherwise behaved oppressively; and the Indians having ascertained, by the purely philosophical process of holding a Spaniard under water for ten minutes, that the new-comers were mortal, rose against them when familiarity had somewhat taken away the dread of them, and killed some of the garrison.

So long as Columbus and his brother remained in authority the Indians had tolerable treatment, for the influence of the two, weakened though it was by jealousies and mutinies, which sprang up among the Spaniards, was strong enough to hold the greater part of the adventurers in check; but when Spanish governors came to be in power, and every consideration was sacrificed to the greed for gold, the most merciless demands for life were made in order to supply the slave labour necessary for the working of the mines. So rapid was the loss of life from this cause—for the Indians had never been accustomed to such severe work—that in a few years Haiti was all but depopulated, and the Spaniards brought in slaves from the neighbouring islands and from the mainland to fill their place. Porto Rico, Cuba, Jamaica, and all the lesser islands were brought under the yoke; Jamaica, which was densely populated, but which did not yield gold, being made the slave-mart for the gold-seekers, who caught the people as they would have snared so many wild beasts, and shipped them off to the islands where the mines were. Haiti remained for many years the head-quarters of the Spanish Government in the West Indies, but when the attractions of the mainland of Mexico, Peru, and Chili had drawn away many Spaniards, and the negroes imported from Africa began to be more numerous than consorted with the safety of the whites, the island was virtually abandoned, and each separate governor of an island or a province received his orders direct from Spain.

The Spaniards having spoiled all the islands of the West Indies—those which yielded gold for sake of the gold, and those which yielded only slaves for sake of the slaves—turned their attention to the mainland, which hitherto they had not thoroughly explored. Balboa, an independent pioneer, made a settlement on the Isthmus of Darien, and having there learned that on the other side of the isthmus was a kingdom in which any quantity of gold was to be had for the seeking, sent to Isla Española for reinforcements, and went meantime himself with a small body of men to where the mighty Pacific was first revealed to the eyes of a European. Gathering as much gold as he could get, and which the native chiefs freely gave him, he returned for assistance, not daring with his few friends to draw down the hostility of the wealthy nation which he understood was also exceedingly strong. On April 2, 1519, an extensive expedition which had been fitted out in the ports of Cuba, and which sailed under the command of Fernando Cortez, landed on the coast of Yucatan, and was well received by the natives. Cortez immediately formed an entrenched camp, which subsequently became the city of Vera Cruz, and having established himself there began to negotiate for an interview with Montezuma, the emperor of the country.

Whether the Mexicans suspected the character of the wolves who came to them in sheep's clothing; whether the Spaniards, as is most likely, did not refrain from acts of violence even at the beginning of their occupation; or whether it was from fear of the firearms which so greatly astonished the people, the Mexicans held back from this proposal. Montezuma sent rich presents which only inflamed the greed of the Spaniards, and Cortez, after entering into alliances with tribes discontented with the government, marched inland with 500 foot soldiers, fifteen horsemen, and six pieces of cannon. With such a force he proposed to himself the conquest of a populous and powerful empire. By striking terror into opponents who had never seen a gun fired until now, by artifice, by playing off hostile chiefs one against the other, Cortez marched on, his admiration being excited at every step by the magnificence of the scenery, and his cupidity aroused by the signs which he daily saw of the enormous wealth of the soil. After short sojourns in some of the cities which fell before him like snow before the sun, he advanced to the city of Mexico, in the environs of which Montezuma came out to meet him in friendly sort, with barbaric but splendid state, and magnificent gifts. The emperor was so gracious and hospitable that Cortez had much difficulty in knowing how even he was to begin playing the villain. The Spaniards were brought into the city, lodged, fed, and clothed, and all that they wanted was supplied to them. Cortez resolved to avail himself of an outrage on some Spaniards on the coast to possess himself of the person of Montezuma. He first complained of the outrage and demanded the punishment of the murderers, who, including a cacique or chief, were brought to Mexico and burned alive as a punishment; but the sufferers having averred, truly or not, that what they had done was by Montezuma's own order, Cortez seized the emperor, and kept him a prisoner in irons in the Spanish quarters. He wrote to the King of Spain, telling him what he had done, and how that he had done it for the better security of the lives of the Spaniards in Mexico, and for the purpose of more effectually bringing the empire under the dominion of the Spanish king. The enormous consignments of gold sent to Europe astonished the Old World folk, and attracted thousands of them across the water. The gold itself was spent in attempts to found universal dominion, and in endeavours, continued through many years, to crush out as a plague the spirit of liberty both in church and state. In Mexico, after the imprisonment of Montezuma, the Mexicans were compelled to be the slaves of the Spaniards and to work their own gold mines for them. The waste of life became as prodigious as in the West India Islands, and the sufferings of the people so great that the Spanish priests remonstrated, and orders were obtained from the Pope and from the King of Spain for the better treatment of the Indians. But such orders to a man like Cortez were as nothing, and the state of the poor people grew worse and worse. They had resolved at any cost to get rid of their tyrants, when Cortez was called away from the capital to fight a Spanish expedition which had been sent from Cuba, the governor of which thought fit to override the authority of Cortez, and to seek himself to gather where he had not sown. Cortez defeated the expedition, killed its leader, and induced the soldiers to enlist under him.

On his return to Mexico city his quarters were assailed by a vast multitude of Mexicans, desperate at the return of their dreadful enemy, and bent on his destruction. In vain did Cortez try everything that skill or valour could dictate, in vain did he bring out Montezuma on the ramparts to quiet the people. Montezuma was killed by a missile flung by one of his own subjects, and Cortez and his followers had to cut their way out of the city. In due time he returned with fresh troops procured from Isla Española, and captured the city; the successor of Montezuma was put to death by slow torture, multitudes of Mexicans were slain, and possession was formally taken of the country as a dependency of Spain.

Twelve years after Cortez had landed at Vera Cruz, Pizarro (in 1531) arrived with a small force on the coast of Peru, and dissembling his object from people who probably did not know what had befallen Mexico, advanced inland, pretending that he would mediate between Huascar and Atahualpa, sons of the late Inca or king, who were striving for the mastery. Atahualpa had the upper hand, and Pizarro managed to get his consent to an interview, at which the intention was to seize the Inca, and hold him as a hostage and as a lever of power. At the meeting the Inca was informed that Alexander VI., Pope of Rome, had given Peru and all the other kingdoms in America to the Spaniards; that the Pope of Rome was lord of the whole earth by virtue of his being vice-gerent of Christ, of whom until this moment the Inca had never heard. Atahualpa was required to acknowledge the supremacy of the King of Spain, and to be baptised into the Christian faith. On the luckless man treating these modest demands with derision, a tumult was raised, a heavy fire of musketry and artillery was opened on the Peruvians, and Atahualpa was seized and loaded with irons. Cruel as had been the conduct of the Spaniards in Mexico, it was *very* cruel in Peru; the grossest frauds were practised on the natives, who were reduced to the most dreadful form of slavery, and compelled to yield forced labour. Atahualpa was made to pay as ransom a room full of bars of gold, and then, the gold having been received, he was strangled, and his body burned at a stake. Furious dissensions arose among the Spaniards about the division of the spoil; Pizarro was murdered, his murderer succumbing in turn to some other ruffian, and a long period of anarchy and bloody revolution ensued, during which the native Peruvians suffered from each successive ruler.

Besides the West Indies, Mexico, Peru, and Chili, the Spaniards did not care for their other possessions in America, which fell in course of time under the dominion of the English, French, and Dutch, and include at the present day the whole of the United States of America.

What of all they once held do the Spaniards retain at this moment? Cuba only, and Porto Rico. Ruthless, selfish government like that they set up, practices subversive of all good such as they practised, could bring about but one conclusion. Even in Benzoni's time (1550), the demoralisation was such that "many Spaniards prophesied for certain that the island (Isla Española) in a short time will fall entirely into the hands of these blacks" (imported Africans), and such has been its fate after many and deadly struggles between Spaniards, French, and English for the mastery there. When the news of the French Revolution in 1789 reached the island, the French being then masters, the population rose *en masse*, and in the awful massacre of San Domingo repaid the wrongs of centuries. Jamaica was taken from Spain by commanders sent by Cromwell, and since that time successive conquests have stripped her of all but Cuba and Porto Rico, the sole remaining relics of their once vast American possessions.

Mexico, Peru, and Chili remained under the curse of Spanish rule till quite recent times; but the bursting of the old bands of tyranny in Europe by Napoleon Bonaparte loosened them indirectly in America. As soon as it was known in Mexico (in 1808) that the Spanish Bourbons were overthrown, the viceroy called on the people to support King Ferdinand, but when they rose to do so the Spanish colonists resented their interference, though it was on their own behalf. "No native American shall participate in the government so long as there is a mule-driver in La Mancha, or a cobbler in Castile, to represent Spanish ascendancy." In this spirit the Spaniards in Mexico conducted themselves, and the result was that after three formidable insurrections, bloodily suppressed, Iturbide, a native Mexican, so gathered up the national party into his hands that he drove the Spaniards out, and received on the 27th of November, 1821, the surrender of the capital on condition that the Spaniards should forthwith leave the country.

After passing through a dreadful ordeal analogous to the above, Peru and Chili, making common cause, threw off the Spanish yoke, and on the 26th of February, 1826, compelled the surrender of Callao, the last foothold of the Spaniards on the territories won for them by Cortez and Pizarro.

LESSONS IN GERMAN.—L.

In this lesson we commence Part II. of our Lessons in German. The sections in this Part, which are distinguished by the sign § in all references made to them in Part I., will be found to furnish a complete and systematic Grammar of the German Language, including its Etymology and Syntax, with examples and extracts from the best German writers.

§ 1.—ETYMOLOGY.

Etymology regards words as *individuals*; discloses their origin and formation; classifies them according to signification; and shows the various modifications which they undergo in the course of declension and conjugation. The inflection of all parts of speech, except the verb, is, in grammar, called *declension*; the regular arrangement of the moods, tenses, numbers, persons, and participles of a verb, is called *Conjugation*; in a *general* way, however, *all* words capable of inflection are said to be *declinable*. The indeclinable parts of speech are often called *Particles*.

§ 2.—DERIVATION AND COMPOSITION.

(1.) In respect to derivation, all German words are divisible into three classes:—*Primitives*, *Derivatives*, and *Compounds*.

(2.) The Primitives, which are also called *roots* or *radicals*, are all *verbs*; forming the basis of what are now generally called the irregular verbs, and of about fifty or sixty others, which *were* once irregular in conjugation, but are so no longer. They are also all *monosyllables*, and are seen in the crude form (so to speak) by merely dropping the suffix (en) of the infinitive mood; thus:—Bind(en), to bind; schließ(en), to close; fang(en), to catch.

(3.) From the primitives, sometimes *with*, sometimes *without*, any change in or addition to the crude form, comes a numerous train of derivatives, chiefly *nouns* and *adjectives*.

Thus, from bind(en), "to bind," we get der Band, the volume, and der Bund, the league, where the derivatives are produced by a mere *vowel* change. The derivative is, also, often distinguished by a mere euphonic or orthographic termination: changing the *form*, indeed, but in no wise affecting the *sense*. The terminations employed in this way are er, el, en, e, de, te, and et; thus, from sprech(en), "to speak," comes die Sprache, speech, language. In some cases, moreover, in forming derivatives, the insignificant syllable ge is prefixed; as:—Gewiß, sure, certain; der Gesang, the song.

(4.) But there is another and a most extensive class of derivatives, sometimes called *secondary* derivatives, formed by the union of radical* words with suffixes that *are significant*: thus, from heilig, "holy, sacred," we get, by adding en, the verb heiligen, "to *make* holy, to consecrate." The suffixes of this class (the *significant* ones) are, however, most of them, used in forming nouns and adjectives. They will be found explained under those heads respectively. Several of them are exactly the same in *form* as the terminations which are often added to *primary* derivatives. From these (that is, from the merely orthographic endings) the significant suffixes are to be carefully distinguished.

* The word *radical*, however, in *this* place, is designed to indicate *any* word capable of assuming a suffix. In this loose sense the word is often employed for the sake of convenience.

(5.) Among the secondary derivatives must also be included those formed by means of *prefixes* as well as suffixes. These are mainly verbs, and are treated somewhat largely under the head of Compound Verbs.

(6.) In respect to COMPOUNDS, properly so called—that is, words formed by the union, not of prefixes and suffixes with radicals, but of radicals, or other independent words, one with another—the German is peculiarly rich. Not only is it rich in the abundance of such compounds already in use, but it possesses a rare facility of forming them, as occasions arise, out of its own resources.

(7.) In forming these compounds, the two components are often merely joined together as one word; as:—Uhrmacher (from Uhr, a clock or watch, and Macher, a maker). But in numerous cases the union is marked by the insertion of certain letters, which may be called *letters of union;* thus—

Die Todesnoth (from Tod, death, and Noth, need, agony), the death-agony.

Das Himmelslicht (from Himmel, heaven, and Licht, light), the light of heaven.

Die Herzensgüte (from Herz, heart, and Güte, goodness), the goodness of heart.

Der Pferdearzt (from Pferd. horse, and Arzt, doctor), the horse-doctor.

Das Hirtenleben (from Hirt shepherd, and Leben. life), the pastoral life.

Der Eierkuchen (from Ei, egg, and Kuchen, cake), the omelet.

(8.) Some of these letters of union are nothing more than the signs of the genitive case of the first component; others are mere euphonic additions.

(9.) In some instances the union of the parts of a compound is characterised by the *omission* of some letters; as:—Der Sonntag (Sonne, the sun, and Tag, day), Sunday. Denkwürdig (denken, to think, and würdig, worthy), worthy of thought.

(10.) Finally, in all compounds, the main accent falls upon the *first* component, which always qualifies or defines the second, as containing the fundamental idea.

§ 3.—PARTS OF SPEECH.

(1.) The parts of speech in German are usually reckoned ten; namely, Articles, Nouns or Substantives, Adjectives, Numerals, Pronouns, Verbs, Adverbs, Prepositions, Conjunctions, and Interjections.

(2.) Of these, *six*—namely, Articles, Nouns, Adjectives, Numerals, Pronouns, and Verbs—are capable of *inflection*, that is, admit of changes of termination by which various modifications of meaning are expressed; the other *four*—namely, Adverbs, Prepositions, Conjunctions, and Interjections—are in form *invariable.*

(3.) All parts of speech capable of inflection have two numbers: the Singular, which denotes but one; and the Plural, which denotes more than one.

(4.) All parts of speech capable of inflection, except the verb, have four Cases: namely, the Nominative, Genitive, Dative, and Accusative; also, three Genders, namely, the Masculine, the Feminine, and the Neuter.

(5.) Cases are variations made in the form of a word, to indicate its several relations to other words; the nominative being that form which denotes the *subject* of a verb; the genitive that which is chiefly used in signifying *source* or *possession*; the dative that which indicates the person *to* whom, or thing *to* which an action is directed; and the accusative that which points to the *immediate* or *direct* object of an action.

The cases in German correspond well to those in the Latin language. The *Vocative*, however, is never counted, because it is exactly the same in form as the nominative; while the *Ablative* (as in Greek) is wholly wanting, its place being generally supplied by the Dative (with a suitable preposition).

§ 4.—THE ARTICLE.

(1.) There are two articles in German: the Definite, der, *the;* and the Indefinite, ein, *a* or *an.* They are inflected thus:—

Singular.

	MASC.	FEM.	NEUT.
Nom.	Der,	die,	das, the.
Gen.	Des,	der,	des, of the.
Dat.	Dem,	der,	dem, to *or* for the.
Acc.	Den,	die,	das, the.

Plural,

	FOR ALL GENDERS.
Nom.	Die, the.
Gen.	Der, of the.
Dat.	Den, to *or* for the.
Acc.	Die, the.

Singular.

	MASC.	FEM.	NEUT.
Nom.	Ein,	eine,	ein, an *or* a.
Gen.	Eines,	einer,	eines, of an *or* a.
Dat.	Einem,	einer,	einem, to *or* for an *or* a.
Acc.	Einen,	eine,	ein, an *or* a.

This article has no plural.

(2.) Certain prepositions are frequently contracted with the dative and accusative of the definite article into one word.

EXAMPLES.

Dat.	Am,	for an dem,	as, am Feuer, at the fire.
Acc.	Ans,	an das,	ans Licht, to the light.
Acc.	Aufs,	auf das,	aufs Haus, upon the house.
Dat.	Beim,	bei dem,	beim Vater, with the father.
Acc.	Durchs,	durch das,	durchs Wasser, through the water.
Acc.	Fürs,	für das,	fürs Geld, for the money.
Dat.	Hinterm,	hinter dem,	hinterm Hause, behind the house.
Dat.	Im,	in dem,	im Himmel, in (the) heaven.
Acc.	Ins,	in das,	ins Haus, into the house.
Dat.	Vom,	von dem,	vom Uebel, from (the) evil.
Acc.	Vors,	vor das,	vors Fenster, before the window.
Dat.	Vorm,	vor dem,	vorm Thore, before the gate.
Dat.	Überm,	über dem,	überm Feuer, upon the fire.
Acc.	Übers,	über das,	übers Land, over (the) land.
Dat.	Unterm,	unter dem,	unterm Wasser, under (the) water
Dat.	Zum,	zu dem,	zum Flusse, to the river.
Dat.	Zur,	zu der,	zur Ehre, to the honour.

§ 5.—NOUNS.

(1.) In German, as in English, the nouns (that is, the *names* of persons and things) are divided into two great classes; viz. *Common nouns*, which designate sorts, kinds, or classes of objects; and *Proper nouns*, which are peculiar to individuals.

The student will bear in mind the following rules:—

a. In German all *Nouns*, as also all parts of speech when used as nouns, begin with a capital letter; as:—1. Der Sohn, the son; die Tochter, the daughter. 2. Der Gute, the good (man); die Gute, the good (woman). 3. Das Singen, the singing.

b. Also: *The Indefinite Pronouns;* as:—Jemand, anybody, somebody; Jedermann, everybody; Etwas, anything, something; and Nichts, nothing.

Note, that when Etwas and Nichts are connected with a noun, or with an adjective used as a noun, they do *not* begin with a capital; as:—Er hat etwas Brod, he has *some* bread. Er hat nichts Gutes, he has *nothing* good.

c. Also: *The absolute Possessive Pronoun* (when used substantively. Sect. XX. 2); as:—Die Meinigen, my family; das Meinige, my property.

d. Also: *The Indefinite Numerals*, when used without a substantive; as:—Alles, Alle, all; Einige, some; Mancher, many a; Viele, many.

e. Also: *The Personal Pronouns*, Du, Ihr, thou, you, etc., when we would distinguish thereby the person addressed.

f. Also: Ein, when a numeral adjective, and likewise when a pronoun as distinguished from the article; as:—Ich habe nur Einen Freund, I have only *one* friend. Das Eine Pferd ist blind, das andere ist lahm, the *one* horse is blind, the other is lame.

g. Lastly, Adjectives derived from names of persons; as:—Das Schillersche Haus. Observe, that adjectives derived from the names of countries do *not* begin with a capital; as:—Der deutsche Bund, the German confederacy; die französische Sprache, the French language.

(2.) Under the head of common nouns are commonly included several subdivisions; as *Collective nouns*, which are the names of a *plurality* of individuals considered as *unity;* and *abstract nouns*, which are the names of certain qualities or attributes regarded as separate from any given substance.

(3.) The nouns, both common and proper, as before said, are regularly inflected; thus exhibiting by means of terminations the several modifications of gender, number, and case. The numbers and cases will be made sufficiently clear under the head of *declension of nouns.*

§ 6.—GENDER.

(1.) Strictly speaking, the masculine gender belongs exclusively to words denoting males; the feminine, to those denoting females; and the neuter to such only as are neither male nor female. And in English, accordingly, with very little exception, this is found to be actually the case.

(2.) Not so, however, in German; for there the names of many things *without* life, from their real or supposed possession of *qualities* pertaining to things *with* life, are considered and treated as masculine or feminine. Often, moreover, words indicating things without life are deemed masculine or feminine, merely from some resemblance in *form* to those designating things properly male or female. Hence arises, in grammar, the distinction between the *natural* and the *grammatical* gender of words.

(3.) Were the natural gender alone regarded, it would be necessary only to know the MEANING of a word, to know its gender; but since this is not the case, we are often obliged to determine gender chiefly by the FORM. We give below, therefore, the principal rules for determining the gender in either way; suggesting only, as the best mode of learning the *exceptions* (which are numerous, and here purposely omitted), the custom of constantly and carefully noting them in reading and speaking.

§ 7.—RULES FOR DETERMINING GENDER.

BY THE MEANING.	BY THE FORM.
(1.) To the Masculine belong names of	(1.) To the Masculine belong
Male beings: as, der Mann, the man; der Löwe, the lion. *Days:* as, der Montag, Monday; der Dienstag, Tuesday. *Months:* as, der Januar, January; der Februar, February. *Seasons:* as, der Frühling, spring; der Sommer, summer. *Winds:* as, der Nordwind, the North wind; der Südwind, the South wind. *Points of the compass:* as, der Nord, the North; der Süd, the South. *Mountains:* as, der Harz, the Harz; der Atlas, the Atlas. *Stones:* as, der Diamant, the diamond; der Rubin, the ruby. *Fruit-trees:* as, der Birnbaum, the pear-tree; der Apfelbaum, the apple-tree.	*a.* Those primary derivatives (see § 2. 3) ending in the *insignificant* suffixes er, el, en, and those also that are without affixes of any kind. *b.* Those secondary derivatives formed by means of the *significant* suffixes er, ig, ing, and ling.
(2.) To the Feminine belong the names of	(2.) To the Feminine belong
Female beings: as, die Frau, the wife; die Tochter, the daughter. *Rivers:* as, die Weser, the Weser; die Themse, the Thames. *Fruits:* as, die Birne, the pear; die Nuß, the nut. *Trees and flowers:* as, die Birke, the birch; die Erle, the alder; die Rose, the rose.	*a.* Those primary derivatives ending in e, d, de, t (ſt), te. *b.* Those secondary derivatives formed by means of the suffixes e, ei, in, heit, keit, ſchaft, ung.
(3.) To the Neuter belong the names of	(3.) To the Neuter belong
Countries and places: as, Frankreich, France; Berlin, Berlin. *Metals:* as, das Silber, silver. *Materials:* as, das Holz, wood. *Letters:* as, das A, the A; das B, the B, etc. *Infinitives used as nouns:* as, das Leben, life; das Reiten, riding. *Many individuals taken together* (*i.e., collective* nouns): as, das Heer, the host. *Adjectives used as nouns* (in an abstract and indefinite way): as, das Gute, the good; das Schöne, the beautiful. *Pronouns and particles used substantively:* as, ſein liebes Ich, his beloved self; das Wie und das Wo, the how and the where.	*a.* Those secondary derivatives formed by means of the suffixes chen, lein, el, ſal, ſel, niß, thum, *b.* Those nouns having the augment ge.

Under the name of *male beings* must be included that of the Almighty, as also those of angels and other superior powers; those of mythological deities and of human beings; those of beasts, birds, reptiles, and fishes. The term *female beings* must have a like latitude of signification.

KEY TO EXERCISES IN LESSONS IN GERMAN.

EXERCISE 141 (Vol. III., page 43).

1. Sind wir genöthigt, auf unſern Freund zu warten? 2. Nein, nicht ſeinetwegen. 3. Dieſer Menſch wird ſeiner Treuloſigkeit wegen verabſcheut. 4. Grämen Sie ſich unſertwegen nicht! 5. Meinetwegen mögen Sie thun, was Sie wollen. 6. Mein Bruder ſtarb im neunzehnten Jahre ſeines Alters an der Auszehrung. 7. Wiſſen Sie, wer Ihre goldene Uhr geſtohlen hat? 8. Nein, aber ich habe jenen Mann, welcher geſtern in unſer Haus kam, im Verdachte. 9. Zuerſt hatte ich einen Diener des Hauſes im Verdachte. 10. Nachdem ich meine letzte Reiſe vollendet hatte, widmete ich mich dem Studium der lebenden Sprachen. 11. Nachdem wir zu Mittag geſpeiſt hatten, ritten wir ſpazieren. 12. Nachdem er gefrühſtückt hatte, beſuchte er ſeinen Schwager. 13. Dieſe Dame braucht achtzehn Ellen Muſſelin zu einem Kleide. 14. Jener Jüngling wurde Doctor. 15. Jenes Unternehmen machte unſern Nachbar zum reichen Mann. 16. Er ſagte mir, er würde ſeiner ſelbſt wegen mit ſeinem Vater ſprechen.

RECREATIVE NATURAL HISTORY.

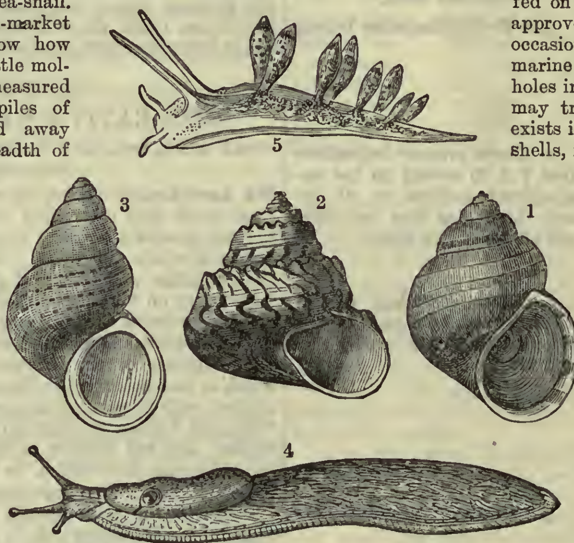
SOME LAND, SEA, AND FRESHWATER SHELLS, WORMS, AND TUBE-DWELLERS.

WE have already shown, in our paper on British pearls and pearl-shells, that all shelled creatures of the sea, fresh-water, or land, possess the power of building up the walls of the tiny castles in which they dwell. There are others which possess no shell-building power, and depend for defence and protection from injury on the shelter afforded by either holes in the earth, crevices amongst the rocks, or pipe-like coverings formed from materials gathered together either by the exercise of the will and ingenuity of the creature, or by natural processes over which it has no control. Then we have shell-dwellers who, not content with their own natural covering, bore deep holes in rocks and timber, in order to secure a perfectly safe place of shelter; and yet another vastly important group of worm-like creatures, the *Helminthes*, or worms which dwell within the tissues of other living organisms.

Although the accomplished naturalist, who is well up in the subject, would distinguish at a glance the distinctions which exist between true land, fresh-water, and marine shells, and assign to earth, sea, or parasitical worms their true position, the casual observer would find some difficulty in determining the particular order to which each or either belonged. As an example of this similarity of structural form and contour, we must refer our readers to the accompanying illustrations. Fig. 1 represents a shell, dwelling in fresh water (*Paludina vivipara*); Fig. 2 a marine shell (*Trochus magus*); and Fig. 3 a land shell (*Cyclostoma subaspera*). The resemblance between land and sea slugs is nearly as close as that between land snails and sea snails. Fig. 4 represents a large land slug (*Arion rufus*), and Fig. 5 a slug from the sea (*Tergipes despectus*).

There are few who know that money may be made of slugs and snails. Land slugs, although occasionally taken medicinally by persons suffering from pulmonary consumption, are of little commercial importance. The Eastern seas, however, yield a slug (*Holothuria edulis*) commonly known as the *Bêche de mer*, or trepang, which ranks high as an article of merchandise, and is the cause of much maritime activity and general briskness of trade. The trepang is in great request in the markets of China as an ingredient in the composition of the gelatinous soups and hashes in which the Celestials so much delight. With pickled sharks' fins, little squares of salt fat pork, and preserved bamboo shoots, the *Bêche de mer* makes a dish perfectly irresistible to a Chinaman. There are six kinds of slugs generally sought for, the best being those obtained by diving amongst the reefs and rocks where they are known to resort; others are taken either by torch or moonlight, in the shallow pools; whilst the inferior kinds are gathered by hand from the rocks at low water. The various kinds, when selected and arranged according to their quality, are cleaned, carefully cut open, cooked in large cauldrons in the water which they themselves yield, and are then subjected to a carefully-conducted and thorough drying process, on trays or shelves arranged in sheds erected for the purpose. Very large quantities of dry wood are consumed before the drying process is complete, as the slugs require very perfect and careful preparation before they are in a condition to be shipped. Some idea of the importance of the trepang trade may be gathered when we inform the reader that one trader obtained amongst the Feejee group of islands, by barter with the natives, 25,000 dollars' worth, during a seven months' round of trade. The influence brought to bear on the shipping interests of the southern seas by the slug trade is immense, as will be believed when we give the returns of one voyage in pursuit of trepang:—Pecals of *Bêche de mer* collected, 1,200; cost of outfit of ship, etc., 3,500 dollars; returns of cash on sales effected, 27,000 dollars. The value of dry *Bêche de mer*, as brought to the markets of China, ranges between ten and sixty dollars per *pecal*,* according to class and quality.

Snails of both land and sea are of very considerable commercial importance and value. The common periwinkle (*Turbo littoreus*) of our coasts is without doubt the most familiar and best-known type of the sea-snail. A visit to Billingsgate at high-market tide will serve at once to show how vast the consumption of these little mollusks must be. Shovelled up, measured by the peck and bushel, like piles of black grain, and then carted away throughout the length and breadth of mighty London, the periwinkle becomes a noteworthy element in British industry, and, although eaten from a pin's point, affords in the gathering and vending honest employment to thousands. A combination of prejudice and custom renders the land-snail of England a production of comparatively small importance. On the Continent, however, especially in France, the snail may be fairly regarded as ranking next to the oyster in the list of shell-food. The true edible snail (*Helix pomatia*), the apple snail, or *Grand escargot* of the French, is by no means common in this country. Specimens are occasionally found in the neighbourhood of Ashford, in Kent, near Dorking, and in some other localities. It has long been a popular belief that this particular kind of snail was first introduced by the Romans, as it has been found in the neighbourhood of the sites of ancient Roman encampments. In England, the existence or non-existence of *H. pomatia* is a question interesting to the scientific only. In France, considerable pains are taken, and much attention paid to its culture and well-doing. Snail-gardens, or *escargatoires*, as the French call them, are established for feeding the snails in. These are formed either by making a sort of pound, or enclosure, with boards and upright posts, or a number of shallow square or oblong pits are dug in the earth for their reception. Vegetables and herbs are scattered on the floors of the snail-pens, in order to afford the shell-bearing flock an agreeable feeding-ground. Whilst summer lasts, the snail's food consists of potatoes, green leaves, and bran. As winter approaches, and the cold wind warns *H. pomatia* that hard times are coming, he proceeds to some corner, or quiet nook, and commences to form and secrete the operculum, or trap-door, with which its castle-gate is soon closed and defended. It is whilst the snails are in this sealed-up and torpid condition, that they are gathered for the market. When a sufficient number have been collected, they are packed in suitable casks or barrels, and dispatched to their purchasers. Over four millions of snails have been gathered annually by the proprietor of one set of snail-gardens,



1. Paludina Vivipara. 2. Trochus Magus. 3. Cyclostoma Subaspera. 4. Arion Rufus. 5. Tergipes Despectus.

and snail-culture is on the increase. Our common brown garden snail (*Helix aspersa*), although inferior in size (and, it is said, in flavour) to the great apple snail, is capable of furnishing good and wholesome food, which might ward off the pangs of hunger in many poor families, did not the stern and unyielding bar of custom and prejudice stand obstructively in the way. Whilst on the subject of snails, it may not be out of place to refer to the belief which exists amongst certain of our sheep-farmers, that the flavour of the celebrated Portland mutton is in great measure owing to the vast number of minute snails which the sheep, in feeding on the close, short pasture of that locality, are necessarily obliged to masticate with it. Two descriptions of land shells are found in countless thousands on the sheep pastures of the Portland dunes: one is *Helix virgata*, a banded, yellow snail; and the other *Bulimus acutus*. That these little creatures contribute largely in building up the tissues of the sheep which feed on them, there can be no doubt, as the mutton from sheep which have been reared in this snail-land has been found to lose its piquant flavour on being removed to other localities, even when fed on a liberal allowance of the most approved artificial food. We shall have occasion, as we proceed, to refer to certain marine creatures, whose habit it is to bore holes in the solid rock. Here, again, we may trace the curious similarity which exists in the habits of both sea and land shells, for we find a particular species of snail (*Helix saxicava*) indulging in regular and systematic rock-boring habits. During the summer months, this description of snail, which is found abundantly in Picardy, feeds in the thickets and about the hedge-rows, but as winter approaches it makes its way to the hills of calcareous rocks (*marbre napoléon*) found in the commune of Retz, and betakes itself to the deep excavations formed by a legion of former stone-borers, and there hybernates until warm weather shall come again; but instead of sealing himself up, as we found *H. pomatia* to do, the living snail finds the bottom of his gallery—which is not unfrequently over six inches in depth by one inch and a-half in diameter—a sufficient protection, without the aid of an operculum. These curious galleries, or rock-tubes, contract gradually from the external orifice to the bottom of the cell, where they terminate in a sort of cup-shaped indentation to which the snail firmly attaches itself by suction. It is most curious, that these snail-burrows are almost invariably made on the rocks which face the east and north-east. It has been computed that the result of the winter's hybernation of each snail deepens the hole in which it shelters at the rate of half an inch per season. The manner in which the boring and perforating process is achieved, has been a subject for much debate and investigation. The labours of the sea-borers have also led to a great deal of scientific controversy, some investigators maintaining that an acid secretion thrown out by the borer softened the rock and so led to its being easily entered by the shell, whilst others have positively asserted that secretion had nothing to do with the process, and that the shell alone, acting by the aid and agency of intensely hard and spine-like cutting teeth, filed or cut away the stone much as an artesian well-boring tool, when moved forward and back, aided by water, cuts its way far into the solid rock. The limits of this paper will not admit of our fully discussing this knotty subject. There are many curious and deeply interesting matters of evidence which have been by experienced naturalists brought to bear on the question of friction *versus* chemistry in the matter of rock-perforation by shells. We must, therefore, defer this question until the publication of another paper enables us to resume it.

* The pecal, consisting of 133⅓ lbs., is a weight in general use amongst the Japanese and Malay traders, and is equal to the "tan" of China.

LESSONS IN CHEMISTRY.—XXX.

MILK—THE EXCRETIONS—FOOD—VEGETABLE COMPONENTS.

Milk.—Seeing that this fluid is the only food of the young of the mammalia for many months, it may be regarded as the most important as well as the most peculiar of the secretions. It is only secreted by the female, who for this purpose is endowed with mammillary glands. It consists of caseine, which, as we have seen, is analogous to muscle; of fatty principles; a peculiar sugar, and sundry salts. Its whiteness is an optical delusion; under the microscope it is a clear liquid, in which small globules of transparent fatty matter, enclosed in a slight pellicle, float. If allowed to stand, these rise to the surface, forming cream. When this cream is churned, the pellicle of the fat-globule is mechanically broken—the fat agglomerates, forming butter. The butter is washed with cold water, in order to remove as much as possible the caseine, which, owing to its complicated composition, readily decomposes, and thus makes the butter rancid. Salt is also added to retard the decomposition of the fat. The caseine, which is in solution in the butter-milk, has been described. Albumen is also found in *colostrum*, that is, milk which is secreted soon after the birth of the young. The milk of the cow contains so much albumen that it coagulates when it is boiled. The sugar in the milk has the peculiar quality of not undergoing alcoholic fermentation, and the consequent liberation of carbonic acid gas. Such a product would be dangerous to the tender stomach and intestines of the young animal. The Arabs prepare a fermented liquor from mare's milk, but in this case a part of the milk-sugar is converted into grape-sugar by the caseine, and becomes the source of the fermentation. When in a warm atmosphere the sugar is liable to undergo a change, and the product is *lactic* acid; and seeing that caseine is insoluble in the presence of an acid, it is precipitated as curds; thus the milk is said "to turn." The composition of cow's milk will be seen from the following analysis:—

Water	873·00
Butter	30·00
Caseine	48·20
Milk-sugar	43·90
Calcium phosphate	2·31
Magnesia	0·42
Iron	0·07
Potassium chloride	1·44
Sodium	0·24
Soda with caseine	0·42
	1000·00

STARCH:—Fig. 55, Starch of Wheat; Fig. 56, Starch of Arrowroot; Fig. 57, Starch of Rice.

Urine, the chief of the fluid excrements, is separated by the kidneys from arterial blood. Its contents, which are subject to much variation, may be thus given:—

Water	933·00
Urea	30·10
Extractive matter	17·14
Uric acid	1·00
Sodium Sulphates, Potassium Sulphates	6·87
Sodium Phosphate	2·94
Ammonium	1·65
Calcium and Magnesium	1·00
Sodium Chloride	4·45
Sal-ammoniac	1·50
Silica	0·03
Mucus	0·32
	1000·00

This excretion is the channel which carries off the waste material from the wear and tear of the body. It is an amber-coloured liquid, possessing an aromatic odour when warm, except in disease; and during the process of digestion it is acid.

Urea (CH_4N_2O) is the principal outlet for the nitrogen of the system. A human adult excretes about an ounce and a quarter daily. It may be separated from urine by adding an equal bulk of nitric acid, and treating the acicular crystals of nitrate of urea thus obtained with baric carbonate. The carbonic acid comes off, and the urea crystallises from the barium nitrate. Since its formula may be written thus, NH_4O,CN, it is sometimes called *Cyanate of Ammonia*. This salt can be made readily, and when a solution of it is evaporated at a gentle heat, it undergoes a metamorphosis, and becomes urea without any change in its elements, which seem to have grouped themselves anew. It will be noticed that an addition of two molecules of water will produce ammonium carbonate, and this explains the cause of the fact that no urea is found in decomposing urine, but a quantity of ammonium carbonate.

Uric or Lithic Acid ($H_2C_5H_2N_4O_3$).—Human urine does not contain much of this acid, but it is present in considerable quantity in the semi-liquid excrement of birds; and the vast beds of guano chiefly consist of ammonium urate. When urine is surcharged with this acid, it deposits itself in hard crystallised grains, forming red gravel. If this deposition go on in the kidney or bladder, calculi are the result. In gouty subjects it is liable to accumulate, joined with soda, about the joints of the fingers and toes, forming what are improperly called *chalk stones*. It is found in combination with the alkalies, and these urates form the deposits which urine frequently gives on cooling. There are many other compounds which are found in minute quantities in urine, but which, although of great chemical use, are not of general interest.

THE NUTRITION OF ANIMALS AND PLANTS.

In order to supply the body with the various compounds of which we have found it is composed, we take food—that is, vegetable and animal substances which contain these requisite bodies. We need say nothing of animal food, for the constitution of all flesh is analogous; but the existence of the compounds which build up the animal frame in the vegetable kingdom is not so evident. Nutritious substances may be divided into two great classes—those which contain nitrogen, or *azotised* bodies; and those which are wanting in nitrogen, or *non-azotised* bodies. The former supply the flesh with building material, for muscle, etc., contains nitrogen; and the latter seem chiefly to devote themselves to the maintenance of animal heat in the system.

Corn.—Taking corn as the staple vegetable food of man, we find its constituents are:—1, starch; 2, gluten, the albumen of the vegetable kingdom; 3, dextrine; 4, oily matter; 5, saline matter; and 6, a skeleton of ligneous tissue, which undergoes no change in passing through the system. The proportion of these ingredients varies in different climates. The following table gives some idea of this:—

	English fine Wheaten Flour.	Bran.	Scotch Oatmeal.	Indian Corn.
Water	16	13	14	14
Gluten	10	18	18	12
Oily Matter	2	6	6	8
Starch, etc.	72	63	62	66
	100	100	100	100

Gluten, which is the characteristic of cereal seeds, may be obtained from flour by making it into a paste with water, then washing this, tied in a muslin bag, in a gentle stream of water; the starch is removed in suspension, and this is being carried on so long as the water runs through the bag milky. Upon opening the bag a grey, sticky, tenacious substance is found adhering to it, which is mainly gluten. It evidently is a compound of at least two substances, one of which is soluble in hot alcohol, the other is not. Liebig regards this latter substance as vegetable fibrine; the former, which is deposited from the alcohol as it cools, has been termed *gluten*.

Starch $(C_6H_{10}O_5)^n$; or *amylaceous matter*, occurs in a large proportion in seeds, roots, and stems of certain plants. It appears in grains: those in wheat (Fig. 55) are $\frac{1}{1000}$th of an inch in diameter; those of arrowroot (Fig. 56), $\frac{1}{300}$th; while those of rice are much smaller, and they are also angular (Fig. 57). As sold in the shops, it is either in a white glistening powder, or in peculiar angular masses, which are easily crushed; it is insoluble in cold water. If the water contain 2 per cent. of alkali, the starch becomes converted into a tenacious mass; or if the water be heated to 60° Cent., it suddenly assumes a pasty condition, in which state it is used by the laundress. Under the microscope the grains seem to be constructed in layers; but it is possible that this appearance is due to folds in the skin which encloses them. The point *a* (Fig. 55) is called the *hilum*, and is supposed to be the point of attachment of the grain to the cellular tissue of the plant. Starch is readily prepared from potatoes, of which root it forms rather more than 80 per cent. of the solid matter, by causing them to be rasped; the pulp is then washed on a sieve, and the water, milky with the granules of the starch in suspension, is received into vats, where the amylaceous matter subsides. After several washings and strainings, it is finally dried.

Rice starch is more difficult to procure, from the fact that it is associated with 7 per cent. of gluten in the seed. This gluten is dissolved by a weak alkaline solution, which leaves the starch untouched.

The presence of starch is easily determined by the action of iodine, which, as has been already noticed, turns it blue.

From what we have seen of the insolubility of starch, it must be evident that this substance is unfitted for the food of the young shoot which the germinating plant puts forth, as all food, to enter the minute vessels of either the animal or vegetable frame, must be in a state of solution, and yet, were the starch soluble, the rain would wash away the contents of the husk as soon as it burst. These difficulties are solved by one of the most wonderful of arrangements—

Dextrine.—When a solution of starch is boiled with a little dilute sulphuric acid, it becomes thin and limpid, and does not give the blue compound with iodine; the starch has become dextrine, a substance closely resembling gum, and is indeed sold as British gum, in those useful bottles of "mucilage."

If this boiling with dilute acid be continued for some time, a further and still more remarkable change takes place—the dextrine becomes grape sugar, or glucose $(C_6H_{12}O_6,H_2O)$.

This very same result is produced in seeds by a minute quantity of a ferment, *diastase*, which is probably albumen or gluten in a particular stage of decomposition; one part of diastase can convert 2,000 parts of starch into sugar. In the germinating plant this conversion is not sudden, but gradual, thus supplying the rootlet with proper aliment as it requires it.

In brewing, this natural process is taken advantage of to convert the starch of the barley into sugar, and this sugar—as will be explained in the next lesson—suffers, by fermentation, a further change, becoming alcohol, carbonic acid gas, and water. The barley is "steeped" in water, and then spread out on a floor; here it begins to germinate, and by continually turning the bed with wooden shovels, this germination goes on uniformly. The *acrospire* is watched, and as soon as it is about half an inch long, and is going to bifurcate, the vitality of the seed is destroyed by rapidly drying the grain, experience having taught the maltster that at this point all the starch has become sugar; the malt is then mixed with water, and allowed to ferment.

The *saline matters* plants contain they obtain directly from the soil in which they grow, and are those phosphates, etc., of which the mineral structures of the body are composed. The great use of artificial manure is to supply soil which is deficient in such salts with those peculiarly required by the nature of the crop proposed to be raised. The decay of the large cities, such as Nineveh and Babylon, has been ascribed to the fact that the land in their neighbourhoods became exhausted of its phosphates, and in time refused to grow cereal crops. The means of importation being very imperfect, the population gradually decreased, or emigrated. We renew the exhausted soil by supplying it with guano, bone-earth, phosphate of lime, and other artificial manures.

Those constituents of the plant which we have noticed, which are not of a mineral character, are assimilated by the plant from carbonic acid gas, nitrogen, water, and oxygen. The process by which these changes are effected is wholly unknown. The green colouring matter of the leaf has the property, in sunlight, of decomposing the carbonic acid which the leaves—the lungs of the plant—inhale. The oxygen is thrown off in a pure state, fit for animal respiration, while the carbon is retained. Some of it forms the woody tissues of the plant; some of it, with the elements of water, and occasionally a little nitrogen, concurs to produce gluten, starch, sugar, and the other organic constituents of plants.

Cellulin or Cellulose $(C_{18}H_{30}O_{15})$.—This substance is the "basement tissue" of all vegetable structures; it occurs nearly pure as cotton, linen, elder pith. The particles of woody matter are deposited in the meshes of this cellulin.

Pyroxyline, or Gun Cotton $(C_{18}H_{21}.9NO_2,O_{15})$.—When cellulin is immersed in a mixture of equal measures of strong nitric acid, whose specific gravity is 1·5, and sulphuric acid, it undergoes a remarkable change. As may be seen by the above formula, one of the oxides of nitrogen is introduced into its composition. Apparently the fibre is not changed, but it has assumed the property of rapid combustion.

To prepare Gun Cotton.—The mixed acids are allowed to cool to the ordinary temperature of the air; the cotton, paper, or sawdust, is then immersed for some minutes; the material must not be immersed in large quantities, but piecemeal—the paper, sheet after sheet. After ten minutes it is removed, and thoroughly drained from the acid, by pressing it between two porcelain plates in an inclined position. It is now washed in cold water, until not a trace of acid is left, and dried with care, at a temperature not above 100° Cent. The rapidity of its explosion may be shown by igniting a little gun-cotton resting on gunpowder—the latter is generally not fired. Although this property renders it peculiarly adapted for blasting brittle rock, yet for military purposes an explosive is required of slower combustion, in order to heave the shot. Gun-cotton exerts its propulsive force but for a short time, and distresses the ordnance. This difficulty is now being overcome by compressing the fibre, which renders the inflammation slower. It possesses great advantages over gunpowder; it can be kept without injury any length of time damp, and speedily dried for use; it leaves no "train" when carried about; it is light, and, above all, yields no smoke upon explosion. It will explode when violently struck. When dissolved in ether, it forms the collodion of the photographer.

Lignine is the encrusting matter in the cellular tissue which gives hardness to wood.

LESSONS IN ITALIAN.—XVI.

VOCABULARY.

Andate, go.
Andrete, will you go?
Arriveremo, shall we arrive?
Avvenire, the future.
Bastonata, blow (with a stick).
Bene, good.
Bristol (also *Bri-stól-le* or *Bri-stó-lio*), Bristol.
Caccia, chase.
Caffè, coffee, coffee-house.
Cena, supper.
Cestria, Chester.
Che, what?
Chi (only of persons), who?
Collera, anger.
Concerto, concert.
Conversazione, intercourse, company, conversation.
Corte, court (of a sovereign).
Cugina (f.), cousin.
Da, from.
Di quì, from here.
Difetto, fault.
Disonore, dishonour.
Dogana, custom-house.
Domani, to-morrow.
Dormire, to sleep.
E' corso, ran.
Egli, he.
Egli se lo reca, he regards or reckons it.
Egli morì, he died.
Egli lo condurrà, he will bring or conduct him.
Egli è nato, he was born.
Ella giunse, she arrived.
Erano, were.
Essi, they.
Festino (dancing, gaming, etc.), evening party.
Fiorino, florin.
Firenze, Florence.
Gli vien imputata, is imputed to him.
Guadagno, profit.
Ha mandato, he has sent.

Imparare, to learn.
Io andrò domani, I shall go to-morrow.
L' avete mostrato, have you shown it?
Liberalità, liberality.
Lione, Lyons.
Lo incitò, he provoked him.
Male, evil.
Mercante, merchant.
Mi, to me, me.
Molino, mill.
Noja, ennui.
Nottingamo, Nottingham.
Nozze (*ts*), f. pl., wedding, marriage feast.
O, or.
Ognuno, everybody.
Palazzo (*ts*), palace, court.
Parola, word.
Passeggiare, to take a walk.
Pensa, thinks.
Pensate, do you think?
Penso, I think.
Pietro, Peter.
Plimutte, Plymouth.
Porta, door.
Pranzo, dinner.
Preferisce, he prefers.
Presto, soon, quickly.
Prossimo (m.), *prossima* (f.), next.
Scrivere, to write.
Si venne, one (they) came.
Soggiorna, he lives or resides.
Spasso, pastime, diversion.
Straniero, stranger.
Subito, immediately.
Suo (m.), *sua* (f.), his, her.
Tira, draws, conveys.
Tirare, to draw, trail, drag; to shoot or fire, etc.
Tocca, falls to the lot or share.
Tutto, all, whole.
Uccello, bird.
Viene, comes, becomes.

EXERCISE 13.—ITALIAN-ENGLISH.

1. Ha man-dá-to la lèt-te-ra a Gio-ván-ni. 2. Ti-rá-re ad un uc-cèl-lo. 3. Il mer-cán-te pên-sa al gua-dá-gno. 4. Tóc-ca un fio-rí-no ad ú-no. 5. O-gnú-no tí-ra l' á-cqua al sú-o mo-lí-no. 6. Dál-le pa-rô-le si vên-ne ál-le ba-sto-ná-te. 7. A chì l' a-vé-te mo-strá-to? a Piê-tro o al-la cu-gí-na? 8. A che pen-sá-te? 9. Pên-so all' av-ve-ní-re. 10. Ar-ri-ve-ré-mo prê-sto ál-la prôs-si-ma pô-sta? 11. E'-gli è cór-so sú-bi-to ál-la pôr-ta. 12. Par-lá-va ad ú-no stra-niê-ro. 13. Lo in-ci-tò ál-la côl-le-ra. 14. Pre-fe-rí-sce il bê-ne al má-le. 15. La sú-a con-ver-sa-zió-ne mi viê-ne a nô-ja. 16. E'-gli se lo rê-ca a dis-o-nó-re. 17. La li-be-ra-li-tà gli viên im-pn-tá-ta a di-fêt-to. 18. E's-si é-ra-no ál-la các-cia, ál-le nôz-ze, a prán-zo, a cé-na, al fe-stí-no. 19. An-dré-te do-má-ni al ri-dót-to? al con-cêr-to? 20. I'-o an-drò do-má-ni a un bál-lo. 21. An-dá-te a im-pe-rá-re, a scrí-ve-re, a dor-mí-re, a man-giá-re. 22. E's-si ván-no a spás-so, a pas-seg-giá-re. 23. An-diá-mo al caf-fè. 24. Per dó-ve si va ál-la pô-sta? ál-la do-gá-na? 25. E'-gli è a Ber-lí-no. 26. Sog-giór-na in Fi-rên-ze. 27. E'-gli mo-rì in Not-tin-gá-mo. 28. E'-gli lo con-dur-rà a Cê-stria. 29. E'l-la giún-se a Lió-ne. 30. E'-gli è ar-ri-vá-to in Bri-stôl. 31. E'-gli è ná-to in Pli-mút-te.

EXERCISE 14.—COLLOQUIAL.*

1. Thy mother has lost her umbrella. 2. My sister has found a pen. 3. Where have you bought this penknife? 4. Hast thou seen our horse? 5. We have seen a large inn. 6. Your little brother has a good watch. 7. Our brother is tall,† but our sister is little. 8. I have a hat which is very fine. 9. The watch which you have bonght is good. 10. Our uncle has received a letter. 11. This son has lost his mother. 12. This daughter has lost her father. 13. This present is for this child.

THE PARTICLE *DA*.

I have already stated that the particle *di* denotes a mere mental separation of ideas or notions, while the particle *da* expresses a real separation of objects. This is the fundamental signification of *da*, and, on this account, it must be pronounced to be the very opposite or logical antagonist of the particle *a*. This latter word indicates any kind of tangible or mental and imaginary approach or direction *to* or *towards* a person or thing, while *da* expresses any kind of tangible or mental and imaginary, but clear and real separation, removal, distance, or direction *from* a person or thing; and the ideas of direction *to* or *towards*, and of a direction *from* a person or thing, are, to some extent, the very poles or extremities of all relations in which words and things stand to each other: for example, in this sentence, *pár-lo di lui*, I speak of him, it is evident that there is no direction whatever *to* or *towards*, but rather a direction *from* a person. This direction is, nevertheless, not sufficiently clear and real enough to justify the use of *da*; while, in the sentence *vên-go da lui*, I come from him, a real removal, distance, or separation from the person from whom I come is understood, which can only be expressed by the particle *da*. As a fnrther illustration, in the phrase *un mer-cán-te di Ve-ró-na*, a merchant of Verona, the particle *di* is a mere sign or intimation to distinguish the merchant from the town in which he lives, and not of his absence from it; while, in the sentence *é-gli viê-ne da Ve-ró-na*, the particle *da* denotes an actual removal from that place. The fundamental explanation of the particle *da*, however, is not sufficient to convey a complete notion of all its uses; every language, generally speaking, being far too complex a vehicle of human thought anywhere to admit of such a summary discussion of its more important branches. Now, and hereafter, I shall be therefore obliged to explain the various modifications and exceptions of this general rule.

The ideas of *removal*, *distance*, *separation*, *dependence*, *deduction*, or *derivation*, and *origin* or *descent*, are, as it were, only collateral or subordinate branches of the fundamental notion of a *direction from* a person or thing, and that word (person or thing), the removal, distance, deduction or derivation, origin or descent *from which*, and the dependence *on which*, is expressed, requires the particle *da* before it. For example:—

Scó-sta-ti da qué-sto luó-go, begone from this place.
Al-lon-ta-ná-re ú-no da un luó-go, to remove one from a place.
Ca-vá-re á-cqua dal pôz-zo, to draw water from the well.
Ve-ní-re da lon-tá-no, to come from afar.
I'-o vén-go dal giar-dí-no, la cá-sa, I come from the garden, from home.
L' uc-cél-lo è u-scí-to dál-la gáb-bia, the bird has flown out of the cage.
Ac-cat-tá-re pá-ne da ú-no, to beg one's bread of one.
Ciò (pron. *ció*) *di-pén-de dál-la for-tú-na, da voi*, that depends on good lnck, on you.
De-dúr-re ú-na ra-gió-ne da un prin-cí-pio fál-so, to dednce an argument, proof, or evidence from a false principle.
Dál-la qual có-sa ná-cque-ro di-vér-se pa-ú-re, from which arose various fears.
De-ri-vá-re l' o-rí-gi-ne di ú-na có-sa da un' ál-tra, to dednce the origin of one thing from another.
Di-ví-de-re ú-na có-sa da un' ál-tra, to separate one thing from another.

It is obvious that the idea of *origin*, expressed by *da*, necessarily includes any *action proceeding from a person or place*. For this reason, on the one hand, the English preposition *by*, whenever in connection with passive verbs it denotes cause, anthorship, instrumentality, etc., mnst be translated by *da*; and, on the other hand, all verbs expressing a going away, or departure, generally demand this particle. For example:—

Car-tá-gi-ne fu fab-bri-cá-ta da Di-dó-ne, Carthage was built by Dido.
Fu é-gli da al-cú-ni suó-i se-gré-ti ne-mí-ci ac-cu-sá-to, he was accused by some of his secret enemies.
A qué-sto giar-dí-no l' á-cqua è ab-bon-de-vol-mén-te som-mi-ni-strá-ta da ú-na fre-schís-si-ma fon-tá-na, the water for this garden* is abundantly supplied by a very cool fountain.
É-gli è par-tí-to da Lón-dra, he has departed from London.
Co-min-ciò a an-dá-re da Na-za-rét-te a Ge-ru-sa-lém-me, he began to go from Nazareth to Jerusalem.

Whenever the verbs *u-scí-re* or *sor-tí-re*, to go or come out or from; *par-tí-re*, to set off, depart; *ve-ní-re*, to come; *fug-gí-re*, to fly, escape, etc., admit of the preposition *di* before that place from which the going away or departure takes place, this apparent deviation from the general rule, without difficulty, will be explained by ellipsis; *i.e.*, by the omission of the preposition *da*, with some other general noun:—

Ve-ní-re, par-tí-re di Ró-ma (i.e., *dál-la cit-tà di Ró-ma*), to arrive, to depart from (the city of) Rome.
É-gli è di A-ber-dó-nia (i.e., *dál-la cit-tà di A-ber-dó-nia*), he is a native of (the town of) Aberdeen.
U-scí-re, sor-tí-re di cá-sa, di cór-te, di pa-láz-zo, di teá-tro, di chié-sa, to go or come from home, from court, from guildhall, from theatre, from church.

The particle *da*, also, is nsed, in order, by naming the birth-place, to distingnish one person from others of the same appellation. The birth-place thns becomes, as it were, the snrname of the individual. This employment of *da* certainly is quite conformable to its fundamental notion, for the birth-place is a part of the general idea of origin, descent, or extraction:—

* After a careful study of the previous colloquial exercises, even ordinary pupils should be able to translate the following sentences without the aid of a vocabulary.

† In Italian, *tall* and *great* are frequently expressed by the same word.

* *Da*, as well as the English *by*, is in these cases the preposition, which must be placed before the nominative case of the original sentence of the active voice whenever the latter is to be changed into the passive: for example, *U'-na fre-schís-si-ma fon-tá-na som-mi-ní-stra ab-bon-de-vol-mén-te l' á-cqua a qué-sto giar-dí-no*, a very cool fountain abundantly supplies the water for this garden.

*Gio-ván-ni da Fié-so-le, Pié-tro da Cor-tó-na, Leo-nár-do da Vín-ci, Guí-do da Sié-na, Po-li-dó-ro da Ca-ra-vág-gio, Ra-faël-lo da Ur-bí-no,** etc.

Da, also, may denote any origin or commencement referring to time, and then it means *since* :—

Da che vi ví-di la prí-ma vól-ta, since (that day when) I saw you the first time.
Dál-la mí-a gio-va-néz-za in sí-no qué-sto tém-po, since my youth till this day.
Dall' án-no pas-sá-to in quà, since last year.
Da dú-e mé-si in quà, two months since.
Dál-la mór-te di mí-o pá-dre in quà, since the death of my father.†

The phrases *da mat-tí-na, da sé-ra, da nôt-te*, mean, in the morning, in the evening, in the night (by night, at night) :—

Ô-pe-ra da far da mat-tí-na, work to be done in the morning.
Non é-sce da cá-sa che da sé-ra, he only goes from home in the evening.
Tá-li có-se non si fán-no da nót-te, such things are not done by night.

Da also signifies *about, nearly, close upon, not far off from*, etc. :—

Hó gua-da-gná-to da cín-que lí-re ster-lí-ne, I have gained or won about five pounds sterling.
Ho per-dú-to da séi a ót-to tál-le-ri, I have lost from about six to eight dollars.
Da Ró-ma a Ná-po-li sa-rán-no da cén-to ses-sán-ta mí-glia, it is about a hundred and sixty miles from Rome to Naples.
É-gli vi re-ste-rà da cín-que a séi giór-ni, he will stay there from about five to six days.
Sti-má-va-si a-vé-re in Fi-rén-ze da no-van-ta-mí-la bóc-che tra uó-mi-ni e fém-mi-ne e fan-ciúl-li, about ninety thousand persons, men, women, and children, were estimated to be in Florence.

A logical contradiction and anomaly, though introduced and sanctioned by a universal usage, for the most part in the place of the preposition *a*, the constant employment of *da* in connection with those verbs which, with some house, mansion, apartments, lodging, or any other place of continuance, denote *any kind of motion to* or *towards, any kind of living* or *residing with, and any kind of visit paid to, a person* :—

An-dá-re dal mé-di-co, dal cal-zo-lá-jo, to go to the physician, to the shoemaker.
Do-má-ni ver-rò da voi, I shall come to you to-morrow.
I'-o vi me-ne-rò da lui, I shall conduct you to him.
Ve-ní-te da me, dal mer-cán-te, come to me, to the merchant.
Só-no stá-to da lui, dal fra-tél-lo, I have been at his, at the brother's house (with him, with the brother).
A'-bi-ta, al-lóg-gia da sú-o zí-o, he lives or resides with his uncle.

Da is sometimes a substitute for *di* :—

Li bia-si-má-va du-ra-mén-te, ó-ra da fol-lí-a, ó-ra da co-dar-dí-a (instead of *di follia, di codardia*), he severely blamed them, now for their folly, now for their cowardice.
És-si hán-no mól-ti mó-di da al-leg-giá-re o da pas-sá-re quél-lo (instead of *di alleggiare, di passare*), they have many means to make it easier or to pass over it.

The particle *da* can never be really omitted, and the cases of ellipsis that I mentioned only serve the purpose of grammatical explanation.

KEY TO EXERCISES IN LESSONS IN ITALIAN.—XIV.

Exercise 9.

1. Il sartore domanda nove braccia di panno, due dozzine di bottoni, e mezza oncia di seta. 2. Mandate a prendere un pane di zucchero, e due libbre di caffè. 3. Io ritornero in un quarto d' ora. 4. Finite di bere questo bicchiere di vino e mangiate questo crostino di pane. 5. Prendete la carta geografica, e cercatemi la città di Parigi e la citta di Londra. 6. Io vengo per ordine del padrone a dirvi che si facciano le preparazioni per il giorno di domani. 7. Il mese d' Aprile è variabile; il mese di Maggio, incontro, è molto ameno. 8. I mesi di Decembre e di Gennajo sono i piu rigidi dell' anno. 9. Che abito metterete per il ballo di domani? 10. Siete stati alla commedia d' ieri? 11. Gli furono assegnate le camere di sotto.

Exercise 10.

1. A gold snuff-box. 2. A silver vase. 3. A velvet dress. 4. Italian wine. 5. A heart of stone. 6. The iron wire. 7. Fine leather gloves. 8. A straw hat. 9. A gold, a silver mine. 10. English steel. 11. Iron of Styria. 12. Frankfort fair. 13. To-morrow's festival. 14. To-day, now-a-days. 15. Yesterday's comedy. 16. The theatre of the present day. 17. A four weeks' illness. 18. The wine of eight, of twenty years. 19. The Seven Years' War. 20. A fine prospect. 21. The sound of the trumpet. 22. A person of fidelity. 23. He is obstinate. 24. A courtier, a fashionable man. 25. A learned man, of agreeable temper. 26. A man of rank, a polite man. 27. An ill-behaved man. 28. A very clever man, of great fame. 29. A man of middle stature. 30. An ill-natured man, a warrior, a man of war. 31. A man of low birth. 32. A man of indifferent health. 33. The matter is of great importance. 34. A celebrated physician. 35. The art of the turner, of the dyer. 36. The types-foundry. 37. A camp of diversion. 38. A cotton-mill. 39. A bridge of boats, pontoon. 40. An inspector of the cannon foundry. 41. The equipment of the soldiers. 42. A law project. 43. The commission, the diploma. 44. The certificate of birth. 45. The United States of America. 46. The Emperor of the Russians. 47. The frontiers of Saxony. 48. Within the space of three months. 49. A prodigy of a man. 50. A man of thirty. 51. A gentleman's model. 52. That blockhead of a servant of yours. 53. This devil of a woman. 54. That sly fox of a William. 55. A little bit of a rogue! 56. That poor brother of mine! 57. So much wine and as much again of water. 58. It is such a bright moonlight. 59. One named Jonas. 60. Judas surnamed Thaddeus. 61. Three months' leave, discharge.

Exercise 11.

1. This horse is beautiful. 2. This snuff-box is very small. 3. This hotel is large. 4. This child is my brother. 5. This book is for my father. 6. This penknife is for my brother. 7. I have found a ring. 8. Where have you found this ring? 9. Your little sister has a handsome book. 10. My mother has bought this hat. 11. Thy brother has seen this fine carriage. 12. Your little brother is a good child. 13. Where hast thou bought this snuff-box? 14. This watch is very good. 15. This beautiful ring is for this child. 16. My uncle has a son and a daughter. 17. I have seen thy brother and sister. 18. We have received a present. 19. Have you written a letter? 20. My sister has received a fine cap. 21. I have sold my carriage. 22. Hast thou also sold thy carriage? 23. This present is for your aunt. 24. Your son is very little, but he is good. 25. My daughter is very tall. 26. This father has a beautiful daughter. 27. This child is my son. 28. The garden that I have seen is very large. 29. My father has lost his hat and his umbrella. 30. Our uncle has sold his beautiful carriage. 31. My sister has found her ring. 32. This father has lost his daughter. 33. This mother has lost her son. 34. My uncle has bought a hood for his little daughter. 35. This present is for my sister. 36. This boy has written a very long letter to his mother. 37. Our aunt has bought a very fine cloak for her son. 38. Have you found a ring? 39. My uncle has lost his cloak.

KEY TO EXERCISES IN LESSONS IN ITALIAN.—XV.

Exercise 12.

1. I tempi d' adesso non sono i migliori. 2. Egli si era nascosto nella stanza di dietro. 3. Nostra città ha un ponte di pietra, la vostra ha solamente uno di legno. 4. Eduardo ha ricevuto da Londra un oriuolo d' oro, una spada d' argento, e un pajo delle fibbie. 5. Una volta si portavono degli abiti di panno e de' gile di veluto. 6. L' uso dei vasi di rame è stato proibito in Svezia. 7. Nella beccheria si trova da vendere della carne di manzo, di vitello, di castrone. 8. Che significa questo suono di campane? 9. Che dite del panno che ho comprato? 10. Esso è buono e fino. 11. E di colore? 12. Esso è bello. 13. Che pensate dell' uomo che vedete, del ragazzo ch' egli mena seco, e del mendico che gli va dietro? 14. Ecco dieci braccia di taffeta del quale volevate avere, e dodici braccia della tela batista che avete domandata. 15. Mandatemi una dozzina di limone, e due libbre di fichi che avete ricevuti da Smirna. 16. Cedetemi una fiaschetta dell' eau di Cologne che vi è stata mandata.

LESSONS IN GEOGRAPHY.—XXXVIII.

CHIEF POLITICAL DIVISIONS OF NORTH AMERICA.

The following table exhibits the principal political divisions of the continent of North America, showing the capital or most important city in each division, and the river, etc., on which it stands; the approximate area in English square miles; the number of inhabitants, also stated approximately; and the number of persons resident, on an average, on each square mile.

* The English learner will, perhaps, best understand this use of *da* by translating it with *sprung from*.

† *Since* (denoting time, and not in the sense of *as* or *because*) is translated by *fin da, da . . . in quà*, or *dó-po*, when it precedes a noun.

THE CHIEF DIVISIONS OF NORTH AMERICA, THEIR CAPITALS, POPULATION, AREA, ETC.

Divisions.	Capitals or Chief Cities.	Rivers, etc., on which the Capitals stand.	Approximate area in Square Miles.	Approximate No. of Population.	No. of Pop. to every sq. mile.
Brit. N. America	Ottawa . .	Ottawa .	3,620,000	4,750,000	$1\frac{1}{4}$
Greenland. .	Julianshaab .	Sea Coast .	380,000	10,000	[illegible]
United States .	Washington .	Potomac .	3,603,880	57,000,000	15[illegible]
Mexico . .	Mexico . .	L. Tezcuco.	751,180	10,007,000	13[illegible]
Central America	New Guatemala.	Montagua .	175,865	2,900,000	$16\frac{1}{2}$
W. I. Islands, etc.	Havanna . .	C. of Cuba.	98,000	4,195,000	43[illegible]

From the above table it will be seen that the great territorial divisions are few in number; but these are subdivided into a number of lesser districts, as will be shown presently. Leaving Greenland out of the question, the reader will be struck at once with the scanty population of British North America, when viewed in comparison with its immense extent, which is larger even than that of the United States. It speaks volumes about the defenceless state of by far the greater part of the British territory, should the jealous and restless people of the United States be inflamed by a furious desire for annexation; and it tells a sad story of the negligence and indifference of the authorities at home, who, by the judicious use of emigration, might have settled the rich acres of the Fertile Belt—a track of rich woodland and meadows, stretching westward from Canada to the Rocky Mountains—with families who are wearily dragging out a cheerless existence at home, thus stocking it with men who would be ready and willing to defend their own, and whose labour would soon render the country an abundant source of food, both animal and vegetable, to those they have left behind in the old mother-land in the distant east.

Greenland, or Danish America, is a barren, snow-covered country, with a coast broken by deep inlets of the sea, on some of which a few fishing towns and villages have been founded. It is, in all probability, an island, though no man as yet has been able to reach its northern limits, or even proceed to any distance into the interior. Its inhabitants are chiefly Esquimaux, who live on seals and whale-blubber. About 500 Danes are found in the fishing-towns of Julianshaab, Christianshaab, Upernavik, Jacobshavn, and Fredrickshaab, who work the whale fisheries and obtain copper on Discoe Islands, and an inferior coal on some parts of the coast.

British North America is divided from the United States by the parallel of 49° north latitude and the chain of great lakes in the upper part of the river St. Lawrence. It is separated from Alaska on the west by the meridian of 141° west longitude, from the Arctic Ocean to Mount St. Elias, where the remainder of the line of demarcation from this mountain to the top of Observatory Inlet, one of the branches of the great strait that divides Queen Charlotte Islands from the mainland, is formed by the coast range of the Rocky Mountains. The following are the principal divisions of British North America:—

DIVISIONS.	CHIEF TOWNS.	DIVISIONS	CHIEF TOWNS.
Hudson Bay Ter.	Fort York.	Stickeen	
Canada .	Ottawa.	Brit. Columbia	New Westminster.
Newfoundland and Labrador.	St. John's.	Vancouver Is.	Victoria.

Of these the Hudson Bay territory, lying round Hudson Bay and stretching westward to the Rocky Mountains, a tract abounding in large lakes and rivers, is chiefly remarkable for the Fertile Belt, which is intersected by Lakes Winnipeg and Winnipegoos, and traversed by the Saskatchewan river. This belt is a fine wheat-producing country, and, abounding in wood, water, and fine pastures, offers considerable advantages to settlers proceeding thither from the United Kingdom. The Dominion of Canada, which was formed in 1867, consists of the provinces of Ontario and Quebec, formerly known as Upper and Lower Canada, or Canada East and Canada West, New Brunswick and Nova Scotia, to which last belongs Cape Breton Island. Ottawa, the capital, is in the province of Ontario. Newfoundland is famous for its fisheries. The governor of this island includes Labrador, with its bleak, iron-bound coast, within his jurisdiction. In the Gulf of St. Lawrence is also found the little colony of Prince Edward Island.

The most important colony on the west side of British North America is Vancouver Island, which, from its rich coal and iron mines, seems destined to become the seat of manufactures of all kinds, and the focus in which will be centred a large trade between our North American colonies and Eastern Asia and Australia, when the Fertile Belt is traversed by a railway running from Canada to British Columbia. The last-named colony, yet in its infancy, yields timber, coal, and gold; while of Stickeen, which lies to the north, and was constituted a British colony in 1862, little is known at present, or will be known while more desirable localities for emigration are found in Vancouver Island and British Columbia.

As regards the United States, which has completed its first century of existence as an independent nation, we can only give a list of the states of which it is composed, distinguishing the states from the territories and territorial districts, and the free states from the former slave states. At the present time the republic of the United States, which stretches from the southern limits of British North America to the head of the Gulf of California and the Rio Grande del Norte, the chief part of the boundary line that separates it from Mexico, consists of one federal district, thirty-eight states, eight territories, and two territorial districts, including Alaska, which was formerly called Russian America. The federal district is Columbia, a small piece of land lying around the capital, Washington, which stands on the Potomac river. Of the states, territories, and territorial districts, there are four groups, supposing the whole country to be divided into two parts by the Mississippi, and each of these parts to be again sub-divided into two portions, the eastern moiety into the north-eastern and south-eastern states by the rivers Ohio and Potomac, and the western half into the north-western and south-western states. It will be as well to state at once that the dates preceding the names of each state show the period at or about which it was formed or settled, or admitted into the Union after the Declaration of Independence in 1776. The states in italics are the former slave states, and those to which the letters C. S. are added conjointly formed the federal union of the Confederate States from 1861 to 1865. The letters T. and T. D. affixed to the territories and territorial districts will serve to distinguish the former from the latter.

1. NORTH-EASTERN STATES (16).

1820 Maine.	Augusta.	1627 *Delaware* (7).	Dover.
1623 New Hampshire (1). .	Concord.	1632 *Maryland* (8).	Annapolis.
1791 Vermont.	Montpelier.	1682 Pennsylvania (9). .	Harrisburg.
1620 Massachusetts (2). ...	Boston.	1802 Ohio.	Columbus.
1635 Rhode Island (3).	Newport, etc.	1816 Indiana.	Indianopolis.
1635 Connecticut (4).	Hartford, etc.	1818 Illinois.	Springfield.
1614 New York (5).	Albany.	1848 Wisconsin.	Madison.
1644 New Jersey (6).	Trenton.	1837 Michigan.	Lansing.

2. SOUTH-EASTERN STATES (10).

1607 *Virginia* (10) c.s.	Richmond.	1669 *S. Carolina* (12) c.s. ...	Columbia.
1863 West Virginia.	Wheeling.	1732 *Georgia* (13) c.s. ...	Milledgville.
1792 *Kentucky*.	Frankfort.	1845 *Florida*, c.s.	Tallahassee.
1796 *Tennessee*, c.s.	Nashville.	1819 *Alabama*, c.s. ...	Montgomery.
1669 *North Carolina* (11) c.s.	Raleigh.	1817 *Mississippi*, c.s.	Jackson.

3. NORTH-WESTERN STATES, ETC. (10).

1846 Iowa.	Des Moines.	Montana (T.)	Virginia.
1858 Minnesota.	St. Paul.	Idaho (T.)	Lewiston.
Dakotah (T.)	Yankton.	1859 Oregon.	Salem.
1867 Nebraska.	Omaha.	Washington (T.)	Olympia.
Wyoming (T.)		Alaska (T.D.)	Sitka.

4. SOUTH-WESTERN STATES, ETC. (12).

1850 California.	Sacramento.	Indian Territory (T.D.)	
1865 Nevada.	Virginia City.	1861 Kansas.	Topeka.
Utah (T.)	Filmore City.	1821 *Missouri*.	Jefferson City.
Arizona (T.)	Prescott.	1836 *Arkansas* (C.S.)	Littlerock.
New Mexico (T.)	Santa Fe.	1812 *Louisiana* (C.S.)	Baton Rouge.
1867 Colorado.	Denver City.	1845 *Texas* (C.S.)	Austin.

It should be stated that the territories send only one delegate to Congress, while the districts are unrepresented. The states send members in proportion to their population. Several of the present states were separated from the thirteen states that originally entered the Union in 1776: thus Maine was included in Massachusetts, and Vermont in New York; West Virginia and Kentucky were portions of Virginia; Tennessee belonged to South Carolina, and Alabama and Mississippi to Georgia. The reader can now trace the original limits of the British American colonies prior to 1776. The New England States—so called because they formed parts of New England, a tract settled by the Plymouth Company—are Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut.

Mexico, stretching southwards from the United States to the Gulf of Tehuantepec, and including the peninsula of Yucatan, was a dependency of Spain from its conquest by Hernando Cortes in 1521 to 1821, when it regained its independence under Iturbide, a native, who then became Emperor, but did not long retain his crown. Since then it has been a prey to civil discord and intestine strife. Mexico consists of twenty-six small states in a federal union, with a constitution somewhat similar to that of the United States.

Central America, which includes the British territory of Honduras, chief town Balize, under the jurisdiction of the governor of Jamaica, contains the following republics, and the Mosquito territory, which is under British protection:—

Guatemala,	*Capital* New Guatemala.	Nicaragua,	*Capital* Managua.
San Salvador,	,, Cojutepeque.	Costa Rica,	,, St. Jose.
Honduras,	,, Comagua.		

The West India Islands, which lie like a breakwater at the entrance to the Gulf of Mexico, and stretch southward between the Caribbean Sea and the Atlantic Ocean to the north coast of South America, are divided among various European powers. The western part of Hayti, or St. Domingo, is the only independent state.

British.—The Bahamas, Jamaica, Barbadoes, Antigua, St. Christopher's or St. Kitts, St. Vincent, Dominica, Grenada and the Grenadines, Trinidad, Montserrat, Nevis, Anguilla, Barbuda, the Virgin Isles, St. Lucia, and Tobago.

Dutch.—St. Eustatius, Saba, Curaçoa, Buen Ayre, St. Martin (south side).

French.—Martinique, Guadaloupe, Grande Terre, Desinade, Marie Galante, and St. Martin (north side).

Danish.—Santa Cruz, St. John, St. Thomas.

Swedish.—St. Bartholomew.

Spanish.—Cuba, Porto Rico, Isle of Pines, and Dominica, on east part of Hayti.

The Bahamas, a cluster in the middle of the Atlantic Ocean, belong to Great Britain. The chief town of the British West Indies is Spanish Town, in Jamaica. The West India Islands, it should be said, are divided into three groups—1, the Bahamas; 2, the Greater Antilles, including Cuba, Porto Rico, and Jamaica; and 3, the Lesser Antilles, comprising the rest of the islands, from the Virgin Islands in the north to Trinidad in the south. A line drawn between Martinique and St. Lucia separates this third group into the Windward and Leeward Islands, the latter being the northern division, and the former the southern.

A projection for a map of North America may be constructed in the same way as projections for maps of Europe and Asia. Those who wish to fill up a projection for themselves may obtain the outline of the coast, and directions of rivers and mountain ranges, from any good map, and the latitudes and longitudes of the principal places, headlands, etc., from the index to any atlas.

LESSONS IN ALGEBRA.—XX.

INVOLUTION, OR RAISING OF POWERS.

173. *When a number is composed of the product of the same factor any number of times, the result is called a power of the factor. Powers are divided into different orders or degrees; as the first, second, third, fourth, fifth powers, etc., which are also called the root, square, cube, biquadrate, etc.*

The powers take their names from the number of times the *root*, or *first power*, is used as a *factor* in producing the given power.

The original quantity is called the *first power*, or *root* of all the other powers, because they are all derived from it.

Thus, if 2 be the root or first power, then

$2 \times 2 = 4$, the square or second power of 2.
$2 \times 2 \times 2 = 8$, the cube or third power.
$2 \times 2 \times 2 \times 2 = 16$, the biquadrate or fourth power, etc.

And, if a be the root or first power, then

$a \times a = aa$, the second power of a.
$a \times a \times a = aaa$, the third power.
$a \times a \times a \times a = aaaa$, the fourth power, etc.

174. The *number* of times a quantity is employed as a *factor* to produce the given power is generally indicated by a *figure* or *letter* placed above it on the right hand. This figure or letter is called the *index* or *exponent*. Thus $a \times a = aa$, is written a^2 instead of aa; and $a \times a \times a = aaa$, is written a^3.

The *index* of the *first power* is 1; *but this is commonly omitted*, that is, $a^1 = a$.

An index is totally different from a *co-efficient*. The *latter* shows how many times a quantity is taken as a *part* of a whole; the *former* how many times the quantity is taken as a *factor*. Thus $4a = a + a + a + a$; but $a^4 = a \times a \times a \times a = aaaa$. If $a = 4$, then $4a = 16$; and $a^4 = 256$.

175. Powers are also divided into *direct* and *reciprocal*.

Direct Powers are those which have *positive* indices, as d^2, d^5, etc., and are produced by multiplying a quantity by itself, as above described. Thus $d \times d = d^2$; $d \times d \times d = d^3$; and $d \times d \times d \times d = d^4$.

The *Reciprocal Power* of a quantity is the quotient arising from dividing a *unit* by the *direct* power of that quantity, as $\frac{1}{d^2}$, $\frac{1}{d^3}$, $\frac{1}{d^4}$, etc.

A reciprocal power is produced by dividing a *direct power* by its *root*, till we come to the root itself; and then *continuing* the division, we obtain the *reciprocal* powers. Thus $\frac{d^3}{d} = d^2$; and $\frac{d^2}{d} = d$; $\frac{d}{d} = d^0 = 1$; and $\frac{1}{d} \div d = \frac{1}{d^2}$; and $\frac{1}{d^2} \div d = \frac{1}{d^3}$, etc.

176. For convenience of calculation and expression, reciprocal powers are written like direct powers with the sign − before the *index*; thus $\frac{1}{d^2} = d^{-2}$, etc. The direct and reciprocal powers of d are d^4, d^3, d^2, d^1, d^0, d^{-1}, d^{-2}, d^{-3}, d^{-4}, etc., in which $d^0 = 1$.

177. INVOLUTION *is the process* of finding any power of a quantity, as explained in Art. 173.

178. To involve a quantity to any required power.

RULE.—*Multiply the quantity by itself, and by its successive products, till it is taken as a factor as many times as there are units in the index of the power to which the quantity is to be raised.*

All powers of unity or 1 are the same, viz., 1. For $1 \times 1 \times 1 \times 1$, etc. $= 1$.

179. A *single letter* is involved or raised to any power, by giving it the *index* of the proposed power; or by repeating it as a factor as many times as there are units in that index.

If the letter or quantity has a *co-efficient*, it must be raised to the *required power* by *actual multiplication*.

EXAMPLES.

1. The 4th power of a is $aaaa$, or a^4.
2. The 6th power of y is $yyyyyy$, or y^6.
3. The nth power of x is xxx ... repeated n times, or x^n.

180. The method of involving a quantity which consists of several *factors*, depends on the principle, that *the power of the product of several factors is equal to the product of their powers.*

EXAMPLE.—What is the square of ay? Here, $(ay)^2 = a^2y^2$. For, by Art. 178, $(ay)^2 = ay \times ay$.

But $ay \times ay = ayay = aayy = a^2y^2$. *Ans.*

In finding the power of a *product*, therefore, we may either involve the *whole* at *once*, or we may involve *each* of the factors *separately*, and then multiply their several powers into each other.

181. *When the root is positive, all its powers are positive also; but when the root is negative, the* ODD *powers are negative, while the* EVEN *powers are positive.*

Hence any *odd* power has the same sign as its root. But an *even* power is positive, whether its root is positive or negative. Thus $(+a) \times (+a) = a^2$. And $(-a) \times (-a) = a^2$.

182. To involve a quantity which is already a power.

RULE.—*Multiply the index of the quantity by the index of the power to which it is to be raised.*

EXAMPLE.—Find the 3rd power of a^2. Here, $(a^2)^3 = a^6$.

For $a^2 = aa$: and the cube of aa is $aa \times aa \times aa = aaaaaa = a^6$; which is the 6th power of a, but the third power of a^2.

EXERCISE 31.

1. Required the 3rd power of $3x$.
2. Required the 4th power of $4y$.
3. Required the 7th power of $2a$.
4. What is the 3rd power of bmx?
5. What is the nth power of ady?
6. What is the 6th power of dhy?
7. What is the 3rd power of $4b$?
8. What is the nth power of $6ad$?
9. What is the 3rd power of $3m \times 2y$?
10. Find the 4th power of a^2b^2.
11. Find the 3rd power of $4a^2x$.
12. Find the 4th power of $2a^3 \times 3x^2d$.
13. Required the 5th power of $(a+b)^2$.
14. Required the 2nd power of $(a+b)^n$.
15. Required the nth power of $(x-y)^m$.
16. Required the nth power of $(x+y)^2$.
17. Required the 2nd power of $(a^3 \times b^3)$.
18. Find the 3rd power of $(a^2b^2h^4)$.

183. *A* FRACTION *is raised to a power by involving both the numerator and the denominator to the power required.*

EXAMPLE.—Find the square of $\frac{a}{b}$.

By the rule for the multiplication of fractions we have $\frac{a}{b} \times \frac{a}{b} = \frac{aa}{bb} = \frac{a^2}{b^2}$. *Ans*

184. A compound quantity, consisting of terms connected by $+$ and $-$, is involved by an actual multiplication of its several parts.

EXAMPLE.—Find the 2nd, 3rd, and 4th powers of $a+b$.

Here, $(a+b)^1 = a+b$, ... the first power;

$$\begin{array}{rl} & a+b \\ \hline & a^2+ab \\ & \quad +ab+b^2 \\ \hline (a+b)^2 = & a^2+2ab+b^2, \quad \text{. . . the second power;} \\ & a+b \\ \hline & a^3+2a^2b+ab^2 \\ & \quad +a^2b+2ab^2+b^3 \\ \hline (a+b)^3 = & a^3+3a^2b+3ab^2+b^3, \quad \text{. the third power;} \\ & a+b \\ \hline & a^4+3a^3b+3a^2b^2+ab^3 \\ & \quad +a^3b+3a^2b^2+3ab^3+b^4 \\ \hline (a+b)^4 = & a^4+4a^3b+6a^2b^2+4ab^3+b^4, \text{ the fourth power.} \end{array}$$

EXERCISE 32.

1. Find the 2nd, 3rd, and nth powers of $\frac{1}{a}$.
2. Find the cube of $\frac{2xr^2}{3y}$.
3. Find the nth power of $\frac{x^2r}{ay^m}$.
4. Find the square of $\frac{-a^2 \times (d+m)}{(x+1)^2}$.
5. Find the square of $a-b$.
6. Find the cube of $a+1$.
7. Find the square of $a+b+h$.
8. Required the square of $a+2d+3$.
9. Required the 4th power of $b+2$.
10. Required the 5th power of $x+1$.
11. Required the 6th power of $1-b$.

185. The squares of *binomial* and *residual* quantities occur so frequently in algebraic processes, that it is important to make them familiar. Thus,

If we multiply $a+h$ into itself, and also $a-h$ into itself, we have

$$\begin{array}{r} a+h \\ a+h \\ \hline a^2+ah \\ +ah+h^2 \\ \hline a^2+2ah+h^2 \end{array} \qquad \begin{array}{r} a-h \\ a-h \\ \hline a^2-ah \\ -ah+h^2 \\ \hline a^2-2ah+h^2. \end{array}$$

Here it will be seen, that in each case the first and last terms are the squares of a and h; and that the middle term is twice the product of a by h. Hence the squares of binomial and residual quantities, without multiplying each of the terms separately, may be found by the following rule:—

(1.) *The square of a* BINOMIAL, *the terms of which are both positive, is equal to the squares of the first and last terms, plus twice the product of the two terms.*

(2.) *The square of a* RESIDUAL *quantity is equal to the squares of the first and last terms, minus twice the product of the two terms.*

EXERCISE 33.

1. Find the square of $2a+b$.
2. Find the square of $h+1$.
3. Find the square of $ab+cd$.
4. Find the square of $6y+3$.
5. Find the square of $3d-h$.
6. Find the square of $a-1$.

186. For many purposes it will be sufficient to express the powers of compound quantities by *exponents* without an actual multiplication.

EXAMPLES.

1. Find the square of $a+b$. *Ans.* $(a+b)^2$.
2. Find the nth power of $bc+8+x$. *Ans.* $(bc+8+x)^n$.

In cases of this kind, *all* the terms of which the compound quantity consists must be included in the parenthesis.

187. But if the root consists of several *factors*, the parenthesis used in expressing the power may either extend over the whole, or may be applied to each of the factors separately, as convenience may require.

Thus the square of $(a+b) \times (c+d)$, is either

$$\left\{ (a+b) \times (c+d) \right\}^2, \text{ or } (a+b)^2 \times (c+d)^2.$$

The first of these expressions is the square of the product of the two factors, and the last is the product of their squares, and these are equal to each other.

In like manner the cube of $a \times (b+d)$ is $\left\{ a \times (b+d) \right\}^3$, or $a^3 \times (b+d)^3$.

188. When a quantity, whose power has been expressed by a parenthesis, with an index, is afterwards involved by an actual multiplication of the terms, it is said to be *expanded.*

Thus $(a+b)^2$, when expanded, becomes $a^2+2ab+b^2$, and $(a+b+h)^2$ becomes $a^2+2ab+2ah+b^2+2bh+h^2$

KEY TO EXERCISES IN LESSONS IN ALGEBRA.

EXERCISE 30.

1. 9 and 19.
2. 17 and 31.
3. 13.
4. £180.
5. 864.
6. 21 and 16.
7. 9 and 3 years.
8. 12 hours.
9. 6 and 9.
10. 156 days.
11. £1,200.
12. 8.
13. $32\frac{1}{2}$ miles.
14. 480.
15. £1,125 and £875.
16. £120.
17. A 200 miles, and B 160 miles.
18. 48 years.
19. 1,920.
20. 35.
21. 100.
22. 800 trees.
23. 47.
24. £280.
25. 84 years.
26. 84.
27. £450.
28. 147lbs.
29. 29 gals. brandy, 44 gals. wine, and 73 gals. water.
30. A, £317; B, £951; C, £1,268; and D, £2,219.
31. 17, 14, 27, 8, and 33.
32. 153 shillings.
33. 147 sheep.
34. 20 days.
35. A, 84; B, 42; C, 14.
36. 20 yards and 26 yards.
37. £320.
38. 12.
39. Chaise, £240; horse, £80; harness, £40.
40. 126 gallons.
41. 10, 14, 18, 22, 26, and 30.
42. 30 and 19.
43. 16 and 24.
44. 36 and 12.
45. 42 and 26.
46. 12, 4, and 18 miles.
47. 8, 12, and 16.
48. £740.
49. 24,000 men.
50. 53.
51. 23.
52. $\frac{6}{11}$.
53. 20 and 13.
54. 233 and 142.
55. 24 feet.
56. 10 shillings.
57. 16 years.
58. 54 years.
59. 21 years.
60. $6\frac{3}{4}$.
61. 56 hours.
62. 20 days.
63. 197 sheep.
64. 6 days.
65. 30 days.
66. 120 minutes.
67. 36 farthings and 3 pence.
68. 5 shares and 120 pence.
69. 300 leaps.
70. 60 days; and 1,800 and 1,200 miles for A and B respectively.
71. £44 from B, and £88 from A.
72. A £312, B £412, and C £476.
73. 12s., 2s., and 16s.
74. $5\frac{1}{3}$ hours.
75. 20s.
76. 804 minutes.
77. $y = \frac{nb-a}{m-n}$, and $x = \frac{m(nb-a)}{m-n}$. When $m = n$, and $a = nb$, the question is indeterminate: when $m = n$, and a greater or less than nb, the values of x and y are infinite, and the question absurd. When x and y are negative, the question will be changed into one in which the quantity of rum is *diminished* by a gallons, and that of the water by b gallons.
78. $\frac{8}{11}$.
79. $\frac{3}{4}$.
80. £60 and £80.
81. $5\frac{5}{11}$ minutes before 11 o'clock.
82. 24 and 20.
83. 18 and 60.
84. 679.
85. Those of the first kind 21 shillings each, and those of the second 25 shillings.
86. At the end of 21 days.
87. 44 lines, each containing 51 letters.
88. £1,200 and £200.
89. In 48 minutes.
90. £13.
91. £6,840.
92. £12,600.
93. 200 cavalry, 600 artillery, and 1,800 foot.
94. 28 and 18.
95. 189.
96. 75 oz. gold, and 25 oz. silver.
97. £4 16s.
98. 72lbs.
99. A, 14[illegible]; B, 17[illegible]; and C, 23[illegible].
100. 12 feet and 15 feet.

RECREATIVE SCIENCE.—IV.

THE REFLECTION OF LIGHT, AND DECEPTIONS WITH PLANE AND CONCAVE MIRRORS.—I.

A PENCIL or ray of light will continue in a straight path through a medium of the same density, but may be acted upon in four ways if it passes into another portion of the same medium of a different density, or into any other gaseous, liquid, or solid body. When light is affected in one or other of these ways, it is said to be reflected, refracted, polarised, or absorbed. The reflection of light from the various objects produced by nature or art, enables us to see and enjoy the works of God and man, which must otherwise have been invisible, or seen only in outline, if they did not one and all possess the property of throwing off more or less of the rays which fall upon them from luminous bodies. The influence of the light in promoting the well-being of all is undoubted. Dr. Forbes Winslow says, "Where light is not permitted to permeate, there are found, in the highest state of manifestation, bodily deformities, intellectual deterioration, crime, disease, early, and often sudden death." A material, as well as a *moral* and *mental*, etiolation or blanching occurs when the vital stimulus of light is withdrawn. The reflection of light into the dwellings of the poor, where the direct rays of the sun cannot reach them, has been insisted on over and over again by philanthropists and philosophers. The late Sir D. Brewster, in one of his addresses to the Royal Society of Edinburgh, thought it a matter of sufficient importance to state how light might be reflected into rooms situated in narrow lanes. He says: "If, in a very narrow street or lane, we look out of a window with the eye in the same plane as the onter face of the wall in which the window is placed, we shall see the whole of the sky by which the apartment can be illuminated. If we now withdraw the eye inwards, we shall gradnally lose sight of the sky till it wholly disappears, which may take place when the eye is only six or eight inches from its first position. In such a case the apartment is illuminated only by the light reflected from the opposite wall, or the sides of the stones which form the window; because if the glass of the window is six or eight inches within the wall, as it generally is, not a ray of light can fall upon it. If we now remove onr window, and substitute another, in which *all the panes are roughly ground on the outside*, and flush with the outer wall, the light from the whole of the visible sky, and from the remotest part of the opposite wall, will be introdnced into the apartment, reflected from the innnmerable faces or facets which the rongh grinding of the glass has produced. The whole window will appear as if the sky were beyond it, and from every point of this luminous surface light will radiate into all parts of the room." "Further," he says, "the opposite sides of the street or lane should be kept whitewashed with lime; and, for the same reason, the ceilings and walls of the apartments should be as white as possible, and all the furniture of the lightest colours. Having seen such effects produced by imperfect means, we feel as if we had introduced our poor workmen and needle-women from a dungeon into a summer-house, where the aged can read their Bibles; where the inmates can see each other, and carry on their work in society and comfort." The reflection of light is governed by laws that admit of easy demonstration.

Fig. 1.

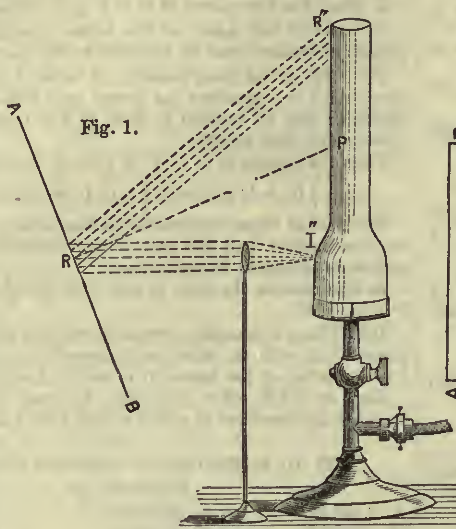
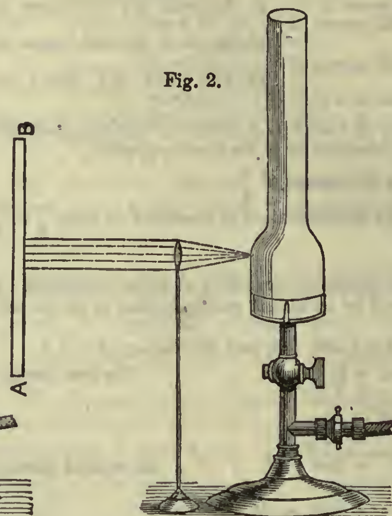


Fig. 2.



1st. The incident and reflected rays are always found in the same plane or direction which is perpendicular to the surface reflecting the light.

A pencil or ray of light can always be obtained in the daytime by making a small hole in the shutter of a darkened room, and at night by putting a sheet-iron or copper chimney over a burning argand oil or gas lamp. The chimney must have a small hole punctured in it, or a series of holes of different sizes may be bored, and each kept closed, with a circular flap crossed at the upper edge by a wire properly riveted; a glass chimney may be coated with tinfoil, in which holes of the reqnired size can be made and pasted up with slips of foil when not required. The experimental results are seen so much better when the spectator confines his attention only to the ray with which he is operating.

Fig. 3.

In Fig. 1 the rays of light, $I''R$ (made parallel by a small double convex lens), called the incident rays, and proceeding from the hole in the chimney, are falling on the slanting mirror A B; and the rays $R R''$, the reflected rays, are proved to be in the same plane or direction, because they strike or impinge on the chimney at R'', and therefore in a perpendicular plane corresponding with the upright chimney.

2nd. The angle of incidence is always equal to the angle of reflection; thus, in Fig. 1, if a line perpendicular to the surface of the mirror, A B, be raised at R and drawn to P, then the angle $P R I''$ is equal to the angle $P R R''$, or, in other words, the incident and reflected rays form equal angles. By moving the mirror about in different planes and angles, the course of the rays is clearly defined, especially if a little smoke from a bit of brown paper, dipped in a solution of nitre, and dried, is produced. The smoke acts like the clouds, vapours, and gases surrounding the earth, and, by a secondary reflection, causes the rays of light to be visible which might otherwise be too feeble to be appreciated.

If the ray of light strikes in a perpendicular line against the mirror A B (Fig. 2), it simply returns again, and is reflected back in a straight line; it is only (as shown above) when it falls obliquely on the mirror that it is thrown off obliquely. There is always a considerable loss of light, even when the rays fall perpendicularly on the reflecting surface; thus, supposing it to be a very brilliant metal, like quicksilver, 334 out of a thousand are absorbed by the metal and lost, and 666 only reflected. When the incident ray of light is at the smallest angle, say 89½, like a cannon-shot just grazing a surface, the loss is less, and is represented by 279, whilst 721 rays are reflected. Thus, more rays of light are lost the nearer the incident ray approaches the perpendicular. Only twenty-five rays out of a thousand are reflected by plate-glass at a perpendicular incidence, and hence, until the figure to be reflected was illuminated by the oxyhydrogen light, the illusion called the "Ghost" was not applied to theatrical or other purposes of entertainment. A model ghost apparatus is very easily constructed out of a box (Fig. 3), with the lid off, and turned on one side.

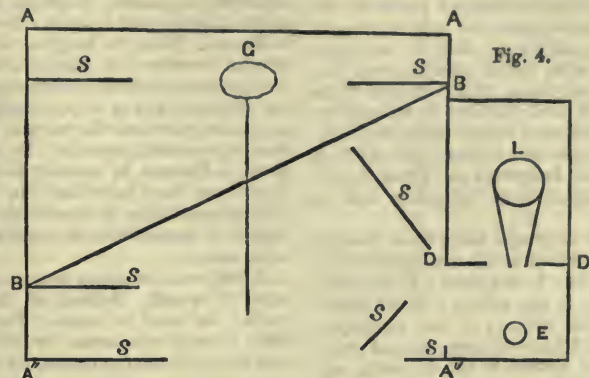


Fig. 4.

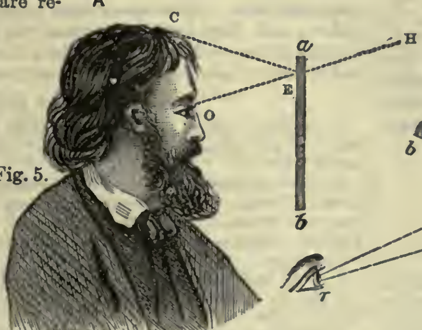


Fig. 5.

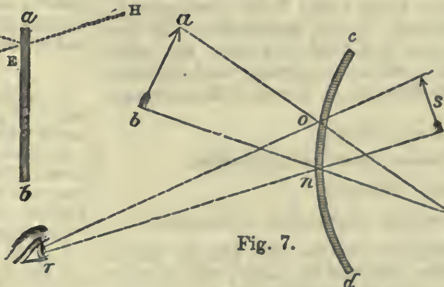


Fig. 7.

Attached to the larger box, on one side, as shown in the gronnd-plan in Fig. 4, should be a smaller one, containing the lamp and lens, and figure which is to be reflected in the glass; a simple contrivance, snch as a sliding door made of tin, must be arranged, in order to cnt off the light or throw it on, as the ghost is required to appear or disappear; the latter effects are caused by alternately lighting up the figure and shading the light.

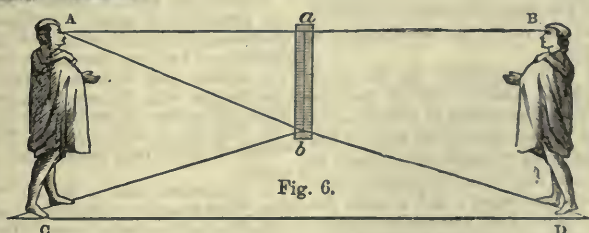


Fig. 6.

In this model the box is represented by the letters A A A″ A″. The glass, made of common window-glass, is shown at B B, and its angle and position shonld be carefully adjnsted, so that the reflection of the figure E should appear in the centre of the back of the box at G; the glass is masked in by scenery representing the laboratory of an alchemist, and is shown at all the places marked S. The figure E is a small doll dressed to represent "a woman in white," and is placed in a smaller box attached to the side of the larger one, which is perforated with an aperture to permit the figure to be reflected in the glass. To illuminate the figure, an ordinary "bnll's-eye," or a small magic lantern, L, may be provided, the top of the little box being open to allow the hot air from the chimney to escape, and in front of the lamp, L, is the sliding panel of tin, D D, which controls the light when the ghost is required to appear or disappear. The proscenium is at A″ A″. In a plate of glass, both the anterior and posterior sides reflect light, but more light is reflected from the second than the first surface; hence the thinner the glass the better and clearer the reflection, which, with thick glass, is apt to be hazy, in consequence of the two images being reflected together and overlapping each other. As light is reflected chiefly from the second surface, more rays are thrown off by covering the back with black varnish, or, better still, with an amalgam of tin and mercury; the intensity of the reflection of light from the second surface then completely overpowers that of the first, and, as in an ordinary looking-glass, it is the coated surface which reflects the image.

We see our faces in a looking-glass, because the face, being strongly illuminated by natural or artificial light, emits rays, and this reflected light moves towards the mirror A B (Fig. 5).

To prevent the confusion arising from the tracing out of too many rays, let one be drawn from the forehead C E, which, according to the laws of reflection, will be sent to the eye at O. But the mind puts C E O into one line, and the forehead is seen at H, as if the lines C E O had turned on a hinge at E. Indeed, it seems a wonderful faculty of the mind to pnt the two oblique lines C E and O E into one straight line O H; yet it is seen every time we look into a mirror, for the ray has really travelled from C to E, and from E to O, and it is that journey that determines the distance of the object; and hence we see ourselves as far beyond the looking-glass as we stand from it. As the human eye is placed in the highest part of the body, the whole person may be seen in a looking-glass of bnt half its length and breadth, as in the mirror *a b*.

The rays from the head travel to the mirror in the line A *a* (Fig. 6), perpendicularly to the mirror, and are returned to the eye in the same line, viz., *a* A; conseqnently, having travelled twice the length A *a*, a man must see his head at B; rays from his feet C, impinging on the bottom of the mirror at *b*, will be reflected to the eye in the direction *b* A. But seeing his feet along the ray that approaches his eye last, he sees his feet at D, along the line A *b* D, and so of all the rest of his person.

The angle of incidence being always equal to the angle of reflection, it follows that a convex mirror—*i.e.*, a surface corresponding with the ontside of a watch-glass—will cause parallel rays to become divergent, and it is easy to show that images reflected by such a surface must be reduced apparently in size, because so few of the reflected rays enter the eye.

Suppose the arrow *a b* (Fig. 7) to be seen in a convex mirror, *c d*, thongh rays proceed from the arrow in all directions, only those reflected from the mirror in the space inclnded in *o n* actually enter the eye, and if the mirror were removed the rays *a o* and *b n* would meet at *p*; bnt the reflected rays *o r* and *n r* become more divergent, and do not meet at *p*, hence the angle *o r n* being so mnch less than *a p b* (had the eye been at *p*), the image *s* will be less than the object, and nearer the mirror.

In the second and concluding portion of this paper on the reflection of light, and the cnrious deceptions that are produced by it, we shall endeavour to explain the special properties of convex and concave mirrors, and the peculiar appearances of objects reflected in them.

LESSONS IN ENGLISH.—XL.

PART II.—INFLECTION.

NOUNS: THEIR ORIGIN AND CLASSES.

I HAVE given my scholars such instruction on the component elements of the English language as the occasion permits. You now see of what materials your mother tongue consists. In their origin, those materials are very diverse:—the Celtic, the Teutonic, the Norman-French, the Latin, the Greek, the Romance tongues—such as the French, the Italian, the Spanish—besides others, have all contributed a portion. Our labours have put us into possession of the constituent parts of the English tongue. These constituent parts we now possess in their simple and in their compound form; that is, we know whence our words come, and of what verbal combinations they are capable. But we do not yet know what changes these simple words and these compound words undergo in themselves. Equally are we uninformed of the laws under which they combine together so as to form sentences and become the vehicle of thought. In other words, we have dealt with the Etymology of our tongue, and have now to treat of its inflections and its Syntax.

All the words of the English language have been brought into nine or ten classes. Arranging these classes according to their importance, I find them to be: 1, the noun; 2, the verb; 3, the adjective; 4, the pronoun; 5, the adverb; 6, the preposition; 7, the conjunction; 8, the article; 9, the participle; 10, the interjection. If, however, I follow a more natural order, it may be better to treat of these classes in the following succession:—1, the noun; 2, the article; 3, the adjective; 4, the pronoun; 5, the preposition; 6, the verb; 7, the participle; 8, the adverb; 9, the conjunction; 10, the interjection. By this means we get together under one head the noun, and what chiefly pertains to the noun; and under another head the verb, and what chiefly pertains to the verb, as is seen in this arrangement:

Nominal Division.

1. NOUN, article, adjective, pronoun, preposition.

Verbal Division.

2. VERB, participle, adverb, conjunction, interjection.

The reasons of this division are obvious; for, 1st, the article limits the noun; the adjective qualifies the noun; the pronoun takes the place of the noun; the preposition governs the noun: and, 2nd, the participle belongs to the verb; the adverb qualifies the verb; the conjunction governs the verb; the interjection is an abbreviated form of a preposition.

Nouns or names are of a very high antiquity. In the noun probably is the root of language to be found. One of the earliest acts of human intelligence must have been to give a name to some object of sight and desire. Accordingly, we read in the Bible (Gen. ii. 20), that at the beginning "Adam gave names to all cattle, and to the fowl of the air, and to every beast of the field." Food, of course, was man's first want; and a name for an edible object would be among man's first articulate sounds. That the noun preceded the verb is clear from the fact that men must have had a subject to speak of, before they could speak of a subject. In other terms, the subject was anterior to the predicate, for it is the business of the predicate to make some averment touching the subject.

Nouns originally were imitations; they were imitations of natural sounds. From the first breeze of wind and the first ripple of water, natural sounds existed and must have drawn attention. These sounds were signs, and those signs would be the names of the things signified. Man's tendency to make names imitative of natural sounds, bears in learned phrase the designation of onomatopeïa, from two Greek words, *ονομα* (on'-o-ma) (Latin, nomen), *a name*, and *ποιεω* (poi'-e-o), *I make*, so that the term literally signifies *name-making*, without any reference to the ground or principle of imitation on which such making proceeds. Instances of onomatopeïa exist in all languages. In English we speak of the *buzz* of the bee, the *mew* of the cat, the *crash* of falling timber, the *crushing* of a shell, etc.

In general, names were originally descriptive. The fact is specially illustrated in the Hebrew nouns, and the book of Genesis is full of instances. Thus Isaac means *laughter*, and Jesus means *saviour*. The names of rivers in other languages, when traced back to their originals, are found to be descriptive of the flow of the stream, according as it is swift, slow, quiet, noisy, etc.

The name declares the qualities of the object; but, observe, there is no necessary connection between the name and the qualities. Not always are names truly descriptive. With the progress of science even scientific names have ceased to be truly descriptive. But however correct a description of the qualities of an object its name may give, nevertheless it has no necessary connection with the object itself. This fact is best illustrated by reference to the different names borne by the same object in different languages. Take the name God. In Hebrew, God is called *Elohim* and *Jehovah;* in Greek, *Theos;* in Latin, *Deus;* in French, *Dieu;* in English, *God*. You see there is no connection between the Almighty and any one of these names. Yet the names are all descriptive. These names, and all names, are only sounds; or if you regard them as written rather than as spoken, then are they certain straight and curved strokes or lines representing sounds. By one sound is the Creator designated in Hebrew, by another sound He is designated in English. Hence you may learn that any sound may denote any object. The appropriation of sounds to particular objects is purely a matter of convention, or passive agreement, or, to use another term, usage.

If usage can originate nouns, usage can erect into nouns other parts of speech. Indeed, all the parts of speech may be regarded and used as nouns. You may know that a word not a noun is used as a noun, by its being constructed as a noun; that is, by its having connected with it such particles as nouns commonly take. Now nouns take before them the articles, *the* and *a;* and they have after them the preposition *of*. Consequently those words are nouns which have *the* or *a* before them, and *of* after them. Attend to these instances of

WORDS USED AS NOUNS.

1. *Adjectives used as Nouns:* "*The blacks of* Africa are bought and sold."—"*The* Ancient *of* Days did sit." (*Dan.* vii. 9.)—"Of the ancients." (*Swift.*)

2. *Pronouns used as Nouns:* "The nameless *He* whose nod is Nature's birth." (*Young.*)—"I was wont to load my *she* with knacks." (*Shakespeare.*)—"When I see many *its* in a page, I always tremble for the writer." (*Cobbett.*)—"Let those two try to do this with their *whos* and their *whiches.*" (*Spectator.*)

3. *Verbs used as Nouns:* "The officer erred in granting a permit."—"*A may be* of mercy is sufficient." (*Bridge.*)—"To err is human, to forgive divine." (*Pope.*)

4. *Participles used as Nouns:* "Neither regardeth he the crying of the driver." (*Job* xxxix. 7.)—"Reading, writing, and ciphering are necessary parts of education."—"Knowledge of the past comes next." (*Harris.*)—"I am my beloved's." (*Song of Sol.* vii. 10.)

5. *Adverbs used as Nouns:* "One long *now.*"—"In these cases we examine the *why*, the *what*, and the *how* of things."—"'Tis Heaven itself that points out an *hereafter.*" (*Addison.*)

6. *Conjunctions used as Nouns:* "None of your *ifs.*" (*Shakespeare.*)—"Your *if* is the only peacemaker; much virtue lies in an *if.*" (*Shakespeare.*)

7. *Interjections used as Nouns:* "Will cuts him short with a *What then?*" (*Addison.*)—"With *hark* and *whoop* and wild *halloo.*" (*Scott.*)

8. *Other words used as Nouns:* "Us is a personal pronoun." (*Murray.*)—"I and J were formerly expressed by the same character, as were U and V." (*Allen.*)—"*Th* has two sounds." (*Murray.*)—"Let *B.* be a *now* or instant." (*Harris.*)—"Within this wooden O." (*Shakespeare.*)—"Here are eight *ands* in one sentence." (*Blair.*)

From the study of these instances you will learn the grounds of the rule given by Campbell, in his Rhetoric, "All words and signs taken technically (that is, independent of their meaning, and merely as things spoken of) are nouns; or rather are things read and construed (constructed) as nouns; as, 'For this reason I prefer *contemporary* to *cotemporary.*" You will also see that adjectives, when they represent more than one, take *s* in the plural, as if they were nouns: for example, the ancients, the elders. Yet we do not say "the wises," but "the wise." The reason seems to be, that *elder* and *ancient*, though adjectives in form and import originally, have come to have a permanent force as nouns; as is seen in the fact that you can say "an ancient," "an elder;" but you cannot say "a wise;" "a sage" you can say, though *sage* and *wise* are nearly the same in meaning, and though properly they are both adjectives. These remarks illustrate the extent to which usage prevails in language, and show that in a living language so rich as the English, rules to which no exception can be given are not easily laid down.

With the aid of the logical terms, *abstract* and *concrete*, two other divisions of nouns are formed. *Qualities* may be considered under two aspects. They may be considered as belonging to some subject, as *white* paper; or they may be considered as altogether detached from any subject, as *whiteness*. In the former we regard the quality in question as *concrete*, in the latter as *abstract*. Hence *whiteness* is an *abstract* noun. Abstract nouns are numerous in English, being readily formed from their respective concrete adjectives by certain terminations, as black, *blackness*; pure, *purity*.

If regard is had to the origin of nouns, we may be led to recognise another class, namely, *verbal* nouns. *Verbal* nouns are such as are formed from verbs: thus, "If the blood of bulls sanctifieth to the *purifying* of the flesh." (Heb. ix. 13.) Here *purifying* is a noun derived from the verb *to purify*. The addition of the syllable *ing*, or the employment of the *present participle* as a noun, is a very prolific source of nouns. But observe, when a noun is thus formed, it has the *attributes* because it performs the *functions* of a noun. Now a noun is connected with another noun, when the one is dependent on the other, by the preposition *of*. Thus we say, "the *purification* of the temple." In the same way we ought to say "the *purifying* of the temple." But inaccurate writers, while they use verbal nouns as nouns, allow them to retain their qualities as participles or parts of verbs, and deprive them of their rights as nouns; omitting the connecting *of*, and writing thus, "to the *purifying* the flesh;" "his *handling* the subject was good."

Nouns are ordinarily divided into *common* and *proper*. This is the most general division of nouns. A *common* noun is a noun which is common to a whole class or kind. *Tree* is a common noun, for it may be used of any tree, and of the whole class; thus we say *a tree*, and *the tree*. A *proper* noun is a noun which is proper or peculiar (Lat. proprium, *peculiar*) to an individual, as to a person, a place, a city, a nation. Thus *Alfred* is a proper noun; so is *Lancashire*, and *London*, and *England*.

The distinction between *common* and *proper* is not very satisfactory. If *tree* is a common noun because the term *tree* is common to all trees, might not *George* be accounted a common noun because it is common to all the Georges? And is not the name Tree as peculiar to the class Tree, as the name George is peculiar to the class of persons who bear this name? If, then, Tree is a noun peculiar to an individual and a class, and if George is the same, the distinction between common and proper does not appear determinate. In truth, the terms *peculiar* and *common* do not here essentially differ, for what is peculiar to each of a class is common to all the members of that class.

The difficulty seems to arise from the multiplication of the objects which are considered as nouns proper. So long as there is but one *London*, the word London is strictly a proper or peculiar name. But let there be several cities so called, then a class is formed, and the original peculiarity is lost. What was once peculiar to an individual place, is now common to several places. Proper names, you thus see, pass into common names.

This want of fixedness and precision is an objection. Nevertheless, the classification of nouns as nouns *common* and nouns *proper* has so rooted itself in our grammar, that I think it better to retain it, than to propose another which might be scarcely free from exception.

Emerson has written a book on what he calls "Representative Men." There are also representative nouns or names. Thus *Solomon* stands for a *wise* man, *Crœsus* for a *rich* man, *Judas* for a *traitor*, *Demosthenes* for an *orator*, *Cicero* for the same, and *Homer* for a *poet*. Now mark how these are constructed. Shylock exclaims—

"A Daniel come to judgment! Yea, a Daniel."

And we also say of an eminent orator, "he is the Cicero of his age." Daniel and Cicero, in themselves, are proper nouns. In virtue of the articles they become common.

As proper nouns become common, so common nouns become proper, under the influence of the article. In the latter case, however, it is the definite article which produces the effect. A *strand* is a river's bank. *The Strand* is a thoroughfare in London, so called because it runs alongside the Thames. So we speak of *the Channel*, *the Downs*, *the United States*, *the Netherlands*. We also say *the Harbour*; but *the Harbour* is not a proper name, except at Portsmouth, where *the Harbour* means the particular harbour that is there; but the usage is local; whereas it requires national usage to convert such a common noun into a proper noun. This fact is exemplified in the phrase *the Lakes*, which from national usage means *the Lakes of Westmoreland*. *The Lakes*, therefore, has become the specific name for the whole district in the North of England where certain lakes are found. After a similar manner we speak of *the Highlands*.

The figure termed Personification (ascribing personal qualities to inanimate objects) may give to a common noun the attributes of a proper noun. "Reason is the highest gift of God; may we, O Divine Reason, listen reverently to thy voice!" In the first member or part of the sentence, *reason* is a common noun; in the second, in consequence of being the object of a direct address, it is a proper noun.

We have already seen that common nouns may represent an individual or a class. Thus *a* pigeon is one bird, but *the* pigeon is the class of birds so denominated. Some common nouns in their essential import denote a number; such as a *fleet*, a *navy*, a *flock*. These nouns are called *collective*, or nouns of multitude. Singular in form, they are plural in import. Indeed, they denote a class. Thus a *crowd* is a number of individuals considered as forming one body; a *council* is a number of men met for consultation, forming the class councillor, in relation to some particular locality. Thus we say, *I am in the council; I am of the council*; that is, *I am one of the class or body* known under that general term.

READINGS IN GREEK.—IV.

SOPHOCLES.

Of the three great tragic poets of Greece, Sophocles occupies a position midway between Euripides on the one hand and Æschylus on the other. More polished in his style and the treatment of his subjects than the latter, he never condescends to the triviality and mere exhibition of mechanical skill which are the signs of the commencement of a degenerating taste in the former. Sophocles may be said to represent the best period of Greek literature. Moreover, he flourished at a period when Athens was at the very zenith of her fame, with the Persian invader triumphantly driven from her shores—when the Macedonian power had not begun to throw its dark shadow over her greatness, and her land was still untouched by the inroads of her neighbours and rivals in the Peloponnesus. The battle of Salamis, B.C. 480, in which the hosts of the Persian king Xerxes experienced a decisive overthrow, serves as a link to bind together in the student's memory the names of the three great tragic poets. Æschylus, the eldest of the three, fought as a soldier in the ranks of the Athenian army on that day; Sophocles, a youth of fifteen, led the chorus at the festival in which the people of Athens returned thanks for their success; and the same day witnessed the birth of Euripides. Of the many plays which Sophocles wrote, only seven have come down to us in a perfect form, but we have fragments of several others. Of many we only possess the titles, allusions having been made to them by subsequent writers. In depicting mental emotion and simple natural affection, Sophocles has been peculiarly happy; and Antigone's love for her brother, and the tender, affectionate care which she and her sister Ismene show for their ill-starred father Œdipus, are among the most beautiful pictures in ancient Greek poetry. The language, though hardly so simple as that of Euripides, presents no remarkable difficulty to the translator, and the versification is always faultless, forming the very best model that can be found for imitation.

Eteocles and Polynices having fallen by each other's hand, Kreon, king of Thebes, allowed to the former the customary rites of burial, while he ordered the body of Polynices to be cast out unburied, and forbad its interment, proclaiming death against any one who should dare to bury it. The body, however, is found some days after covered with earth, and inquiry being instituted, it is discovered to be the act of Antigone, his sister. The following passage contains her defence of herself:—

SOPHOCLES.—"ANTIGONE," 441—470.

ΚΡ. Σὲ δή, σὲ τὴν νεύουσαν ἐς πέδον κάρα,
φῄς, ἢ καταρνεῖ μὴ δεδρακέναι τάδε;
ΑΝ. Καὶ φημὶ δρᾶσαι, κοὐκ ἀπαρνοῦμαι τὸ μή.
ΚΡ. Σὺ μὲν κομίζοις ἂν σεαυτὸν ᾗ θέλεις
ἔξω βαρείας αἰτίας ἐλεύθερον·

σὺ δ' εἰπέ μοι μὴ μῆκος, ἀλλὰ σύντομα
ᾔδης τὰ κηρυχθέντα μὴ πράσσειν τάδε;
AN. Ἤδη, τί δ' οὐκ ἔμελλον; ἐμφανῆ γὰρ ἦν.
KP. Καὶ δῆτ' ἐτόλμας τούσδ' ὑπερβαίνειν νόμους
AN. Οὐ γάρ τί μοι Ζεὺς ἦν ὁ κηρύξας τάδε,
οὐδ' ἡ ξύνοικος τῶν κάτω θεῶν Δίκη,
(οἳ τούσδ' ἐν ἀνθρώποισιν ὥρισαν νόμους)
οὐδὲ σθένειν τοσοῦτον ᾠόμην τὰ σὰ
κηρύγμαθ' ὥστ' ἄγραπτα κἀσφαλῆ θεῶν
νόμιμα δύνασθαι θνητὸν ὄνθ' ὑπερδραμεῖν
οὐ γάρ τι νῦν γε κἀχθές, ἀλλ' ἀεί ποτε
ζῇ ταῦτα, κοὐδεὶς οἶδεν ἐξ ὅτου 'φάνη
τούτων ἐγὼ οὐκ ἔμελλον, ἀνδρὸς οὐδενὸς
φρόνημα δείσασ' ἐν θεοῖσι τὴν δίκην
δώσειν, θανουμένη γὰρ ἐξῄδη, τί δ' οὔ;
κεἰ μὴ σὺ προὐκήρυξας· εἰ δὲ τοῦ χρόνου
πρόσθεν θανοῦμαι, κέρδος αὔτ' ἐγὼ λέγω·
ὅστις γὰρ ἐν πολλοῖσιν ὡς ἐγὼ κακοῖς
ζῇ, πῶς ὅδ' οὐχὶ κατθανὼν κέρδος φέρει;
οὕτως ἔμοιγε τοῦδε τοῦ μόρου τυχεῖν
παρ' οὐδὲν ἄλγος, ἀλλ' ἂν εἰ τὸν ἐξ ἐμῆς
μητρὸς θανόντ' ἄθαπτον ἠνσχόμην νέκυν,
κείνοις ἂν ἤλγουν· τοῖσδε δ' οὐκ ἀλγύνομαι.
σοὶ δ' εἰ δοκῶ νῦν μῶρα δρῶσα τυγχάνειν
σχεδόν τι μώρῳ μωρίαν ὀφλισκάνω.

NOTES

441. Σὲ δή, *you there.* The δή emphasises the pronoun. Σὲ is in the accusative case, as being the *object* of Kreon's address, though there is no actual verb to govern it.

442. Καταρνεῖ μή. In Greek two negatives strengthen, instead of, as in other languages, nullifying each other. So in the next line, οὐκ ἀπαρνοῦμαι το μή, *I do not deny the fact*, sc. τὸ μὴ δεδρακέναι.

444. Σὺ μέν. Addressed to the soldier who had been responsible for carrying out the king's mandate, and had detected Antigone in the act of violating it. Κομίζοις ἄν, opt. with ἄν, is equivalent to κόμιζε, imperative, "*you may take away*," to "*take away.*"

446. Μῆκος. The *accusativus respectus*, used adverbially, *at length.* Ἀλλὰ σύντομα, *but briefly.* Acc. plural neut., used as adverb.

447. Μὴ πράσσειν is used as in apposition to and explanatory of τὰ κηρυχθέντα. *You knew the terms of the proclamation, viz., that you were not to do this.*

448. Τί δ' οὐκ ἔμελλον; etc., *what was there to prevent me? Why, it was distinct.* Γάρ gives the reason why she could have no excuse—*I cannot say I did not, for*—and may be translated as above, *why.*

451. Ξύνοικος τῶν κάτω θεῶν. *Who sits associate of the gods below.*

455. Θνητὸν ὄνθ'. Sc. σε, understood from τὰ σὰ κηρύγματα. *I did not think that decrees issued by thee were so powerful that thou, a mortal, couldst*, etc.

456. Νῦν κἀχθές, *to-day and yesterday, from one day to the next.* Ἀεί ποτε. The ποτε supplies the idea that the operations of the law are continually, from time to time, removing.

457. Ἐξ ὅτου 'φανη, *from what*, or *from whom, they come.*

458. Τούτων—δώσειν δίκην, *I was not going to pay the penalty of these laws*, sc. *render myself amenable* to them. Δοῦναι δίκην like the Latin *dare pœnas.*

460. Θανουμένη. *For I knew that I must die as a matter of course.* When the participle, as here, refers to the subject of the finite verb, it is often put in the nominative, as if it were, *I, about to die, knew it.* So Euripides has ἐπεὶ πρὸς ἀνδρὸς ᾔσθετ' ἠδικημένη, and Milton, in the "Paradise Lost," has imitated the same construction—"And knew not eating death."

461. Τοῦ χρόνου, the natural time.

464. Πῶς οὐ φέρει, *how does he not*—i.e., *surely he does—achieve a gain?*

465. Ἔμοιγε, *my grief at meeting with this fate is as nothing.*

466. Ἀλλ' ἄν. The ἄν is used in a sort of anticipatory way here to prepare the mind for the condition that is coming.

468. Κείνοις, *in such a case, at such things.*

470. Μώρῳ μωρίαν, sc. *I am about incurring (it is something like incurring) a charge of folly at the hands of a fool.*

In the following beautiful passage, taken from the "Œdipus Colonæus," we have the touching lament of Œdipus, who has been driven from his country, and having wandered about, attended only by his faithful daughters Antigone and Ismene, has arrived in Attica and taken shelter on some consecrated spot. From this the superstitious fears of the people impel them to drive him away:—

SOPHOCLES.—"ŒDIPUS COLONÆUS," 258—267.

OI. Τί δῆτα δόξης, ἢ τι κληδόνος καλῆς
μάτην ῥεούσης ὠφέλημα γίγνεται,
εἰ τάς γ' Ἀθήνας φασὶ θεοσεβεστάτας
εἶναι, μόνας δὲ τὸν κακούμενον ξένον
σῴζειν οἵας τε καὶ μόνας ἀρκεῖν ἔχειν;
κἄμοιγε ποῦ ταῦτ' ἐστὶν, οἵτινες βάθρων
ἐκ τῶνδε μ' ἐξάραντες εἶτ' ἐλαύνετε,
ὄνομα μόνον δείσαντες; οὐ γὰρ δὴ τό γε
σῶμ' οὐδὲ τἄργα τἄμ'· ἐπεὶ τά γ' ἔργα μου
πεπονθότ' ἐστὶ μᾶλλον ἢ δεδρακότα.

NOTES.

259. Μάτην ῥεούσης, *that flows in vain, that after all means nothing.* "It is useless to depend upon the good name of any place for hospitality or kindness, for the Athenians are reported to possess these virtues in the highest extent, yet at the mere mention of my name they are ready to drive me from the country."

263. Κἄμοιγε, etc. (lit.), *and yet where is all this as far as I am concerned?—and yet what avails me this?*

263. Οἵτινες. The antecedent to this must be supplied by Ἀθηναῖοι out of Ἀθήνας in l. 260—*since her people*, etc

265. Ὄνομα μόνον, *fearing the mere sound of my name.* Δή emphasises the οὐ γάρ, *since of course it cannot be*, etc.

267. Πεπονθότα, etc., *are rather suffered than done*—rather passive than active. So Shakespeare makes King Lear exclaim—

"I am a man
More sinned against than sinning."

The following beautiful passage is from the choral ode in the same play, in which the people of Athens are represented as welcoming the wanderer to their land, and praising the beauties of the country. It may be compared with the ode in praise of Athens from the "Medea" of Euripides, already cited in these Readings; while, as a description of the beauties of natural scenery, it finds a pendant in the passage from the "Bacchæ," which we have also on a previous occasion introduced to our readers:—

SOPHOCLES.—"ŒDIPUS COLONÆUS," 668—693.

Εὐίππου, ξένε, τᾶσδε χώρας
ἵκου τὰ κράτιστα γᾶς ἔπαυλα,
τὸν ἀργῆτα Κολωνόν, ἔνθ'
ἁ λίγεια μινύρεται
θαμίζουσα μάλιστ' ἀηδὼν
χλωραῖς ὑπὸ βάσσαις,
τὸν οἰνῶπα νέμουσα κισσὸν
καὶ τὰν ἄβατον θεοῦ
φυλλάδα μυριόκαρπον ἀνήλιον
ἀνήνεμόν τε πάντων
χειμώνων· ἵν' ὁ βακχιώτας
ἀεὶ Διόνυσος ἐμβατεύει
θεαῖς ἀμφιπολῶν τιθήναις.
θάλλει δ' οὐρανίας ὑπ' ἄχνας
ὁ καλλίβοτρυς κατ' ἦμαρ ἀεὶ
νάρκισσος, μεγάλαιν θεαῖν
ἀρχαῖον στεφάνωμ' ὅ τε
χρυσαυγὴς κρόκος· οὐδ' ἄϋπνοι
κρῆναι μινύθουσιν
Κηφισοῦ νομάδες ῥεέθρων,
ἀλλ' αἰὲν ἐπ' ἤματι
ὠκυτόκος πεδίων ἐπινίσσεται
ἀκηράτῳ ξὺν ὄμβρῳ
στερνούχου χθονός· οὐδὲ Μουσᾶν
χοροί νιν ἀπεστύγησαν, οὐδ' ἁ
χρυσάνιος Ἀφροδίτα.

NOTES.

668. Τᾶσδε for τῆσδε—α for η, according to the usage of the Doric dialect, in which the choruses of the Greek plays were written. Many other examples will be found in this extract.

669. Γᾶς ἔπαυλα must be construed as one substantive, on which χωρας depends.

674. Οἰνῶπα, lit. *wine-coloured*, so *dark as wine.* A frequent epithet. Homer often applies it to the sea—οἰνόπα πόντον, *the wine-dark sea.*

677. Ἀνήνεμον, etc., *untouched by the wind of any storms that blow.* The genitive is governed by the α privative in ἀνήνεμον. The expression is equivalent to ἄνευ ἀνέμου πάντων χειμώνων. So we find in the same way ἄχαλκος ἀσπιδων for ἄνευ χάλκους ἀσπιδων.

682. Κατ' ἦμαρ ἀεί, *always day after day.* A pleonastic expression, like αἰεν επ' ἤματι, a few lines below.

689. Ὠκυτόκος generally is found in a passive sense. Here, however, it seems undoubtedly to be active, signifying *quickly fertilising.*

TRANSLATION OF EXTRACT II. IN LAST READING.

DEMOSTHENES, "DE CORONA," 250—261.

Turn we now to our man of dignity—to him who considers others as worthy only of the spittle of his mouth—and beg him to compare his fortunes with mine. (*Addresses himself to Æschines.*) Born and bred in the veriest poverty, your earliest years found you attached to a mean school of which your father was the preceptor. To prepare the ink, to sponge the benches, and to sweep the schoolroom; such were your occupations—occupations befitting a menial, but unworthy a freedman's son. Arrived at manhood, you became your mother's aid; as she performed her stock of initiatory rites, you read the mystic formulæ, and bore a part in all the subsequent operations. At night it was your business to clothe the candidates in skins of fawn, to pour them out huge cups of wine, to wash them with the lustral water, to cleanse their skins with loam and bran; and, the holy rites thus done, to raise them up and bid them cry—

(*Mimics*) "My bane I have fled,
My bliss I have sped:"

none, as was your boast, giving forth the holy shout with such a potent voice as yourself. (*Turns to the bystanders.*) Verily I can believe it! for who that hears those powerful tones of declamation in which he now indulges can for a moment doubt that his religious exclamations were pre-eminently grand? (*To Æschines.*) The day found you a different employment. You had then to conduct your noble troop through the public streets, their heads crowned with fennel and with poplar leaves, while yourself were seen—now pressing the coppered serpents—now elevating them above your head—now shouting "Evoi Saboi"—now raising a dance to the words "Hyes Attes, Attes Hyes!"—while all the crones and beldames of the quarter honoured you with the pompous titles of Exarch, chief conductor, chest-carrier, fan-bearer—gingerbread and cake and twisted bun falling plentifully upon you as the reward of your pious labours. Happy and distinguished lot! Who can think it were his own, and, so thinking, not deem himself supremely blest?—*Mitchell.*

LESSONS IN ENGLISH LITERATURE.—V.

CHAUCER AND HIS TIMES—THE "CANTERBURY TALES."

WE have reserved to the last the consideration of the "Canterbury Tales," probably the latest, and certainly by far the greatest of Chaucer's works.

The general conception of this great work is, in one sense, not altogether original. Writers before Chaucer had done what many have done since, that is, had brought together a number of imaginary personages, more or less naturally grouped, and had placed a series of stories in the mouths of these characters; by this means giving a sort of continuity to what would otherwise be a collection of isolated stories, and securing a double interest for the whole work. Boccaccio, shortly before, had adopted this scheme in his "Decameron," in which he introduces a number of young ladies and gentlemen who have taken refuge in the same villa to escape the pestilence in Florence; and it is not improbable that the plan of the "Canterbury Tales" may have been to some extent suggested by the "Decameron;" though it is more likely still that this method of grouping was so familiar to the writers of Chaucer's day, and therefore suggested itself so naturally to his mind, that it could not be said to have been due to any one example. But, however this may be, it is clear that in the judgment with which Chaucer has selected his group of personages and the mode of bringing them together, the unequalled power with which he has given life to the individuals composing it, and the dramatic force with which he has conducted the action of the poem, this great work is in the highest and best sense original.

The poet begins by telling us that one night in spring, the season of pilgrimages, he found himself at the hostelry of the Tabard (afterwards the Talbot), in Southwark, ready to start on a pilgrimage to the shrine of St. Thomas à Becket at Canterbury. He finds there nine-and-twenty or thirty other persons bound upon the same pilgrimage with himself. The company is a most varied one. The first group we are introduced to consists of a knight, a young squire, his son, and a yeoman, his servant, going to perform the vow made by the knight, as we may gather, during his last foreign expedition. A prioress, Madame Eglantine, a very dignified lady, was also there, and in her train an attendant nun and three priests. Then there was a monk, a great man of his class, delighting in the chase and despising the restraints of monastic rule. The mendicant friar, again, is in an inferior rank a man of the same type, "a wanton and a merry." Of very different, but not less strongly-marked types are the sober and prudent merchant, the poor clerk or scholar from Oxford, the serjeant-at-law, and the franklin or country gentleman. Then there are the haberdasher, the carpenter, the webbe or weaver, the dyer, and tapiser or carpet-maker, the cook or keeper of a cook-shop, and the shipman or sea captain. A doctor of physic is also of the party, and a wife of Bath—a well-to-do cloth manufacturer. In strong contrast with some of the preceding characters is the poor parson of a country parish, who is going on pilgrimage accompanied by his brother, a ploughman. The list is completed by a miller, a manciple or steward of some public institution, a reeve or bailiff, a sompner or summoning officer of an ecclesiastical court, and a pardoner or seller of papal indulgences. With this company, and the good cheer of the Tabard, the evening passes pleasantly; and at its close the host of the inn proposes that he should accompany his guests to Canterbury, acting as their guide upon the way; that to shorten the road each of the company should tell two stories on the journey to Canterbury, and two on the return journey; that he himself should act as arbiter among them, to whose decisions all should be bound to yield obedience; and that the most successful story-teller should be entertained at supper by the whole party on their return to the Tabard. This proposal is at once accepted. The pilgrims start for Canterbury the following morning; and in accordance with their agreement they tell their tales in the order in which the host calls upon them. And the incidents of the journey and the tales of the travellers form the subject of the poem.

The special advantages of this plan are evident. No scheme could have enabled Chaucer to fill his canvas with a greater variety of characters, taken from all classes of society, and of all shades of opinion and temperament, or to have brought them together in a manner more natural and unstrained. No plan, in short, could have enabled him to give us a more complete and living picture of the life of his day. And the same thing enables him, without any appearance of incongruity, to give endless variety to his stories, suiting in each case the character of the story to the circumstances of the story-teller with admirable judgment. Had this plan been worked out in its entirety, the "Canterbury Tales," which as it is form a long work, would have been one of the longest in the world; for we should not only have had the story of the journey to Canterbury, and the journey back, with probably the incidents of the stay at Canterbury, and the farewell supper to the teller of the best tale; but we should also have had more than 120 tales. But the work as we have it is manifestly incomplete. We have only twenty-four tales, and even this number is only reached by certain departures from the original plan. Of the pilgrims who started in company, the knight, the miller, the reeve, the cook,* the man of law, the wife of Bath, the friar, the sompnour, the clerk of Oxenford, the merchant, the squire, the franklin, the second nun, the doctor of physic, the pardoner. the shipman, the prioress, the monk, the nun's priest, the manciple, and the parson tell one tale each. Chaucer himself begins to tell the Tale of Sir Thopas, a dreary rhyming tale, intended as a burlesque upon the romances of chivalry still common, as we have seen, in Chaucer's time. But he has not gone far when the host indignantly interrupts him, telling him he will have no more of such "drafty speche" and "rhyme doggerel;" whereupon the poet begins again, and tells in prose the moral tale of Melibœus and his wife Prudence. One of the existing tales, too, is told by one who is not among the company which started from the Tabard. During the journey the cavalcade is joined by a canon, an alchemist and a most unscrupulous rogue, and his yeoman or servant. And the yeoman tells a tale, in which he exposes the fraud and folly of his master so effectually, that the canon leaves the company as abruptly as he had joined it. The story, too, of the pilgrimage itself is as incomplete as the number of the tales. All that has come down to us—and no doubt all that was written has come down to us—is the general prologue, in which the pilgrims are described, the plans for the journey formed, and the start related; the twenty-four tales already mentioned; and short prologues or introductions

* The cook's tale is a mere fragment. A second cook's tale, printed in almost all editions of Chaucer—the "Tale of Gamelyn"—is certainly not Chaucer's.

to the several tales, containing detached portions of the history of the journey. But whether the tales are now preserved in the order in which their author would have finally retained them, and to what portions of the journey the various prologues refer, it is often impossible to decide. There is much reason to think that Chaucer, at his death, left what he had written very much in confusion, and that some other hand arranged the fragments.

The work naturally divides itself into two parts, the one dealing with the history of the pilgrims and the incidents of their journey, and consisting of the general prologue to the whole work, and the special prologues, or introductions, by which the tales are connected together; the other consisting of the twenty-four tales told by the pilgrims.

The prologue is the most remarkable of all Chaucer's works, and one of the most remarkable in the whole range of literature. It consists, for the most part, of a series of masterly portraits of the pilgrims, every one of which is now, after an interval of nearly five hundred years, as fresh, as clear, and as vivid as if it had been painted yesterday. Each one of them embodies the characteristics of the class of which it is the type so fully, that we feel convinced that we know what kind of men the monks, the lawyers, the doctors of Chaucer's day were; that we know, in fact, what our forefathers and their manner of life were like. Yet each one is also marked by individual traits belonging to the man, not to the class, which impress upon the mind that those we read of are no mere abstract representatives of classes, but real living men and women. Every student of literature ought to make himself thoroughly familiar with this prologue. All that we can do is to show Chaucer's manner of description by means of a few selected examples. The first portrait we choose is that of the prosperous monk or abbot. In this extract we alter the old spelling in some places:—

A monk there was, a fair for the maistrie,[1]
An out-rider, that loved venerye;[2]
A manly man, to be an abbot able.
Full many a dainty horse had he iu stable;
And when he rode, men might his bridle hear
Jingle in a whistling wind so clear,
And eek as loud as doth the chapel bell.
There as this lord was keeper of the cell,[3]
The rule of Saint Maure or of Saint Beneyt,[4]
Because that it was old aud somedeal straight,[5]
This ilka monk let forby hem pace,[6]
And held after the newe world the space.[7]
He gaf not of that text a pulled hen,[8]
That saith, that hunters beu none holy men;
Ne that a monk, when he is cloisterless,
Is likened to a fish that is waterles;[9]
This is to say, a monk out of his cloistre,
But thilke text held he not worth au oyster;
Aud I saide his opinion was good.
What[10] should he study and make himselven wood,[11]
Upon a book in cloistre alway to pore,
Or swinke[12] with his handes, and labour,
As Austyn bit?[13] How shall the world be served?
Let Austyn have his swynk to him reserved.
Therefore he was a pricasour aright;[14]
Greyhounds he had as swift as fowl in flight;
Of prikyng and of huntiug for the hare
Was all his lust,[15] for no cost wolde he spare.
I saw his sleves purfiled at the hand[16]
With grys, and that the fiuest of a land;[17]
And for to fasten his hood under his chin,
He had of gold i-wrought a curious pin;
A love knot in the greater end there was.
His head was bald, and shone as any glass,
And eek his face as he had been auoynt;[18]
He was a lad full fat and in good point;[19]
His eyen steep,[20] and rolling in his head,
That steamed as a furnace of a lead;[21]
His boots supple, his horse in great estate.
Now certainly he was a fair prelate;
He was not pale as a forpined[22] ghost.
A fat swan loved he best of any roast.
His palfray was as brown as any berry.[23]

Our next extract, also taken from the prologue, is the character of the poor country parson, and the contrast between it and the picture of the luxurious monk will at once remind the reader of what has been said of Chaucer's sympathy with the party of Wickliffe, and his dislike of the monks:—

A good man was ther of religioun,
Aud was a pore parsoune of a toun;[1]
But riche he was of holy thought and werk.
He was also a lerned man, a clerk
That Cristes Gospel gladly wolde preche;
His parisschens[2] devoutly wolde he teche.
Beuigne he was, and wouder[3] diligent,
And in adversite ful pacient;
Aud such he was i-proved ofte sythes.[4]
Full loth were him[5] to curse for his tythes,[6]
But rather wolde he geven out of dowte,
Uuto his pore parisschens aboute,
Of his offrynge, and eek of his substaunce.[7]
He could in litel thing han suffisance.[8]
Wide was his parisch, and houses fer asondur,
But he ne lafte not[9] for reyne ne thondur,
In siknesse ne in meschief to visite
The ferrest[10] in his parisch, moche and lite,[11]
Uppou his feet, and iu his hand a staff.
This noble ensaumple unto his scheep he gaf,[12]
That first he wroughte and after that he taughte.
Out of the Gospel he the[13] wordes caughte,
And this figure he added yit therto,
That if golde ruste, what schulde yren doo?
For if a prest be foul, on whom we truste,
No wondur is a lewed man[14] to ruste;
And schame it is, if that a prest take kepe,[15]
A schiten[16] scheppard and a clene schepe:
Wel oughte a prest ensample for to give,
By his clennesse, how that his scheep schulde lyve.
He sette not his benefice to huyre,[17]
And lefte his schepe encombred in the myre,
Aud ran to Londone, unto Seynte Paules,
To seekeu him a chauuterie for soules,[18]
Or with a brotherhede be withholde;[19]
But dwelte at hoom, and kepte well his folde,
So that the wolfe ne made it not myscarye.
He was a schepperde and no mercenarie;
And though he holy were, and vertuous,
He was to sinful men nought dispitous.[20]
Ne of his speche daungerous ne digne,[21]

[1] A fine-looking man, *for the mastery*—*i.e.*, above others.
[2] Hunting.
[3] Where this monk was superior of the monastery.
[4] St. Benedict.
[5] Somewhat strict.
[6] Let them pass by. We still say, "Gave the go-by to."
[7] Followed the ways of the modern world.
[8] He gave not (would not give) a plucked fowl for—placed no value upon.
[9] It was an old and familiar saying that a monk out of his monastery was like a fish out of water.
[10] Why.
[11] Mad.
[12] Toil.
[13] As Austin bade—*i.e.*, according to the rule of St. Augustine.
[14] A thorough horseman.
[15] Pleasure.
[16] Embroidered at the wrist.
[17] With fur, and that the finest in the country.
[18] As if he had been anointed.
[19] From the French *embonpoint*, plump.
[20] His eyes deep-set.
[21] Like a lead furnace.
[22] Wasted away.
[23] This last liue illustrates a peculiarity of Chaucer's versification, which ought to be noted. Modern poets, writing in this metre, almost invariably end each paragraph with the second line of a couplet. Chaucer generally ends the paragraph with the first line of the couplet, making the end of one paragraph rhyme with the beginning of the next, and so connecting the two to the ear. Thus, it will be observed, the last liue in the description of the monk ends with "berry;" the next paragraph, introducing another personage, begins, "A frere there was, a wanton and a merry."

[1] A poor parson of a townland or rural parish.
[2] Parishioners.
[3] Wonderfully.
[4] Oftentimes.
[5] Very disagreeable would it be to him.
[6] To excommunicate for non-payment of tithes.
[7] Both of what he had received in voluntary offerings and of his property, that is, his benefice.
[8] Have sufficient. *Han* contracted from *haven*, infinitive of *have*.
[9] He omitted not.
[10] Furthest.
[11] Great and small.
[12] Gave.
[13] Those.
[14] Layman.
[15] Take note of it.
[16] Foul, dirty.
[17] Did not place a hired substitute in his benefice. The abuses among the clergy referred to in these lines are the constant theme of the satirists of the period.
[18] An endowment for saying masses for the soul of the giver of the endowment in St. Paul's Cathedral.
[19] To be maiutained in a monastic brotherhood.
[20] Not uncharitable, not pitiless to the sius of others.
[21] Harsh or proud.

But in his teching discret and benigne,
To drawe folk to heven by fairnesse,
By good ensample, was his busynesse;
But it were any person obstinat,
What so[22] he were of high or lowe estat,
Him wolde he snybbe[23] scharply for the nones.[24]
A bettre preest I trowe ther nowher non is.
He waytud after no pompe ne reverence,
Ne maked him a spiced conscience,[25]
But Cristes lore, and his apostles twelve,
He taught, and first he folwed it himselve.

The short passages of narrative which occur under the title of prologues between the various tales, are scarcely inferior to the general prologue in dramatic skill. The most noteworthy character in them is the good-humoured host, with his ready mother-wit, managing the somewhat troublesome pilgrims.

Of the other portion of the poem, the tales themselves, we must speak but briefly. We have already pointed out the judgment with which Chaucer adapted the tale to the teller. The stories may be roughly divided into two classes—the dignified, or pathetic tales told by the higher and more educated class of the pilgrims; and the broad, coarse, but humorous stories told by the travellers of lower rank. The first and longest of the tales of the first class is the Knight's tale, which contains the story of Palamon and Arcite, derived no doubt by Chaucer from Boccaccio. The Squire's tale is suited to the character of the squire. It is a wild story of love and enchantment, probably of Oriental origin, and only half finished. The Man of Law's tale is the pathetic story of Custance, borrowed by Chaucer from the "Confessio Amantis" of Gower, as it had been by Gower from earlier writers. The Doctor of Physic tells the Roman story of Virginia. The Prioress relates the characteristic story of a little Christian child murdered by Jews, and of the miracles that followed his death, and revealed the crime. The Clerk's tale, the most pathetic of the whole number, is the story of Patient Griselda, since become familiar in many forms to all readers, but then told in English for the first time, being taken from the Latin of Petrarch.

Among the stories of the second class, the most humorous perhaps are those of the Miller, the Prior, and the Canon's Yeoman; but the first and second of these, like most of Chaucer's humorous tales, are much too coarse to suit the taste of the present day. The Parson's tale is of a class by itself. It is in prose, and is, in fact, a sermon or moral discourse.

The following powerful description of the Temple of Mars and its decoration is taken from the Knight's tale:—

And downward on a hil under a bent,[1]
Ther stood the Tempul of Marz Armypotent,
Wrought al of burned steel of which thentre[2]
Was long and streyt, and gastly for to see.
And thereout came a rage and such a prise,[3]
That it made all the gates for to rise.
The northen light in at the dore schon,
For window on the walls ne was ther noon,
Thorugh the which men might no light discern.
The dores were alle ademauntz eterne,
I-clenched overthwart and endelong[4]
With iren tough; and for to make it strong
Every piler the tempul to susteine
Was tonne greet, of iren bright and schene:[5]
Ther saugh I first the dark ymagining
Of felony, and al the compassyng;
The cruel ire, ees rad as eny gleede;[6]
The pikepurs,[7] and eek the pale drede;
The smyler with the knyf under his cloke;
The schipne brennyng[8] with the blake smoke;
The tresoun with the murtheryng in the bed;
The open werres, with woundes al bi-bled;[9]
Contek[10] with bloody knyf, and sharp manace;[11]
Al ful of chirkyng[12] was that sory place.
The slur of himself yet saugh I there,
His herte-blood[13] hath bathed al his here;[14]
The nayl y-drove in the schode[15] a-nyght;
The colde deth, with mouth gapyng upright.
Amyddes of the tempul sat mischaunce,
With sory comfort and evel contenaunce
I saugh woodnes[16] laughyng in his rage:
Armed complaint, outhees,[17] and fiers outrage.
The carroigne[18] in the busshe, with throte y-corve;
A thousand slain, and not of qualme y-storve;[19]
The tiraunte, with the preye by force y-raft;
The town destroied, there was no thing laft.
Yet saugh I brente the schippes hoppesteres;[20]
The hunte[21] strangled with[22] the wild beres:
The sowe freten[23] the child right in the cradel;
The cook i-scalded, for al his longe ladel.
Nought beth forgeten the infortune of Mart;
The carter over-ryden of his cart,
Under the whel ful lowe he lay adoun.
Ther wer also of Martz divisioun,[24]
The barbour,[25] and the bowcher, and the smyth,
That forgeth scharpe swerdes on his stith.
And all above depeynted in a tour
Saw I conquest sitting in gret honour,
With the scharpe sword over his heed
Hangynge by a sotil twyne threed.[26]

[22] Whether. [23] Snub, rebuke.
[24] On that occasion, then and there.
[25] Did not spoil the natural simplicity of his conscience.
[1] A bend—that is, a slope.
[2] The entry. This contraction is very common in Chaucer.
[3] Press or crowd.
[4] Across and along.
[5] Shining. [6] Spark.
[7] Pickpurse, thief.
[8] Ships burning.
[9] Bled, covered with blood.
[10] Contention.
[11] Menace.
[12] Shrieking.
[13] Heart's blood. [14] Hair.
[15] Driven into the hair—i.e., into the head.
[16] Madness. [17] Outcry.
[18] Carrion, corpse.
[19] Not dead of disease. To streve or starve is to die.
[20] Schippes hoppesteres is probably the dancing ships, from the motion of a ship on the waves.
[21] Hunter.
[22] *With* is frequently used for *by*.
[23] Devouring.
[24] Of the company, the army of Mars.
[25] The barbour-surgeon.
[26] The reference is to the sword of Damocles.

LESSONS IN FRENCH.—LIX.

§ 48.—Paradigms of the Auxiliary Verbs.

To familiarise the student with the frequent use made by the French of the indefinite pronoun on [§ 41 (4)], we have introduced it in our conjugation of the verbs.

(1.) AVOIR, *TO HAVE*,—AFFIRMATIVELY.

Infinitive Mood.

Present.		Past.	
Avoir,	*to have.*	Avoir eu,	*to have had.*

Participles.

Present.		Compound.	
Ayant,	*having.*	Ayant eu,	*having had.*

Past.

En, *had.*

Indicative Mood.

Simple Tenses.		Compound Tenses.	
Present.		**Past Indefinite.**	
J'ai,	*I have.*	J'ai eu,	*I have had.*
Tu as,	*thou hast.*	Tu as eu,	*thou hast had.*
Il or elle a,	*he* or *she has.*	Il *or* elle a eu,	*he* or *she has had.*
On a,	*one has, people have.*	On a eu,	*one has had.*
Nous avons,	*we have.*	Nous avons eu,	*we have had.*
Vous avez,	*you have.*	Vous avez eu,	*you have had.*
Ils or elles ont,	*they have.*	Ils or elles ont eu,	*they have had.*
Imperfect.		**Pluperfect.**	
J'avais,	*I had, was having,* or *I used to have.*	J'avais eu,	*I had had.*
Tu avais,	*thou hadst.*	Tu avais eu,	*thou hadst had.*
Il or elle avait,	*he* or *she had.*	Il or elle avait eu,	*he* or *she had had.*
On avait,	*one had, people had.*	On avait eu,	*one had had.*
Nous avions,	*we had.*	Nons avions eu,	*we had had.*
Vous aviez,	*you had.*	Vous aviez eu,	*you had had.*
Ils or elles avaient,	*they had.*	Ils *or* elles avaient eu,	*they had had.*
Past Definite.		**Past Anterior.**	
J'eus,	*I had,* or *did have.*	J'eus eu,	*I had had.*
Tu eus,	*thou hadst, etc.*	Tu eus eu,	*thou hadst had.*
Il eut,	*he had.*	Il eut eu,	*he had had.*
On eut,	*one had, etc.*	On eut eu,	*one had had.*

PAST DEFINITE.		PAST ANTERIOR.	
Nous eûmes,	*we had.*	Nous eûmes eu,	*we had had.*
Vous eûtes,	*you had.*	Vous eûtes eu,	*you had had.*
Ils eurent,	*they had.*	Ils eurent eu,	*they had had.*

FUTURE.		FUTURE ANTERIOR.	
J'aurai,	*I shall* or *will have.*	J'aurai eu,	*I shall, will have had.*
Tu auras,	*thou wilt have.*	Tu auras eu,	*thou shalt have had.*
Il aura,	*he will have.*	Il aura eu,	*he will have had.*
On aura,	*one will have.*	On aura eu,	*one will have had.*
Nous aurons,	*we shall have.*	Nous aurons eu,	*we shall have had.*
Vous aurez,	*you will have.*	Vous aurez eu,	*you will have had.*
Ils auront,	*they will have.*	Ils auront eu,	*they will have had.*

Conditional Mood.

PRESENT.		PAST.	
J'aurais,	*I should have.*	J'aurais eu,	*I should have had.*
Tu aurais,	*thou wouldst have.*	Tu aurais eu,	*thou wouldst have had.*
Il aurait,	*he would have.*	Il aurait eu,	*he would have had.*
On aurait,	*one would have.*	On aurait eu,	*one would have had.*
Nous aurions,	*we would have.*	Nous aurions eu,	*we should have had.*
Vous auriez,	*you would have.*	Vous auriez eu,	*you would have had.*
Ils auraient,	*they would have.*	Ils auraient eu,	*they would have had.*

Imperative Mood.

Aie,	*have (thou).*
Qu'il ait,	*let him have.*
Qu'on ait,	*let one, people, them have.*
Ayons,	*let us have.*
Ayez,	*have (ye* or *you).*
Qu'ils aient,	*let them have.*

Subjunctive Mood.

SIMPLE TENSES. PRESENT.			COMPOUND TENSES. PAST.		
Que j'aie,	*that I may*		Que j'aie eu,	*that I may*	
Que tu aies,	*that thou mayest*		Que tu aies eu,	*that thou mayest*	
Qu'il ait,	*that he may*		Qu'il ait eu,	*that he may*	
Qu'on ait,	*that one may*		Qu'on ait eu,	*that one may*	
Que nous ayons,	*that we may*	*have.*	Que nous ayons eu,	*that we may*	*have had.*
Que vous ayez,	*that you may*		Que vous ayez eu,	*that you may*	
Qu'ils aient,	*that they may*		Qu'ils aient eu,	*that they may*	

IMPERFECT.			PLUPERFECT.		
Que j'eusse,	*that I might*		Que j'eusse eu,	*that I might*	
Que tu eusses,	*that thou mightest*		Que tu eusses eu,	*that thou mightest*	
Qu'il eût,	*that he might*		Qu'il eût eu,	*that he might*	
Qu'on eût,	*that one might*		Qu'on eût eu,	*that one might*	
Que nous eussions,	*that we might*	*have.*	Que nous eussions eu,	*that we might*	*have had.*
Que vous eussiez,	*that you might*		Que vous eussiez eu,	*that you might*	
Qu'ils eussent,	*that they might*		Qu'ils eussent eu,	*that they might*	

(2.) AVOIR, *TO HAVE*,—NEGATIVELY.

Infinitive Mood.

PRESENT.	PAST.
Ne pas avoir, *or* n'avoir pas, *not to have.*	Ne pas avoir eu, *or* n'avoir pas eu, *not to have had.*

Participles.

PRESENT.		PAST.	
N'ayant pas,	*not having.*	N'ayant pas eu,	*not having had.*

Indicative Mood.

SIMPLE TENSES. PRESENT.		COMPOUND TENSES. PAST INDEFINITE.		
Je n'ai pas,	*I have not.*	Je n'ai pas eu,	*I have*	
Tu n'as pas,	*thou hast not.*	Tu n'as pas eu,	*thou hast*	
Il n'a pas,	*he has not.*	Il n'a pas eu,	*he has*	
On n'a pas,	*one has not.*	On n'a pas eu,	*one has*	*not had.*
Nous n'avons pas,	*we have not.*	Nous n'avons pas eu,	*we have*	
Vous n'avez pas,	*you have not.*	Vous n'avez pas eu,	*you have*	
Ils n'ont pas,	*they have not.*	Ils n'ont pas eu,	*they have*	

IMPERFECT.		PLUPERFECT.		
Je n'avais pas,	*I had not.*	Je n'avais pas eu,	*I had*	
Tu n'avais pas,	*thou hadst not.*	Tu n'avais pas eu,	*thou hadst*	
Il n'avait pas,	*he had not.*	Il n'avait pas eu,	*he had*	
On n'avait pas,	*one had not.*	On n'avait pas eu,	*one had*	*not had.*
Nous n'avions pas,	*we had not.*	Nous n'avions pas eu,	*we had*	
Vous n'aviez pas,	*you had not.*	Vous n'aviez pas eu,	*you had*	
Ils n'avaient pas,	*they had not.*	Ils n'avaient pas eu,	*they had*	

PAST DEFINITE.		PAST ANTERIOR.		
Je n'eus pas,	*I had not.*	Je n'eus pas eu,	*I had*	
Tu n'eus pas,	*thou hadst not.*	Tu n'eus pas eu,	*thou hadst*	
Il n'eut pas,	*he had not.*	Il n'eut pas eu,	*he had*	
On n'eut pas,	*one had not.*	On n'eut pas eu,	*one had*	*not had.*
Nous n'eûmes pas,	*we had not.*	Nous n'eûmes pas eu,	*we had*	
Vous n'eûtes pas,	*you had not.*	Vous n'eûtes pas eu,	*you had*	
Ils n'eurent pas,	*they had not.*	Ils n'eurent pas eu,	*they had*	

FUTURE.			FUTURE ANTERIOR.		
Je n'aurai pas,	*I shall not*		Je n'aurai pas eu,	*I shall*	
Tu n'auras pas,	*thou wilt not*		Tu n'auras pas eu,	*thou shalt*	
Il n'aura pas,	*he will not*		Il n'aura pas eu,	*he will*	
On n'aura pas,	*one will not*	*have.*	On n'aura pas eu,	*one will*	*not have had.*
Nous n'aurons pas,	*we shall not*		Nous n'aurons pas eu,	*we shall*	
Vous n'aurez pas,	*you will not*		Vous n'aurez pas eu,	*you will*	
Ils n'auront pas,	*they will not*		Ils n'auront pas eu,	*they will*	

Conditional Mood.

PRESENT.			PAST.		
Je n'aurais pas,	*I should*		Je n'aurais pas eu,	*I should*	
Tu n'aurais pas,	*thou wouldst*		Tu n'aurais pas eu,	*thou wouldst*	
Il n'aurait pas,	*he would*		Il n'aurait pas eu,	*he would*	
On n'aurait pas,	*one would*	*not have.*	On n'aurait pas eu,	*one would*	*not have had.*
Nous n'aurions pas,	*we would*		Nous n'aurions pas eu,	*we should*	
Vous n'auriez pas,	*you would*		Vous n'auriez pas eu,	*you would*	
Ils n'auraient pas,	*they would*		Ils n'auraient pas eu,	*they would*	

Imperative Mood.

N'aie pas,	*have not (thou).*
Qu'il n'ait pas,	*let him not have.*
Qu'on n'ait pas,	*let one not have.*
N'ayons pas,	*let us not have.*
N'ayez pas,	*have not (ye* or *you).*
Qu'ils n'aient pas,	*let them not have.*

Subjunctive Mood.

SIMPLE TENSES. PRESENT.			COMPOUND TENSES. PAST.		
Que je n'aie pas,	*that I may*		Que je n'aie pas eu,	*that I may*	
Que tu n'aies pas,	*that thou mayest*		Que tu n'aies pas eu,	*that thou mayest*	
Qu'il n'ait pas,	*that he may*		Qu'il n'ait pas eu,	*that he may*	
Qu'on n'ait pas,	*that one may*	*not have.*	Qu'on n'ait pas eu,	*that one may*	*not have had.*
Que nous n'ayons pas,	*that we may*		Que nous n'ayons pas eu,	*that we may*	
Que vous n'ayez pas,	*that you may*		Que vous n'ayez pas eu,	*that you may*	
Qu'ils n'aient pas,	*that they may*		Qu'ils n'aient pas eu,	*that they may*	

IMPERFECT.			PLUPERFECT.		
Que je n'eusse pas,	*that I might*		Que je n'eusse pas eu,	*that I might*	
Que tu n'eusses pas,	*that thou mightest*		Que tu n'eusses pas eu,	*that thou mightest*	
Qu'il n'eût pas,	*that he might*		Qu'il n'eût pas eu,	*that he might*	
Qu'on n'eût pas,	*that one might*	*not have.*	Qu'on n'eût pas eu,	*that one might*	*not have had.*
Que nous n'eussions pas,	*that we might*		Que nous n'eussions pas eu,	*that we might*	
Que vous n'eussiez pas,	*that you might*		Que vous n'eussiez pas eu,	*that you might*	
Qu'ils n'eussent pas,	*that they might*		Qu'ils n'eussent pas eu,	*that they might*	

*

NATURAL HISTORY OF COMMERCE.

CHAPTER III. (*continued*).

THE EFFECTS OF GEOLOGY ON THE INDUSTRY OF THE BRITISH PEOPLE (*continued*).

Geological Distribution of Mineral Products (*continued*)—Relation of Geology to Agriculture—Botanical Aspect presented by Geological Formations.

(*c.*) *Association of Iron and Coal in their Relation to Industrial Pursuits*

The carboniferous system contains our greatest sources of natural wealth. It yields the coal which gladdens our hearths, and heats our roaring furnaces. It supplies us with iron ores and lime, and with the fuel necessary for smelting the iron, for the most part in close proximity to the ores. We have thus two conditions especially favourable to the production of cheap iron—abundant ore and fuel—occurring together. In no other country perhaps, save Belgium, do we find an equally favourable combination of circumstances. The absence from Ireland of any vast deposits of bituminous coal necessarily prevents the establishment in that country of those branches of industry in which the cost of fuel forms any very large proportion of the total cost of production. Hence, we have not had there any successful establishment of iron-smelting in recent times. The iron ores, however, both as earthy and bituminous carbonates and as hæmatites, are now largely exported from Ireland to England and Scotland to supply the enormously increasing demand.

Large quantities of copper and other ores raised in Ireland, Chili, Mexico, etc., are sent to Swansea to be smelted, as the proportion of fuel which is required would render the process in those countries too costly to be profitable. In other words, it is cheaper to carry ore to the coal than coal to the ore. Similarly the various clays raised in the south of England are transported to Staffordshire to be converted into useful articles.

Previous to the employment of steam as a motive force, water was the prime mover; consequently our manufactories, at that time, were located where water-power was at command. But on the application of coal to the generation of steam, the seats of manufacturing industry were necessarily transported to districts where this mineral could be obtained abundantly and cheaply. Norwich, York, and Spitalfields could then no longer compete with the towns more favourably circumstanced, and in course of time ceased to be the great manufacturing centres. Lancashire, on the introduction of steam machinery, soon became the greatest manufacturing district, owing to its situation with respect to our coal-fields and to our outlets of commercial industry.

From the time of the Romans to the seventeenth century the Weald of Kent and Sussex was one of the chief sites for the production of iron, because of the close proximity of the fuel, wood, to the ore; but when coal came to be used in the reduction of the ores, this branch of industry declined, and was soon removed to districts where the more abundant and cheaper supply of fuel was to be found.

From the foregoing remarks we have an explanation why the coal-producing counties are the centres of our manufacturing industry.

(*d.*) *Other bedded mineral products* are met with in strata of various ages. Slates are quarried in Silurian rocks in Carnarvon and Merioneth, in Cumberland, and in some parts of Scotland. In these districts there is a very large population supported entirely by the quarrying and preparing of slates.

Rock salt is confined in Great Britain to the Keuper sandstone and marls.

Building and architectural stones are chiefly quarried in the Devonian, carboniferous, Permian, and oolitic strata.

The mining of *iron pyrites* is a large branch of industry in Ireland, and the basis of an extensive series of chemical manufactures in which the cost of fuel does not form a preponderating item. This mineral is collected in Scotland, the north-eastern parts of England, etc., being derived from the carboniferous and newer formations.

Coprolites, the exuviæ of extinct gigantic reptiles, and *pseudo-coprolites*, the osseous remains of large vertebrates, and nodular concretions of phosphate of lime of organic origin, cannot be expected to occur in strata of an epoch anterior to that in which those animals lived. They occur in the liassic, and neocomian, and cretaceous strata, and in the newer tertiaries, these last formations being characterised by the remains of whales and other mammals, as the first are by *ichthyosauri*, *plesiosauri*, and other huge reptiles. As a source of manure, coprolites have become important.

3. *Detrital.*

The chief minerals found in detrital deposits are gold and tin-stone, *i.e.*, stream-tin. Being derivative, the occurrence of these minerals indicates the existence of rocks containing them, either in the immediate neighbourhood, or in tracts drained by a local stream or its tributaries.

Keeping in view the geographical distribution of the palæozoic rocks, especially of the Silurian, Devonian, and carboniferous systems, and the fact of these strata being the sources of our chief mineral wealth, let us now apply these phenomena to the industrial pursuits of the people of these areas.

III. *Relation of Geology to Agriculture.*

1. *Botanical Aspect presented by Geological Formations.*

It has been stated that the soils of a country vary to a great extent with the nature of the underlying geological formations. This phenomenon may be best illustrated by reference to the district in the line of section shown in Fig. 1. (See page 225.)

The western parts of Wales, where the land attains an elevation of from 2,000 to 4,000 feet above the sea-level, are covered with heath, and are only fit for inferior pasture lands. Monmouthshire, Brecknockshire, Hereford, and parts of Worcestershire are occupied by the rocks of the old red sandstone formation; and in consequence of their susceptibility of decomposition, the marls breaking up into rich earth fitted for tillage, they naturally form a more fertile soil than that derived from the slates of the west; hence we have in the former districts good corn lands and productive orchards.

The low plain of new red sandstone presents facilities for agriculture similar to those of the old red sandstone tract.

The configuration of the surface of the country occupied by the Jurassic rocks which succeed, may be viewed as an alternation of clays and limestones. The outcrops of the clays can actually be traced by the wide valleys, which are permanent grass lands; whilst the limestones compose ranges of low hills or more elevated grounds. These limestone ridges form escarpments (see Fig. 1) along the line of strike, that is, on the side (N.W.) on which the several clays rise up from beneath the calcareous beds. The soil on these limestones is well adapted for the growth of cereals, turnips, and clovers.

Passing on to the cretaceous series, which in the south forms extensive tracts, we meet with siliceous, argillaceous, and calcareous soils. The rocks in the western part of the wealden area contain little lime and much silica, and are covered by some very wide-spread heaths not worth bringing into cultivation. The natural forest-lands of the Weald or Wold are on the wealden clay, which has been cultivated, though only of late years, by the help of deep drainage.

The base of the chalk escarpments is usually marked by a stratum of clay—the gault—which thus occupies a valley, and is a pasture tract. But the chalk strata which form the South Downs and stretch far to the west, into the centre of England, and thence away to the north-east, are chiefly used for the purpose of sheep-pasturage. There is little or no soil upon them, the herbage is short, and trees are absent; however, the chalk ranges, especially the broad, sweeping plain of Wiltshire and Hampshire, are gradually coming under tillage—the chief crops being grain, turnips, clover, and sainfoin.

The soils derived from the decomposition of rocks containing magnesia—such as the dolomite of the Permian, which ranges from Nottingham, through Derbyshire and Yorkshire, to Tynemouth, and the serpentines of Cornwall—are rich, but perhaps less so than those derived from ordinary calcareous strata. The Lizard Downs are, however, reckoned fine pasture-land; the cultivated parts are amongst the best corn-lands in the county, and agriculturists agree that the land in the Permian tracts is extremely fertile.

The tertiary beds of the basin of the Thames are for the most part cultivated tracts, excepting where the "Bagshot Sands" form the superficial stratum. These are familiar to us as heathy wastes, such as Aldershot Heath, Bagshot Heath, Hampstead Heath, etc., and have been converted into camping and exercise grounds for our troops and volunteers.

The older palæozoic rocks, although rich in minerals, are generally barren, and seem peculiarly dreary and desolate. This arises partly from the nature of the strata, and partly from the circumstance that, occupying hilly regions, they are to a great extent above the limits of the growth of economic plants, even if within the reach of ordinary agricultural operations.

The Highlands of Scotland, composed of masses of gneiss and granite, are heathy and barren, since their hard rocky materials come almost everywhere bare to the surface, forming a wild pastoral country, browsed by black cattle, poor sheep, and red deer. The neighbourhood of Parys Mountain, in Anglesea, is singularly marked by sterility and gloominess—there is neither shrub nor tree, and the barrenness is unrelieved even by a single blade of grass. Other examples might be adduced in illustration of the unproductive nature of the soil of the oldest palæozoic and metamorphic rocks. But in all these regions the character of the surface will be more or less modified by the occurrence of *alluvial* deposits bordering the rivers, and by the presence of a glacial drift—the effect of denudation upon various rocks, producing a favourable mixture of clay, sand, and lime, which forms a rich soil.

LESSONS IN GREEK.—XXX.

THE PERFECT, PLUPERFECT, AND OTHER TENSES.

THE perfect stem is formed from the stem of the present by adding κ and prefixing the reduplicative augment, as λυ-, λυκ-, λελυκ-; the tense itself is formed by adding to the stem the person-endings. We are now speaking exclusively of the active voice. Observe that, as σ is in general the sign of the future and the first aorist, so κ is the sign of the perfect and the pluperfect. Qualifications of these statements will appear as we proceed.

To form the stem of the pluperfect, prefix ε to the stem of the perfect; thus, to λελυκ- I prefix ε, and produce ἐλελυκ-, which, when the person-endings are suffixed, constitutes the pluperfect tense.

VOCABULARY

Γυναικειος, -α, -ον, womanly, belonging to a woman.
Δαρειος,-ου, ὁ, Darius.
Διοδωρος, -ου, ὁ, Diodórus.
Ενδυω, I enter, I put on.
Επιδιωκω, I pursue.
Καταδύω, I go down, sink.
Κυριευω, I become mastor of, gain.
Μαντις, -εως, ὁ, a soothsayer, a diviner.
Μελλω, I purpose, I am on the point of; το μελλον, the future.
Μηδεια,-ας, ἡ, Medéa.
Περσης, -ου, ὁ, a Persian.
Πολεμιος, -ου, ὁ, an enemy.
Προφητευω (our word *prophesy*), I foretell.
Σαρδαναπᾶλος, -ου, ὁ, Sardanapálus.
Φερεκυδης, -ους, ὁ, Pherecydes.
Φονευω, I kill, slay, murder.
Φυω, I beget, produce; in the perfect, I am produced, I have become.

EXERCISE 84.—GREEK-ENGLISH.

1. Οἱ στρατιωται των πολεμιων δισχιλιους διακοσιους ἑξηκοντα πεντε πεφονευκασιν. 2. Φερεκυδης ελεγε μηδενι θεῳ τεθυκεναι. 3. Νεος πεφυκως πολλα χρηστα μανθανε. 4. Ὁ μαντις τα μελλοντα καλως πεπροφητευκεν. 5. Τα τεκνα ευ πεπαιδευκας. 6. Μηδεια τα τεκνα πεφονευκυια εχαιρεν. 7. Οἱ Λακεδαιμονιοι Πλαταιας κατελελυκεσαν. 8. Σαοδαναπᾶλος στολην γυναικειαν ενεδεδυκει. 9. Ὁτε ἡλιος κατεδεδυκει, οἱ πολεμιοι επλησιαζον. 10. Αλεξανδρος επιδιωκων Δαρειον, τον Περσων βασιλεα, πολλων χρηματων εκεκυριευκει.

EXERCISE 85.—ENGLISH-GREEK.

1. I have slain. 2. They have slain. 3. He had slain. 4. They will slay. 5. He slew (first aorist). 6. We will slay. 7. We have slain. 8. We had slain. 9. They will sacrifice. 10. They have sacrificed. 11. They had sacrificed. 12. They sacrificed. 13. The soothsayer sacrificed to the god. 14. The soothsayer has sacrificed to the god one hundred oxen. 15. I educate my children. 16. I was educating my children. 17. I will educate my children. 18. I educated my children. 19. I have educated my children. 20. I had educated my children. 21. Alexander destroyed Babylon. 22. Alexander had destroyed Babylon. 23. The boy puts on a woman's garment. 24. The boy has put on a woman's garment. 25. The boy had put on a woman's garment. 26. The boy will put on a woman's garment.

REMARKS ON THIS EXERCISE.

In forming the tenses of verbs compounded with prepositions, the student is advised to drop the preposition while so doing, restoring it afterwards. For instance, in ενδυω I drop the εν, and form the stems according to rule; thus, δυ-, δυσ-, εδυσ-, δεδυκ-, εδεδυκ-; εν-ε-δε-δυ-κ, that is, ενεδεδυκ. So with καταλυω: λυ-, λυσ-, ελυσ-, λελυκ-, ελελυκ-; κατελελυκ: where observe that κατα loses its final α before the vowel ε.

I have accented the proper names, as Diodórus, Sardanapálus, etc., according to the Greek, the rule being that in proper names, as well as generally, a long vowel in the Greek should receive the stress of the voice in English.

PRESENT AND IMPERFECT MIDDLE OR PASSIVE.

The present middle or passive is formed from the stem of the present active by adding ομαι, as λυ-, λυ-ομαι. Of ομαι the ο may be considered as a connecting vowel, and μαι the person-ending. This connecting vowel is seen in other persons of the same tense; thus, λυ-ο-μαι, λυ-ε-ται, λυ-ο-μεθον, λυ-ε-σθον, λυ-ο-μεθα, λυ-ε-σθε, λυ-ο-νται, where ε and ο are the connecting vowels—vowels, that is, that unite the stem with the person-endings.

The imperfect middle or passive is formed by prefixing the augment and changing μαι into μην—thus, λυομαι, ε-λυο-μην. It may also be formed from the imperfect active by changing the active termination ον into the middle termination ομην.

VOCABULARY.

Αδελφος, -ου, ὁ, a brother.
Αποδεχομαι, I receive, am favourable to, welcome.
Αυλος, -ου, ὁ, a flute.
Εγχωριος, -ον, domestic, belonging to the country (χωρα).
Ειθε (with the optative), O that!
Εργαζομαι (from εργον, work), I work.
Ερχομαι, I come, go.
Λανθανω (Latin, *lateo*), I lie hid, am concealed.
Πενομαι (πενης, poor; Latin, *penuria*; English, *penury*), I am poor.
Πραττω, I do; πραττω καλως, I do well (that is, I am in a good condition).
Στρατευω (from στρατια, an army), I make an expedition.
Ψευδομαι (from ψευδος, a falsehood), I lie.

EXERCISE 86.—GREEK-ENGLISH.

1. Δυο ανδρε μαχεσθον. 2. Γενναιως μαχωμεθα περι της πατριδος. 3. Αναγκαιον εστι τον υἱον πειθεσθαι τῳ πατρι. 4. Πολλοι

αγαθοι πενονται. 5. Νομοις τοις εγχωριοις ἑπεσθαι καλον εστιν. 6. Μη αποδεχου των φιλων τους προς τα φαυλα χαριζομενους. 7. Ἑκαστος ἡσυχος μεσην την ὁδον ερχεσθω. 8. Οἱ πολιται τοις νομοις πειθεσθων. 9. Τω αδελφω υιοι ἑπεσθον. 10. Ει βουλει καλως πραττειν, εργαζου. 11. Εαν βουλη καλως πραττειν, εργαζου. 12. Ψευδομενος ουδεις λανθανει πολυν χρονον. 13. Οἱ Λακεδαιμονιοι μετ' αυλων εστρατευοντο. 14. Ειθε παντες ανευ οργης βουλευοιντο. 15. Δυο καλω ἱππω εις την πολιν ηλαυνεσθην. 16. Εαν πενη, ολιγοι φιλοι (sc. εισι σοι).

Remarks on this Exercise.

Μη αποδεχου, etc. If this sentence be arranged a little differently, the student will be better able to see its meaning—μη αποδεχου τους των φιλων (or των φιλων τους) χαριζομενους σοι προς τα φαυλα: in English, *do not welcome those of your friends who gratify you in bad things.* Προς (Latin, *ad*), *in regard to*, in.

Πραττειν is of a wider signification than ποιειν. The former signifies *to do*, the latter *to make*; the former, therefore, may be used with adverbs in a general sense, as κακως πραττειν, *to do ill*; that is, *to be in bad circumstances.*

The conjunction ει requires an indicative or optative mood; the conjunction εαν takes a subjunctive.

Μετ' αυλων, *with flutes*; that is, *to the sound of flutes.*

Ηλαυνεσθην, the third person, dual number, imperfect indicative, from ελαυνω, *I drive.* The η is the temporal augment, ε being lengthened into η.

Εργαζομαι, and several other verbs, such as ἑλκω, ἑπομαι, beginning with ε, form their temporal augment by changing ε into ει.

Exercise 87.—English-Greek.

1. That man is poor, and has few friends. 2. I am poor. 3. He was consulting. 4. They two were consulting. 5. I consult. 6. He consults. 7. Thou wishest to do well, work. 8. If (εαν) you wish to do well, work. 9. They work. 10. He works well. 11. He was working. 12. Ye were working. 13. Ye two were working. 14. We work. 15. I fight. 16. I was fighting. 17. They were fighting. 18. They fight bravely. 19. You fight. 20. You were fighting. 21. O soldiers, fight bravely for your country. 22. It is honourable to fight for one's country. 23. I follow thee. 24. He follows me. 25. They follow me. 26. We follow the general. 27 We were following the army. 28. Obey the laws, O boys

The Perfect and Pluperfect Passive.

The perfect passive may be formed directly from the perfect active by changing κα into μαι, as—perfect active λελυκα, perfect passive λελυμαι.

The pluperfect passive may be formed from the perfect by changing μαι into μην, and prefixing the augment ε, as—perfect λελυμαι, pluperfect ε-λελυ-μην.

Vocabulary.

Ακρα, -ας, ἡ, a summit, a fort or citadel.
Αυτονομια, -ας, ἡ (αυτος, self, and νομος, law), self-government, freedom, independence.
Εμφυτευω, I plant in (εν, and φυτευω, I plant).
Ἱδρυω, ἱδρυσω, ἱδρυμαι, I sit down, place, build.
Κατακλειω, κλεισω, κεκλεισμαι (from κλεις, a key), I shut up.
Λεγομαι (Latin, *dicor*), I am said.
Ληστης, -ου, ὁ, a thief, a robber, a pirate.

Exercise 88.—Greek-English.

1. Οἱ λησται πεφονευνται. 2. Δυο αδελφω ὑπο του αυτου διδασκαλου πεπαιδευσθον. 3. Ἡ βασιλεια ὑπο του δημου λελυται. 4. Τοις θεοις ὑπο των Αθηναιων πολλοι νεῳ ἱδρυνται. 5. Ἡ θυρα κεκλεισθω. 6. Προ του εργου εν βεβουλευσο. 7. Πασιν ανθρωποις εμπεφυτευμενη εστιν επιθυμια της αυτονομιας. 8. Οἱ λησται πεφονευσθων. 9. Οἱ πολεμιοι εις την ακραν κατακεκλεισθαι λεγονται. 10. Ξενοφωντος υἱω, Γρυλλος και Διοδωρος, επεπαιδευσθην εν Σπαρτη.

Remarks on this Exercise.

Κεκλεισθω, *let the door have been shut.* This, which is something like the literal rendering of the imperative perfect passive, scarcely makes sense in English. The force of the perfect lies in representing the active as already done, and so in denoting despatch, as in our vulgarism *have done*, that is, *cease immediately.*

Εις την ακραν, *into the citadel*: εις with the accusative, instead of εν with the dative, being used, because motion is implied. We, however, in English say in such a case, *in the citadel.*

Exercise 89.—English-Greek.

1. He has been murdered. 2. The boys have been murdered. 3. The soldiers had been slaughtered. 4. He has been shut up. 5. Ye have been shut up. 6. Ye had been shut up. 7. They have been shut up. 8. The two men had been shut up. 9. The oxen are said to have been shut up. 10. I have been well educated. 11. Thou hadst been well educated. 12. They have been well educated. 13. I had been ill educated. 14. Thou hadst been ill educated. 15. The trees have been well planted. 16. The trees had been ill planted.

KEY TO EXERCISES IN LESSONS IN GREEK.—XXIX.

Exercise 80.—Greek-English.

1. Two roads lead to the city. 2. A pair of oxen are drawing the plough. 3. Let us rejoice, O boys. 4. How sweet is beauty when it has good sense (sc. allied to it). 5. Let the citizens keep the laws. 6. Let companions take care for each other (lit., *let companion take care for companion*). 7. Let father and mother take care for the education of their children. 8. He who is unskilful in letters does not really see (lit., *sees not, while he sees*). 9. Bear bravely the chances that befall you. 10. The boy brings a rose to his father, that he may rejoice. 11. The boy was bringing a rose to his father, that he might rejoice. 12. Socrates used to speak as he knew. 13. When the Greeks approached, the barbarians fled. 14. Themistocles and Aristides once had a quarrel. 15. The Lacedæmonians are ignorant of music. 16. Turn away peril from us, O ye gods. 17. Do not keep one thing concealed in your heart when you are saying other things (i.e., *do not say one thing and mean another*).

Exercise 81.—English-Greek.

1. Αυτη ἡ ὁδος προς την πολιν αγει. 2. Δυο ὁδω προς την πολιν αγετον. 3. Δυο ἱππω (or ἱππω alone) το αροτρον αγετον. 4. Αὑται αἱ ὁδοι προς την πολιν αγουσιν. 5. Αἱ γυναικες καλαι εισιν ὁταν νουν σωφρονα εχωσιν. 6. Οἱ πολιται φυλαττουσι τους νομους. 7. Οἱ πολιται εφυλαττον τους νομους. 8. Ὁ πολιτης φυλαττει τους νομους. 9 Ὑμεις, ω πολιται, φυλαττετε τους νομους. 10. Ὁ πατηρ εμος προνοιαν εχει της εμου παιδειας. 11. Ἡ μητηρ εμη και αἱ αδελφαι εμαι προνοιαν ειχον της εμου παιδειας. 12. Οἱ πολιται τας προσπιπτουσας τυχας γενναιως φερουσιν. 13. Ἡ μητηρ τῳ πατρι ῥοδον φερει, ἱνα χαιρῃ. 14. Ἡ αδελφη τω αδελφῳ ῥοδον εφερεν ἱνα χαιροι. 15. Ἡ θυγατηρ και ἡ μητηρ και ὁ πατηρ εστασιαζον. 16. Μη στασιαζοιτε, ω γονεις. 17. Οἱ παιδες εχαιρον. 18. Χαιρω. 19. Χαιρετε. 20. Χαιρομεν. 21. Χαιρεις. 22. Χαιρουσιν. Εχαιρετε. 24. Εχαιρον. 25. Ἡ εμη αδελφη εχαιρεν. 26. Ο νεανιας μουσικης απειρως εχει. 27. Αὑται αἱ παιδες μουσικης απειρως εχουσι. 28. Μουσικης απειρως εχω. 29. Ἡμεις, ω παιδες, μουσικης απειρως εχομεν. 30. Οἱ γραμματων απειροι ου βλεπουσι βλεποντες. 31. Εκειναι αἱ γυναικες γραμματων απειραι εισιν. 32. Ουκ απειρος ειμι γραμματων. 33. Ουκ απειροι γραμματων εσμεν. 34. Δυο ανθρωπω αποφευγετον. 35. Κευθει τον νουν εν τῃ καρδιᾳ. 36. Οτε οἱ βαρβαροι επλησιαζον απεφευγεν. 37. Το δεινον αφ' ἡμων αποτρεποιεν οἱ θεοι.

Exercise 82.—Greek-English.

1. The soldiers will free the city from the enemy. 2. The good man will plant for his offspring also. 3. The messenger reported to the citizens that the enemy would plot against the army. 4. Achilles was angry with Agamemnon. 5. The Greeks prevailed much by their valour. 6. Socrates did not implore the judges with many tears, but trusting in his own innocence, incurred the furthest extreme of danger. 7. Judge not before you have heard the tale of both. 8. The Lacedæmonians destroyed Platæa. 9. Who can believe a liar? 10. Hear me, my friend. 11. The messenger reported that the enemy had plotted against the army. 12. Hear me, my friend. 13. Let one friend believe another. 14. They say that the city incurred great danger.

Exercise 83.—English-Greek.

1. Ὁ στρατηγος την πολιν απο των πολεμιων απολυσει. 2. Οἱ χρηστοι ανθρωποι και τοις εκγονοις φυτευουσιν. 3. Οἱ χρηστοι ανθρωποι τοις παισι φυτευσουσιν. 4. Οἱ αγγελοι πολλα επαγγελλουσιν. 5. Οἱ πολεμιοι επιβουλευουσι τῳ βασιλει. 6. Οἱ πολεμιοι εμοι επιβουλευουσιν. 7. Πολλα τοις πολιταις επαγγελλω. 8. Αχιλλευς Αγαμεμνονι μηνιει. 9. Αχιλλευς Αγαμεμνονι μηνισει. 10. Συ τῳ αδελφῳ μηνιεις. 11. Εμηνισα τοις πολεμιοις. 12. Τους δικαστας ἱκετευσω. 13 Σωκρατης ουκ ἱκετευσει τους δικαστας. 14. Οἱ χρηστοι πολιται ουκ ἱκετευσουσι τους δικαστας. 15. Οἱ πολεμιοι Πλαταιας καταλυουσιν. 16. Οἱ στρατιωται Πλαταιας καταλυσουσιν. 17. Οἱ στρατιωται την πολιν κατελυσαν. 18. Ακουσατε μου, ω εκγονοι. 19. Ἑταιρος ἑταιρῳ πιστευει. 20. Ἑταιρος ἑταιρῳ πιστευσει. 21. Ἑταιρος ἑταιρῳ επιστευεν. 22. Επιστευσαν. 23. Επιστευον. 24. Πιστευουσι. 25. Πιστευσουσι. 26. Πιστευσεις. 27. Επιστευσατην. 28. Πιστευσομεν. 29. Πιστευομεν. 30. Ὁ στρατιωτης τῃ ανδρειᾳ πολλα ισχυει. 31. Εγω τῃ ανδρειᾳ πολλα ισχυσα.

GEOMETRICAL PERSPECTIVE.—XVI.

THE PERSPECTIVE OF SHADOWS.

We now enter upon another division of our subject, Sciography, a term which signifies *the science of shadows.* The rules for their projection are founded, generally speaking, upon the same principles as those for the projection of solids and planes; yet, on account of many peculiarities arising from the causes which originate them, in reference to the sources of light, together with the various inclinations of surfaces upon which shadows fall, there must necessarily be additional and distinctive rules for their construction. We might point out a few of these changes in cause and effect, but we think it better to leave them until we come to special cases in which they are found, when we can enter fully into all the particulars belonging to them. The great source of light is the sun, whose rays may be said to be parallel, on account of its great distance from the earth. The rays emanating from an artificial light, as a candle in a room, are not parallel; in this case they spread in all directions from one common centre, upwards, downwards, and horizontally, so that under some conditions we shall have to introduce rules for the construction of shadows subject to an artificial light, which the pupil will find very different from anything that has been previously placed before him. In working the problems relating to shadows, it will be necessary first to draw the perspective representation of the objects we shall have to introduce: an explanation of this part of the work will not be repeated in every case, as we trust our pupils are sufficiently competent to do most of the work that is required previous to determining the shadows. Should there be an exception to this regulation, it will be when a question is proposed in which there may be something unusual in the perspective of the object which has not been considered before.

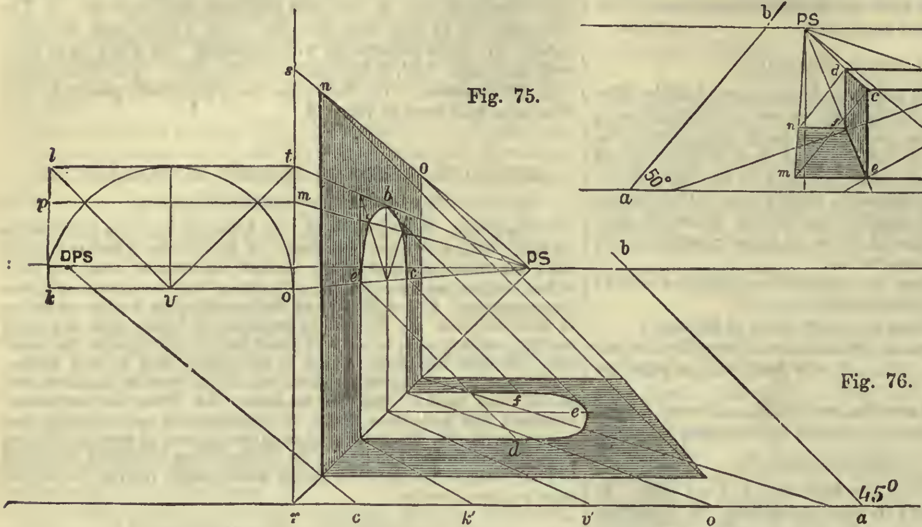


Fig. 75.

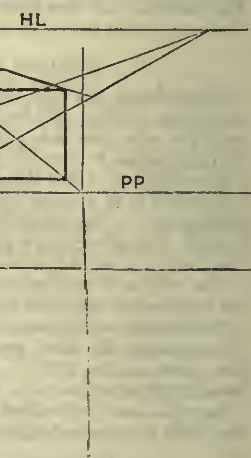


Fig. 76.

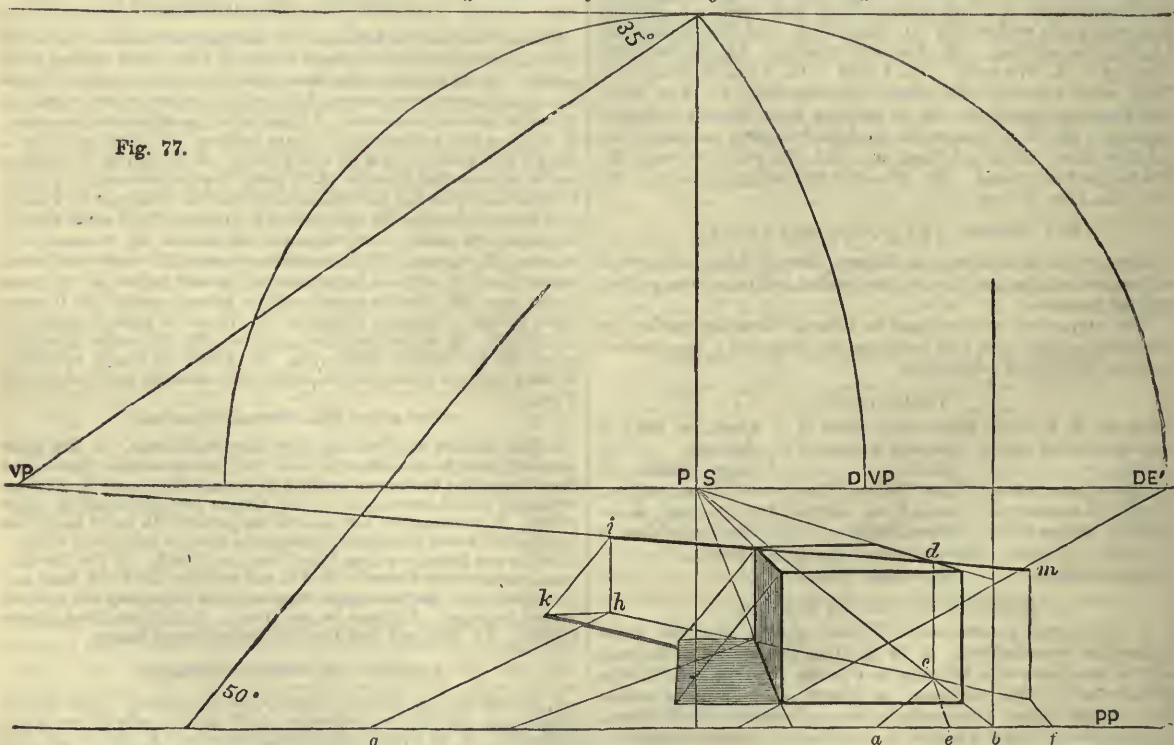


Fig. 77.

The position of the sun, the source of light, may be—first, when its rays are parallel with the picture; secondly, when the sun is before, or in front of the picture; thirdly, when it is behind the picture.

1st. *When its rays are parallel with the picture.* The sun is then either on the right hand or on the left; its rays, although at an inclination with the ground, are parallel with the picture-plane.

2nd. *When the sun is before or in front of the picture;* that is, when it is behind the spectator, or when the spectator is between the sun and the object.

3rd. *When the sun is behind the picture.* By this is meant when the object upon which the light falls is between the sun and the spectator. Our first examples will be to illustrate the first of these positions.

PROBLEM XLV. (Fig. 75).—*A block of stone 3 feet high, 4 feet wide, and 5 feet long, has its end parallel with the picture plane, 2 feet to the right of the eye and 1 foot within the picture. Height of the eye, 5 feet, and 10 feet from the picture plane. The angle of the inclination of the rays, or the sun's elevation, is 50° with the horizon, and to the right of the eye. Project the shadow of the block.*

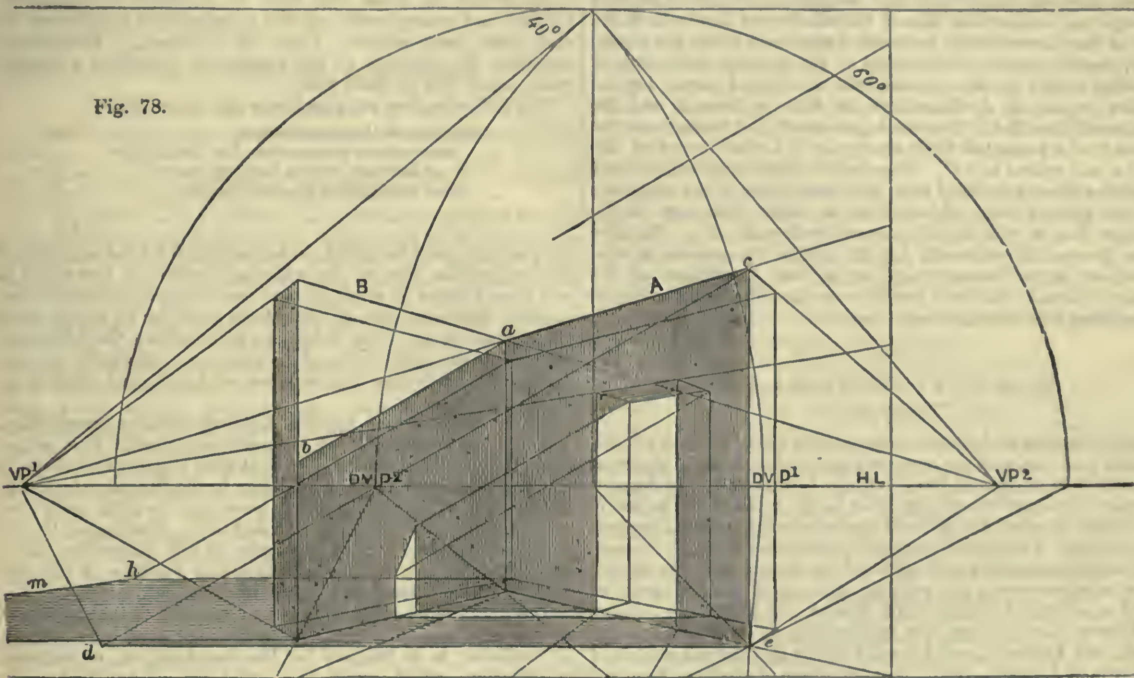
Anywhere upon the PP draw an indefinite line *a b*, at an angle of 50° with the PP. Through the angles of the block *c* and *d* draw lines parallel to *a b*, until they meet other lines drawn from *f* and *e* parallel with the PP in *m* and *n*. The side of the block *c d f e* will be the *broad shadow*, that is, the shadow *on the object; e f n m* will be the cast shadow on the ground, that is, the shadow *caused by the object.* It will be seen that the edge of the shadow on the ground from the upper edge of the block retires to the PS, the same vanishing point to which the block retires, because it is parallel with the block.

PROBLEM XLVI. (Fig. 76).—*The face of a wall pierced by an opening having a semicircular arch; retires at right angles with the* PP, *nearest end 1 foot within the picture. Height of wall, 9 feet. Horizontal length, 10 feet, and 5 feet to the left of the eye. Breadth of opening, 5 feet, and height 7 feet. Height of eye, 5 feet; distance 10 feet. Sun's elevation, 45°, and its rays parallel with the picture plane. The thickness of the wall is purposely omitted.*

To draw the perspective elevation of the arch, its elevation must be constructed parallel with the PP. At the given height of the spring of the arch from the ground at *o*, draw *k o* equal to the width of the arch; draw the diagonals *v l* and *v t*; also the horizontal lines *p m* and *l t*; *p m* must intersect the diagonals where they intersect the arch; these lines meet the line of contact *r s* in *m* and *t*, and are continued on the face of the wall to PS; from *r* to *c* is 2 feet, to cut off from *c* the nearest angle of the wall within the picture; from *c* to *k'* is 2·5 feet, the portion of wall on this side the opening. Lines drawn from *k' v' o'* (equal to *k v o*) to the DPS will cut the base of the wall for the perpendiculars of the opening; between these perpendiculars the parallelogram *l k t o* and the diagonals must be repeated; the corresponding points will be easily recognised, and through them the perspective of the arch must be drawn by hand. For the shadow draw any line *a b*, as in the last problem, at an angle of 45° with the PP, and draw lines parallel to it through *e, b, c*, to meet lines on the ground drawn from the bases of the perpendicular lines *e b* and *c*, and parallel to the PP in the points *d, e, f;* draw the arc *d e f* by hand. The shadows of the angles of the wall *n, o* are found as *d* and *c* in the last problem.

PROBLEM XLVII. (Fig. 77).—*The block of Problem 45 has a pole 10 feet long laid across it horizontally at an angle of 40° with the picture plane. The nearest portion of the pole which is in contact with the block is 1 foot from the right-hand corner of the block, and 2 feet of the pole as it approaches the picture plane hang over the side. Project the shadows of the block and the pole. Sun's inclination 50°.*

Fig. 78.



Project the shadow of the block as in Problem XLV. To determine the perspective position of the pole, mark the point *a* 2 feet from *b;* this will include the distance of the block from the PP, and rule it towards DE′, cutting *b* PS in *c.* Draw the perpendicular *c d* (*d* marks the edge of the block over which the pole projects). Through *c* and *d* draw indefinite lines towards VP (the vanishing point for the pole); the lower line through *c* will be the plan of the pole. Draw a line from *c* to *e* directed by the DVP, and make *e f* equal to 2 feet; draw a line from *f* towards DVP to meet the plan of the pole in *o;* draw the perpendicular *o m; d m* will then be that part of the pole which projects 2 feet over the side of the block; make *f g* equal to 10 feet, and draw from *g* to DVP, cutting the plan of the pole in *h;* draw the perpendicular *h i;* then the portion of the line between *m* and *i* will be the perspective representation of the pole in the position given. To project the shadow, draw lines from the end of the pole parallel to the sun's inclination, and from *h* draw a line *h k* parallel to the PP to cut the inclined line; from this intersection will be traced the shadow of the pole in the direction of VP, appearing only beyond the shadow of the block.

PROBLEM XLVIII. (Fig. 78).—*Two walls* A *and* B *form a right angle, of these* A *is 40° with the picture plane. Height of the walls, 9 feet 6 inches. Depth of* A, *9 feet; that of* B, *7 feet. The nearest angle of the wall* A *is 2 feet from the picture plane, and 5 feet to the right of the eye. A doorway is in the wall* A, *2 feet from the nearest end; width of doorway, 3 feet; height, 7 feet. Horizontal line, 5 feet. Distance of the eye from the picture plane, 10 feet. Angle of sun's rays, 60° with the vertical, and parallel to the plane of the picture.*

In this subject the pupil has to notice especially the angles of the wall and doorway, from which the lines parallel to the sun's rays are drawn. First, those of the door, where it will be seen the sun's rays are drawn from *the angles on the other side* of the wall, at the top, and the projecting line of the rays for the edge of the shadow on the ground; the opposite edge of the shadow on the ground of the doorway is drawn from the nearest angle of the further perpendicular, because the interior of that side of the doorway is in light. After the lines of the shadow on the ground have met the base of the opposite wall B, they are drawn perpendicularly until they meet their respective inclined lines or sun's rays; the line of the shadow on this wall of the top of the doorway will be easily understood from the figure. The greater portion of the edge of the shadow of the top of the wall A falls on the opposite wall B to *b* and passes beyond to the ground at *d*, determined by the ray from *c*, and the horizontal line *d e;* the small portion of the shadow on the ground at *d* projected from the upper and near corner of the wall A at *c* retires to VP^1. The shadow of the angle of the wall B on the ground is found from the outer angle of the two walls on the further side projected at *h;* whilst the edge of the shadow *h m* of the top of the wall retires to VP^2. We give these general directions as a guide during the process of construction, in preference to giving a close description of the work in detail, that our pupils may have the opportunity of completing the drawing as an exercise.

THE UNIVERSITIES.—VIII.

LONDON.—I.

THE University of London is essentially the university of self-taught students, and the one most interesting, because the most accessible to readers of the POPULAR EDUCATOR. Its degrees, honours, and emoluments are open to all, without distinction of sex, creed, or rank, and without the requirements of residence in any college. The lists of successful candidates embrace students of almost every nation and religion, from the ancient universities, from what were once the peculiar colleges of the University of London—King's College, in the Strand, and University College, in Gower Street—from the universities of Scotland, Ireland, India, and Australia, and from the public and private schools of all parts of England; while large numbers of students have not only graduated successfully, but have attained honours and exhibitions at the metropolitan university as the result of self-tuition. It is not our purpose to discuss the advantages and failings of such a university system. We are not disposed to question the social benefit of college life, and of the indirect intellectual and moral training which it involves. On the contrary, we deem residence one of the most valuable elements in university education; and the high esteem in which the degrees of the three older universities are universally held is due, in a great measure, to the social connotation which they possess, to the evidence which they afford of the refined and gentlemanly as well as scholarly qualifications of those who hold them. But to many the privileges and advantages of the older university system are impossibilities, as neither the time nor the necessary expenditure can be spared. Such is the case with the sons of the great majority of professional men and men of business, and with the large number of earnest students who desire to elevate themselves by means of education and to have their attainments stamped by some competent authority. Such students are willing to work hard, and to submit with others possessing greater advantages to a high examinational test of their acquirements; but they must read and study as they can. Evening classes and lectures, night-work, mutual instruction, and such works as the POPULAR EDUCATOR and similar publications, afford the only materials for preparation of which they can avail themselves; but with these they are willing to enter the lists of competitive examinations. A university, therefore, which stimulates self-tuition by permitting such candidates—both male and female—to present themselves for its degrees, honours, and prizes, and which, in its character of an examinational board, demands high and comprehensive scholarship, must be regarded as a necessary and useful supplement of any university system which professes to be national, and is one which will become more obviously so with the extension of popular education and a taste and facilities for study. The University of London effects this purpose; and since its curriculum embraces the majority of the subjects taught in our columns, and is an excellent test of the results of study; and since many of our readers have the honourable ambition to possess some academical degree, we propose to indicate briefly the course of study requisite, and the mode in which to proceed for that purpose.

We shall speak successively of the matriculation or entrance examination of the university, which must be passed by all candidates for degrees in the various faculties, and which is often passed by those who have no intention of proceeding further, and subsequently of the examinations for degrees in arts, laws, and science. There is, however, a preliminary question, the question of the expense of obtaining a degree, which must first be dealt with.

The following fees are payable to the university:—

At the matriculation examination	£2
,, intermediate examination for the degrees of bachelor of arts, laws, or science .	5
,, final examination for those degrees . .	5
	£12

To this sum must be added, in estimating the total expenses of graduating, the cost of the necessary books, of travelling to and from London or other place of examination in the provinces on three occasions, and of living from home for an aggregate of about three weeks. The total cost of obtaining the bachelor's degree of the University of London can, therefore, seldom exceed £50, including the purchase of books, and must be in many cases less.

Before proceeding to speak of the matriculation examination, a word must also be said of the university itself. It is not, as is very generally supposed, identical with University College in Gower Street, or with King's College in the Strand, which, like many other colleges and schools, have now the little more than nominal connection of being affiliated to it. Burlington House, in Piccadilly, was formerly the home of the university, but it now boasts an appropriate and imposing building of its own, erected by the Government, adjoining Burlington House.

The first step in order to become a member of the university, and to graduate in any of the faculties of arts, laws, science, or medicine, is to prepare for the matriculation or entrance examination, which must be passed by all candidates for degrees, even though they may be graduates in arts of other universities. Two matriculation examinations are held in each year, the first commencing on the second Monday in January, and the second on the third Monday in June. Intending candidates should in the first instance either purchase a copy of the University Calendar for the year or write to the registrar of the university, and ask him to forward a copy of the regulations for the time being, in which information will be found of the general and special subjects of examination, and of the places at which the examination will be held.

One calendar month at least before the commencement of the examination, each candidate must transmit to the registrar a certificate showing that he has completed his sixteenth year, upon the receipt of which the registrar will inform him of the time appointed for the entry of his name upon the register, when the matriculation fee of £2 must be paid.

Thus much of the preliminaries. In its general character the matriculation examination, which lasts during five days, is comprehensive, and includes a thorough knowledge of the elements of the chief subjects of a good general education. It is conducted by printed papers containing questions to be answered in writing; and although the examiners have power to put *vivâ-voce* questions, this is very seldom done. The preparation for passing the examination will demand some conscientious work, and since the statistics of the university show that fully half the candidates who present themselves fail to satisfy the examiners, we recommend our students to study diligently, and to test their own knowledge carefully before presenting themselves for examination, and incurring the risk of rejection. It must also be remembered that although the classification of those who pass is dependent on the total number of marks gained for their papers, candidates must satisfy the examiners by obtaining at least the minimum of marks in each of the several branches, and that numerous cases occur at each examination in which failure is to be attributed to deficiency in only one of the many subjects. Of these, classics, mathematics, and natural philosophy appear to be the most fatal, and special attention should be paid to them.

Candidates will not be approved by the examiners unless they show a competent knowledge in each of the following subjects:—

1. Latin.
2. Any *two* of the following languages:—
   (a) Greek; (b) French; (c) German; and (d) either Sanskrit or Arabic.
3. The English Language, English History, and Modern Geography.
4. Mathematics.
5. Natural Philosophy.
6. Chemistry.

Of each of these we will now proceed to give details.

MATHEMATICS.

This branch includes—1. Arithmetic. 2. Algebra. 3. Geometry.

The questions in arithmetic and algebra form the subject of one paper, for which three hours are allowed.

1. *Arithmetic.*—The arithmetical questions usually set involve a knowledge of numeration and the theory of numbers,* in addition to which the Calendar specifies "the ordinary rules," which must be held to include those which are known as the first four rules, simple and compound, direct and inverse proportion, simple and compound interest, discount, the purchase of stocks, etc. The preponderance of questions in interest, rule of three, and discount renders it desirable that special attention should be paid to these rules. The addition, subtraction, multiplication, division, and reduction of vulgar and decimal fractions,† and the extraction of the square root, must also be carefully studied. The lessons in this work and most of the ordinary school arithmetics will contain the information requisite in this branch.

2. *Algebra.*—In algebra knowledge is required of the processes of simplification, addition, subtraction, multiplication, and division of algebraical quantities, and some facility in performing these operations and in the solution of simple equations and easy problems involving them must be acquired.‡ Arithmetical and geometrical progression, the formulæ of which should be remembered, and algebraical proportion must also be read, and their *rationale* mastered. §

3. *Geometry.*—The first four books of Euclid are the subject of a three hours' paper on geometry, which usually comprises one or more propositions from each book, with simple deductions from them. It is not, however, essentially necessary, though highly desirable, that the latter should be done. The propositions should be rendered perfectly familiar, in order that they may be readily written, and that time may be devoted to the exercises upon them, which may require some thought. It is scarcely necessary to caution the student against merely committing the words and figures to memory without mastering the various steps in the reasoning process.

The examiners merely require that the latter shall be made manifest. A symbolical Euclid will be useful to the student, but, as few abbreviations are permitted at the examinations, it is not desirable that it should be read alone.

The less conventionally Euclid is studied the better, and we recommend the student to construct carefully his own statements and diagrams of the various propositions. This is a work involving some time and thought, but its value is unquestionable. ||

* See POPULAR EDUCATOR, "Lessons in Arithmetic," I.—XVIII.
† POPULAR EDUCATOR, "Lessons in Arithmetic," XIX.—XXV.
‡ POPULAR EDUCATOR, "Lessons in Algebra," I.—XII.
§ Galbraith and Haughton's "Manual of Algebra" is a good work for the purpose of preparation.
|| See the "Lessons in Geometry," in the POPULAR EDUCATOR.

NATURAL PHILOSOPHY.

The University Calendar used to state that the requisite knowledge of natural philosophy was such as might be attained by attending a course of experimental lectures on the elements of mechanics, hydrostatics, hydraulics, pneumatics, optics, and heat. But this information was deceptive, and is no longer given. Attendance at such a course of lectures is highly desirable for the sake of the illustrative experiments, but the subject will also demand considerable reading and study. The fact that the examinational statistics of the university show this paper to be a very fatal one to candidates confirms the opinion we have expressed, and induces us to recommend great attention to the principles of a subject which is not susceptible of being crammed. Whichever work upon the subject may be selected should be read thoughtfully and with attention, and the principles of the several sciences should be so thoroughly mastered that they may be readily applied to the solution of the questions submitted in the examination-room.*

In mechanics the student must be able to explain and illustrate the theory of the composition and resolution of statical forces, to describe the simple machines, *i.e.*, the pulley, the lever, the inclined plane, and to answer questions depending on the ratio of the power to the weight in each. The principle of the centre of gravity, the general laws of motion, and the law of the motion of falling bodies, must also be thoroughly understood, and the chief experiments illustrative of them must be made so familiar to the student's mind that he may be able to describe them readily on paper.

In hydrostatics, hydraulics, and pneumatics the Calendar directs attention to the pressure of liquids and gases, its equal diffusion and variation with the depth, and to specific gravity, and the modes of determining it. The principles of the action of the barometer, the siphon, the common pump, the forcing pump, and the air pump must also be studied, and, if possible, the action of these instruments should be observed with a view to a written description of their working.

In optics the examination is limited to the laws of reflexion and refraction, and the formation of images by mirrors and simple lenses. Heat includes a knowledge of its sources; expansion; thermometers, and the relations between various scales in common use; the difference between temperature and quantity of heat; specific and latent heat; calorimeters; liquefaction; ebullition; evaporation; conduction; convection; and radiation.

Thus only the elementary principles of light and heat are dealt with, but the student is nevertheless advised to thoroughly familiarise himself with the general principles of these sciences, since the omission to do so may prove embarrassing at the examination, and the knowledge acquired will certainly not only prove useful, but, from the position which science has assumed as a prominent branch of general education, may now be considered essential in a well-educated member of society.

COMPARATIVE ANATOMY.—XX.

BIRDS.

THIS class of the vertebrates, though possessing an external configuration which apparently differs much from all other animals, is closely allied to, and may be considered as an extremely modified reptilian type—the two constituting a great order, which Huxley calls Sauropsida.

The rule, that animals are constructed according to their habits and the medium in which they live and move, is beautifully exemplified in birds. Their bones are extremely light, and rendered still more so by being, in the majority of instances, permeated by air. The outer covering, or epidermis, which in the preceding divisions we have seen variously modified, also undergoes a wonderful change, thus contributing to the same end, and exhibiting a characteristic difference from the scale-clad cold-blooded animals we have described. The cuticle appears no longer as scales, but as closely aggregated appendages, or feathers, which closely envelop the body, for the double

* The "Elements of Natural Philosophy," by the Rev. Professor Haughton, M.D., will be found a useful work in preparing for the examination. The Lessons in Natural Philosophy in the POPULAR EDUCATOR will also prove extremely useful.

purpose of maintaining warmth, and assisting in aerial progression. Each feather is, as Paley truly observes, a mechanical wonder. When fully formed, a feather is composed of a central cylinder or quill, by which it is attached to the skin; a shaft, which is the tapering continuation of the quill; and the vane or beard which projects from each side of the shaft. The latter is composed of barbs and barbules. The feathers present some variations in size and form in different parts of the body. They are variously coloured, and form the chief feature of ornamental beauty of birds. The feathers are formed by the conversion of the cells of the outer layer of the epidermis (skin) into horn-like material.

The Mandible or Bill consists of two portions, formed by the elongated upper and lower maxillary bones, covered over with a horny sheath, which serves the place of teeth. Besides being a prehensile organ, the bill aids in the masticatory process to a certain extent, and in some birds, *e.g.*, the parrot, assists in climbing, thus acting as a third foot. It presents many interesting modifications of size and shape, from the filamentous cone of the humming-bird to the huge bill of the toucan. The food, and manner of obtaining it, peculiar to each species, determines the size, shape, and degree of hardness of the bill. Thus it is strong and hook-like in those which tear their prey; short and conical in the grain-eaters; probe-shaped in those which live principally on insects. In the ibis, the bill is curved down. In the jabiru (Fig. I., *c.*) it is bent up. It is dilated at the extremity in the spoonbill. Ducks, geese, etc., have their bills flattened. In some birds it is dentated. Besides these, there are a variety of shapes, extremely interesting.

The Tongue presents almost as many peculiarities as the mandible, and like it serves for the most part as an organ of prehension. It is composed of muscles, covered with a horny sheath, and supported by one or two bony pieces (hyoid apparatus), prolonged backwards behind the head (Fig. VIII.). This hyoid apparatus is very remarkable, especially in those birds which dart the tongue rapidly at insects, as the woodpecker (Fig. VIII.). In the latter, the tongue is armed at its tip with sharp-pointed processes for transfixing insects. In the fieldfare (Fig. II., *b.*) the horny sheath of the tongue terminates in fine filaments. In the snipe (*a*) it is long and slender. It is very short in the kingfisher (*d*). The tongue of the goose (*c*) has projecting from its sides a number of recurvated spines. The honey-eaters have the extremity of their tongue furnished with a tuft of horny, hair-like filaments. These peculiar shapes of the tongue are, like the mandibles, determined by the kind of food, and the method of obtaining it. Beneath the tongue there are a number of small cellular masses, called salivary glands. These furnish a gummy-like fluid (saliva), which moistens the food. In the woodpeckers, and other insectivora, the saliva is viscid, to enable them to entrap insects.

Alimentary Canal.—The first portion of the digestive tract, extending from the mouth to the stomach, is called the gullet. Its length is proportionate with the bird's neck. It is usually wide, and in some birds capable of great distension. At the lower part of the neck it communicates with a receiving cavity or crop (Fig. III.), where the food, after swallowing, remains lodged for a time. A little below the crop there is another dilatation, the proventriculus, or second stomach (Fig. III., 3), and below this a third, the gizzard. The crop is a temporary reception-bag, the food lodging there until the gizzard is ready to receive it. It is single, but of large size in the common fowl (Fig. III., 4). The pigeon has a double crop. In many birds it is wanting, the food passing along the gullet to the true stomach at once, or, as in some birds that swallow whole fish, the gullet is distended into a pouch-like cavity, serving the purpose of a crop. The proventriculus (Fig. III., 3) may be smaller or larger than the gizzard. Its walls are thickly studded with small follicles called gastric glands, which pour out a fluid to macerate the food, and to reduce it to a condition more readily acted on by the gizzard. The gastric glands are variously arranged, and present some differences in size and shape. Some of these are shown in Fig. IV., *a*, *b*, *c*, *d*, *e*.

The gizzard, composed of a dense aggregation of muscular fibres, is covered on its internal aspect by a dense skin-like membrane, thus forming a powerful agent for the mechanical reduction of the food. Many birds further increase the power of reduction by swallowing pieces of flint, or other hard substances.

The intestinal portion of the alimentary canal retains much of the simple reptilian form. It varies from twice to eight times the length of the body. The first portion of the intestine, immediately succeeding the stomach, is called the duodenum, and is arranged in a characteristic loop-like fold, the interval being occupied by a gland called the pancreas, which is similar in structure to the salivary glands. The remaining portion is also more or less folded, but in an irregular manner, and finally terminates in a short tube of greater calibre, called the large intestine. In the mammalia, the large and small intestines are separated by a valvular fold of the mucous lining; in birds, however, there is no such arrangement. The point of termination of the one and commencement of the other is marked by one or two pouches called cæca (Fig. III., 6), one on each side of the intestine. They vary in length from a simple offset, as in the Soland goose, to processes three feet in length, as in the grouse. The interior of the cæca of the ostrich is arranged in a spiral manner. The cæca are wanting in many birds, as the cormorant, wryneck, toucan, some vultures, etc. The large intestine is short, straight, and destitute of folds, and terminates in the cloaca (Fig. III., 10). There is an appendage (Fig. III., 11) connected with the small intestine, the remains of the duct of communication between the yolk-bag and intestine in the chick. Birds have no diaphragm or partition-muscle separating the thorax from the abdomen; consequently, the liver, which is large and two-lobed, occupies a part of both cavities. It has appended to it a gall-bladder and a bile-duct. The latter opens into the first part of the small intestine, and the fluid which it conducts plays an important part in the digestive process. The spleen is small. The kidneys are large, and lodged along the upper part of the pelvis. From each kidney a tube—the ureter (Fig. III., 8)—passes downwards, terminating in the cloaca. Birds have no urinary bladder, the urine being voided along with the excrements.

The Respiratory Apparatus.—This consists of an air-tube (the trachea), with an upper and lower larynx, two lungs, and a number of air-sacs variously disposed throughout the body. The trachea, or wind-pipe, is a cylindrical tube, composed of a number of cartilaginous rings connected together by fibrous membranes. Its length accords with that of the neck of the bird. It is surmounted above, and also below, by a larynx. The upper larynx is homologous in position, and in some respects in structure, with the mammalian larynx. But not in function. The lower one is the true larynx, from whence emanate the sweet songs by which the feathered tribe relieve the monotonous stillness of country life.

The rings which enter into the formation of the air-tube are not invariably of a uniform diameter, but sometimes present eccentric arrangements, as in the turkey, heron, eagle, etc., increasing in size from above downwards. Sometimes the windpipe is found of a fusiform shape, thicker in the centre than at the extremities; or it may be convoluted at the root of the neck. Sometimes one or more chamber-like dilatations are found developed upon it.

The lower and true larynx is situated upon the inferior extremity of the trachea, just before its bifurcation into the bronchi. This complex apparatus will be best understood by a reference to Fig. VII., *a*, *b* (after Milne-Edwards). It may be compared to a kind of osseous drum, the interior of which is divided inferiorly by a traversing beam of the same nature, surmounted by a thin semi-lunar membrane (Fig. VII., *b*, 2). This drum communicates inferiorly with two apertures of the glottis (*rimæ glottidis*), formed by the termination of the bronchi, and each provided with two lips, or vocal cords. Finally, muscles, whose numbers vary with the species, extend between the different rings of which these parts are composed, and move them so as to stretch more or less strongly the membranes they support. In birds which do not modulate the sounds, the membranous septum is wanting. In those which do not sing there are no muscles proper to the inferior larynx (Milne-Edwards). The lungs are small and undivided. A subdivision of the trachea (bronchus) enters the inner and lateral aspect of each lung, and after traversing the lung by smaller subdivisions (Fig. V., *aa*, *bb*), communicates on their inferior surface, by four or more pairs of orifices, with the air-sacs of the body. The latter communicate with the interior of the bones. Respiration is thus seen to be a very active and complicated process in birds, and not confined to the lungs, but shared in by every part of the body where air penetrates.

Circulation.—The temperature of the blood exceeds that of any other vertebrates, ranging on an average from 100° to 109° or 110°. In sea-birds, as the gull, the temperature is lower than that of other birds, varying from 100° to 105°. In the common fowl it ranges from 107° to 110°. In the swallow it is said to be as high as 111¼°. The blood-corpuscles are for the most part red, and nucleated.

The heart is double, each one presiding over a separate system; the right one over the pulmonary, the left one over the general or systemic. The main object of the right system is to remove from the blood carbonic acid, which results from the waste-tissue products, and replace it with oxygen.

Nervous System.—The brain of birds makes some little advance towards the mammalian character. The cerebral hemispheres are increased in size, and possess traces of convolutions. The ganglia which preside over the sense of taste are small. The optic lobes are large, as might be anticipated from the keen sense of sight and the complete power of adaptation of it, at all distances, which birds possess. The cerebellum and spinal cord are both of large size. The latter presents enlargements where the nerves emanate to be distributed to the extremities.

The Skeleton.—The skull of birds is made up of a number of bones, separate in the young bird, but which, speedily growing, become inseparably blended together in the adult. The jaws, as already mentioned, are elongated, and both are movable. The lower one is connected to the cranial bones by the intervention of a second one called the tympanic or quadrate bone. The skull is connected to the vertebral column by means of a single condyle. The vertebræ vary in number, the cervical ranging from ten to twenty. The dorsal, lumbar, and sacral vertebræ are generally found fused together and immovable. The coccygeal, which support the tail, are movable. The sternum, or breast-bone, is large and expanded, and has projecting in the median line a keel-like ridge, to increase the surface of attachment of the large elevator and depressor muscles of the wing. It has connected with it two bones; one small, the furculum or clavicle; the other large and strong, the coracoid bone. The latter acts as a powerful fulcrum to the wing, as well as a point of attachment to muscles. The

I. Beaks of (*a*) Shrike, (*b*) Crow, and (*c*) Jabiru. II. Tongues of (*a*) Snipe, (*b*) Fieldfare, (*c*) Goose, and (*d*) Kingfisher. III. Digestive Canal of Common Fowl. IV. Gastric Glands in (*a*) Eagle, (*b*) Pigeon, (*c*) Swan, (*d*) Rhea, and (*e*) Ostrich. V. Diagram of Lobule of Bird's Lung VI. Female Organs of Fowl at Breeding Season (Owen). VII.*a*. Inferior Larynx of Rook. VII.*b*. Vertical Section of Inferior Larynx of Rook. VIII. Head of Woodpecker (Milne-Edwards).

Refs. to Nos. in Figs.—III. 1, gullet; 2, crop; 3, proventriculus; 4, gizzard; 5, small intestine; 6, cæca; 7, large intestine; 8, 8, ureters 9, 9, oviducts; 10, cloaca; 11, process for attachment of yolk-bag. V. *a a*, subdivisions of bronchus; *b b*, smaller subdivisions. VI. 1, ova, or yolks; 2, vascular membrane of calyx; 3, zone, or stigma; 4, empty calyx; 5, infundibulum; 6, 6, oviduct; 7, oblique ridges of lining membrane of oviduct; 8, shell-forming dilatation; 9, egg exposed; 10, villi, containing follicles concerned in the secretion of shell; 11, convolutions of oviduct; 12, cloaca. VII.*a*, 1, trachea; 2, drum formed by the lower end of trachea; 3, middle ossicle; 4, first ring of the bronchi; 5, bronchi; 6, proper muscles of the larynx; 7, depressor muscles of the trachea. VII.*b*. 1, inferior portion of the trachea divided as regards the half; 2, semi-lunar membrane; 3, osseous cross-bearer; 4, little rim formed by internal lip of the right glottis; 5, inner surface of right bronchus, formed by a tympaniform membrane; 6, portion of the cavity of the right bronchus exposed by a section of part of this membrane. VIII. 1, hyoid apparatus; 2, tongue.

extremity of the bird's wing (hand) merely serves the purpose of a support for feathers. The legs vary considerably in length, according to habits. Each foot has three or four toes, terminated by claws; in aquatic birds connected together by an intervening web—this is principally confined to the three anterior toes. The feet and legs are generally covered with horny, scale-like plates, and destitute of feathers. The power of flight which many birds possess is indeed wonderful. The muscles in connection with the upper extremity may be said to consist of two classes: one by which great power is obtained; and the other, speed at the expense of power.

Generative System.—In their reproduction birds are strictly oviparous. The generative organs exhibit for the most part a close analogy to those of the higher reptilia. The ovary is racemose and single, the right with its oviduct being permanently atrophied, a singular violation of symmetry which is confined to birds. In this class of Vertebrata, incubation attains its highest perfection. It appears to arise from the concurrence of these three exigencies—the necessary life and early maturity of the young, the necessity of warmth to their development, and the incompatibility of utero-gestation with flight.*

Classification.—Birds are divided by Professor Huxley into three orders.

1. *Saururæ.*—Distinguished by having a long tail like a lizard. This order contains only the extinct bird, archæopteryx.

2. *Ratitæ.*—From their raft-like keelless sterna. This order comprises ostriches, rheas, emeus, cassowaries, and the apteryx.

3. *Carinatæ.*—Having the sternum raised into a median ridge or keel. All ordinary birds belong to this order.

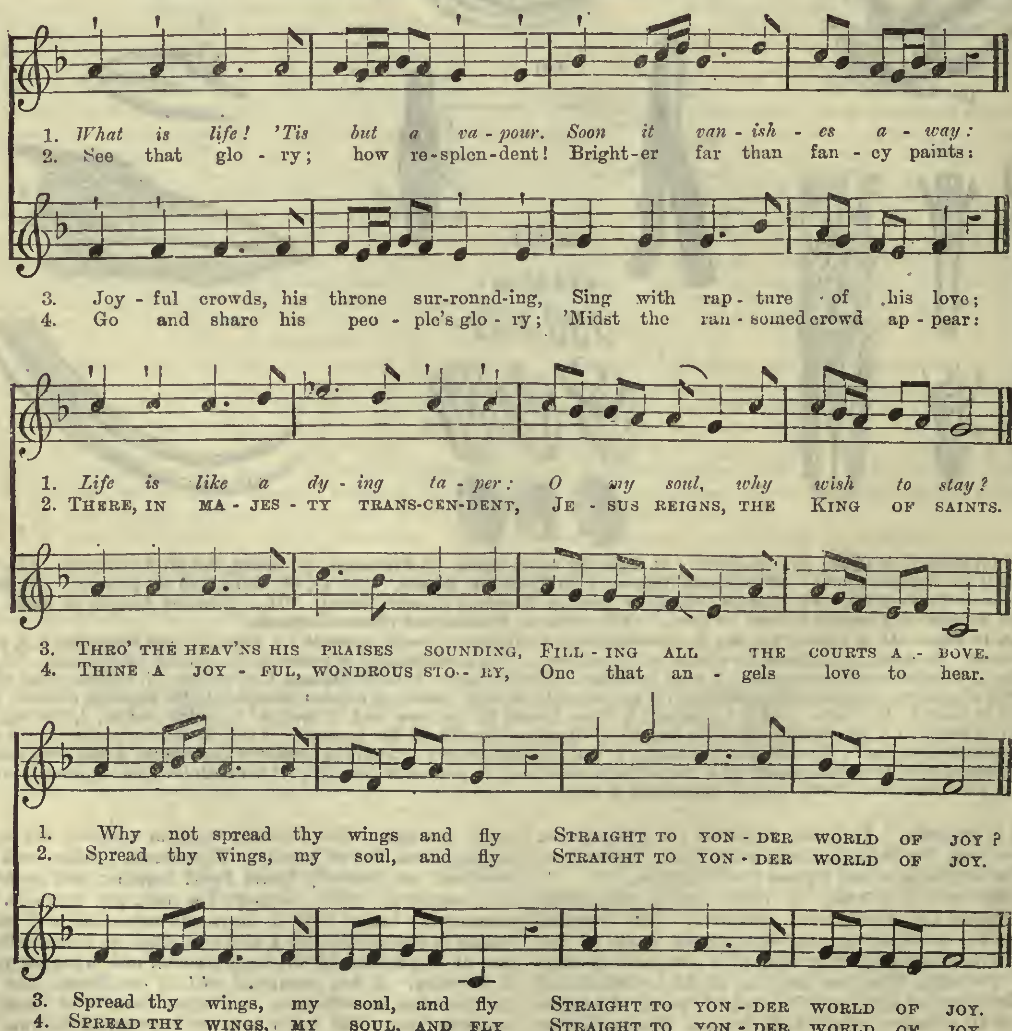
* Todd and Bowman.

LESSONS IN MUSIC.—XXIV.

THE DEAD MARCH IN "SAUL"—BOYCE'S CHANT—ETC.

The strikingly effective piece which follows, adapted from Handel's "Dead March" in his oratorio of "Saul," will exhibit to the pupil the effects of transition in a still more striking manner. [The key-note F is in the lowest space.] Boyce's Chant illustrates both transitions.

Exercise 43.—**DEAD MARCH IN "SAUL."** Key F Major. M. 50.



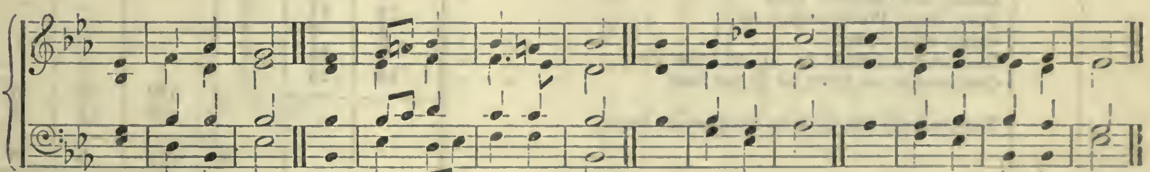
Exercise 44.—DEAD MARCH IN SAUL (in the New Notation). Key F Major. M. 50.

[Music from Handel. Words by Kelly.]

m :m	m :-.m	m.r,m :f.m	r :r	f :f.s,l	f :-.l
What is	*life? 'Tis*	*but a*	*va - pour,*	soon it	van - ish
d :d	d :-.d	d.t_1.d :r.d	t_1 :t_1	r :r	r :-.f
s.f :m.r,f	m :	s :s	s :-.l	ta :-.l	s :s
es a -	way.	Life is	like a	dy - ing	ta - per,
m.r :d.t_1	d :	m :m	m :-.f	s :-.f	m :m
s.f :f.m	m.r :-.s	s.f,m :f.m	r :—	m :m.f.s	m ,-.m
O my	soul, why	wish to	stay?	WHY NOT	SPREAD THY
m.r :r.d	d.t_1 :-.m	m.r,d :t_1.d	s_1 :—	d :d.r,m	d .-.d
r.d :f.m	r :	s :d'	s :-.s	f.m :r	d' :—
WINGS AND	FLY,	STRAIGHT TO	YON - DER	WORLD OF	JOY?
t_1.d :r.d	s_1 :	m :m	m :-.d	r.d :d.t_1	d :—

Exercise 45.—BOYCE'S CHANT. Key E Flat. M. 66.

To the following music may be chanted—Psalms li., cxxxix.; Isaiah lxiii. 1—7, 9—16; Romans xi. 33—36; 1 Corinthians xv. 51—58; 1 Thessalonians iv. 13—18.



d	r :f	m :—	r	m.fe :s	s :fe	s :—	s	s :ta	l :—	l	f :m	r :r	d :—
s_1	r :t_1	d :—	t_1	d :r	r :-.d	t_1 :—	t_1	d :d	d :—	d	t_1 :d	d :t_1	d :—
m	s :s	s :—	s	s.l :t	l :l	s :—	s	s :m	f :—	f	f :s	s :f	m :—
d	t_1 :s_1	d :—	s_1	d :t_1.d	r :r	s_1 :—	s	m :d	f :—	f	r :d	s_1 :s_1	d :—

We shall now try to elucidate the subject of "Minor Tunes." *Why* they are so denominated we shall explain presently. But, first, let us ask our readers to recall all that we have said in former lessons on the mental effect of the note LAH (the sixth above the key-note or the minor third below), or, better still, let them recall all they have themselves observed and felt in connection with it. Was it not always, when sung slowly, *the sorrowful note?* Then let us suppose ourselves trying to compose a very sorrowful tune—should we not naturally employ this note in the most effective positions? Without composing, however, let us just recall one of the oldest tunes of this kind in existence.

You notice what a sorrowful effect is produced by simply closing on LAH instead of the key-note in Example 1 in the accompanying Exercise. Yet more striking is this effect if the tune also *opens* with this note of sadness. Take, for instance, the second example with which Mr. Hickson illustrates this subject.

Exercise 46.—TWO EXAMPLES OF MENTAL EFFECT IN MINOR TUNES.

Example 1. Key F.

.m	m :m	m :m .m	f :m	r :d	.r	r :r	r :l_1	d :t_1	l_1 :—
A-	gainst Thee,	Thee on-ly,	have I	sin - ned,	And	done this	e - vil	in thy	sight.

Example 2. Key C.

l :t	d' :r'	m' :f'	m' :r'	d' :—	t :-.l	l :—
Far from	home and	all its	kin - dred,	far,	far a-	way.

LESSONS IN BOOKKEEPING.—XXIX.

(2) ACCOUNT SALES BOOK (*continued*). (2)

ACCOUNT SALES of 12 Tierces of Coffee (W. S. & Co.) received per the Wellington, Captain Browne, from Berbice, and sold on account of John Henderson of that place.

1881.			£	s.	d.	£	s.	d.
Oct.	20	Sold per William Knight and Co., at public sale, 14 Tierces of Coffee, net 76 cwt. 0 qrs. 22 lbs., at 121s. 6d. per cwt.	462	17	9			
		Discount, at 1 per cent.	4	12	7			
						458	5	2
Oct.	22	6 Tierces of Coffee, net 32 cwt. 1 qr. 18 lbs., at 120s. per cwt.	194	9	4			
		1 Tierce of Coffee, net 4 cwt. 1 qr. 17 lbs., at 117s. per cwt.	25	15	0			
			220	4	4			
		Discount, at 1 per cent.	2	4	0			
						218	0	4
					£	676	5	6
		CHARGES.						
		Insurance on £700, at 2¼ per cent., policy 36s. 9d., and Commission, at ½ per cent.	22	16	9			
		Freight and Shipping Charges	42	15	0			
		Duties and Customs' Fees	3	4	6			
		Dock Dues, Warehousing, etc.	12	11	1			
		Public Sale Charges	1	7	6			
		Brokerage on £683 2s. 1d., at 1 per cent.	6	16	7			
		Commission on £676, at 2½ per cent.	16	18	0			
						106	9	5
		Net proceeds due to John Henderson, Esq.				569	16	1
					£	676	5	6

London, 30th November, 1881.

White, Smith, and Co.

ACCOUNT CURRENT BOOK.

A *Running* or *Current Account* is an account of the mercantile transactions, principally in money, bills, and sales of consignments, between two parties who have agreed to allow a settlement to lie over for a limited period. Accounts Current are kept mostly by agents against their principals; and it is usual to charge or to allow interest on the different sums entered to the debit and credit of the parties. Besides interest, a commission, commonly ½ per cent., is charged by the agent on the amount of his payments and acceptances. In any account current, where a sum falls due at a date beyond that to which the account is made up, the interest for the time must be entered as a discount on the opposite side of the interest account, in order that the whole of the balance of the account may be considered as due at that date. This book may be journalised in the same manner as the preceding books. In the following examples, taken from the transactions between White, Smith, & Co. and two of their principals abroad—viz., Nathan Herschell, Barbadoes, and John Henderson, Berbice—the Accounts Current are made up to the 30th of June, 1882, that is, six months beyond the last date of the transactions in the memoranda. We have thus extended the date of the making-up of the Accounts Current between the company and its principals, because in the memoranda no notice was taken of such transactions, and because the dates up to the 31st of December, 1881, would have been rather short to show distinctly the nature of such accounts. In these accounts we have not charged the commission above mentioned, because commission was charged on various sums previously, and because the charging of the same would seem to make the subject too complex to the student. Still it is an easy matter for the intelligent student to make out the Accounts Current according to the rule stated above, the principal difficulty being the manner of calculating the interest. In these accounts we have supposed the rate of interest allowed and charged to be 5 per cent. per annum for both principal and agent, and we have shown in the products' column the mode of calculating this interest, according to the following rule:—Multiply the principal by the number of days and by double of the rate per cent.; then divide by 73,000, and the quotient is the interest required.

The student will notice that the products in this column are obtained by multiplying each sum by the number of days opposite to it, neglecting the shillings and pence when below ten shillings, and reckoning the same equal to an additional pound when above ten shillings, a practice very common in many counting-houses where much business is done. The student may, if he pleases, multiply the exact sums by the exact number of days as given in the days' column, and he will most likely find, on calculating the interest to a nicety, that the difference is upon the whole very small, or, perhaps, none at all, owing to a balance of small errors in the whole amount. In cases where "Interest Books" are at hand, the actual sums due for interest may be put down in the products' columns instead of the products themselves, and a balance struck, as we have done; but it will most likely be found that the trouble, even with an "Interest Book," is nearly the same as by the method we have adopted.

*

(1) ACCOUNT CURRENT BOOK. (1)

DR. NATHAN HERSCHELL, Esq., BARBADOES, IN ACCOUNT CURRENT WITH WHITE, SMITH, & Co., LONDON. CR.

Dates.			Sums.			Days.	Products.	Dates.			Sums.			Days.	Products.
1881.			£	s.	d.			1881.			£	s.	d.		
Sept.	23	To Cash paid for Freight . . .	23	15	4	280	6720	June	30	By Balance	1370	5	0	365	500050
,,	25	,, do. do. Duties . . .	107	8	7	278	29746	Nov.	8	,, Cash received for Sugar . .	234	0	0	234	54756
Oct.	1	,, do. do. Dock Dues . .	5	19	6	272	1632	1882.							
Nov.	4	,, do. do. Bills . . .	700	0	0	238	166600	June	30	,, Interest due to you . . .	30	13	0		554806
,,	8	,, do. do. Brokerage . .	2	6	9	234	468								331094
Dec.	4	,, do. do. Bills . . .	600	0	0	208	124800								
,,	24	,, do. do. Insurance . .	5	15	6	188	1128								223712
							331094								74571
1882.															7457
															745
June	30	To Balance due to you . . .	189	12	4										30 | 6485
		£	1634	18	0						1634	18	0		£30 13 0 Interest.

(2) ACCOUNT CURRENT BOOK. (2)

DR. JOHN HENDERSON, Esq., BERBICE, IN ACCOUNT CURRENT WITH WHITE, SMITH, & Co., LONDON. CR.

Dates.			Sums.			Days.	Products.	Dates.			Sums.			Days.	Products.
1881.			£	s.	d.			1881.			£	s.	d.		
Oct.	10	To Cash paid for Freight . . .	42	15	0	263	11309	June	30	By Balance	720	5	0	365	262800
,,	12	,, do. do. Duties, etc. . .	3	4	6	261	783	Nov.	22	,, Cash received for Coffee . .	676	5	6	220	148720
,,	14	,, do. do. Dock Dues . .	12	11	1	259	3367	1882.							
,,	23	,, do. do. Sale Charges . .	1	7	6	250	250	June	30	,, Interest due to you . . .	13	16	2		411520
Nov.	4	,, do. do. Bills . . .	600	0	0	238	142800								310721
,,	19	,, do. do. Bills . . .	400	0	0	223	89200								
,,	22	,, do. do. Brokerage . .	6	16	7	220	1540								100799
Dec.	19	,, do. do. Bills . . .	300	0	0	193	57900								33599
,,	24	,, do. do. Insurance . .	19	6	9	188	3572								3360
							310721								336
1882. June	30	To Balance due to you . . .	24	5	3										13 | 8094
		£	1410	6	8						1410	6	8		£13 16 2 Interest.

EXERCISES IN EUCLID.—IV.

Proposition XXI.—Given two straight lines A B, A C (Fig. 20) meeting in A, and another line D E, of limited length. Required to describe an isosceles triangle A L M, such that A L may coincide with A B, and A M with A C, and L M may be equal to D E.

Take two points P, Q in A B, A C, such that A P = A Q. Join P Q, and produce P Q to R, so that P R may be equal to D E. At the point R in the straight line P R make the angle P R M equal to the angle A P Q (Euc. I. 23), and let R M cut A C in M; then if A L be taken in A B equal to A M, A L M will be the triangle required.

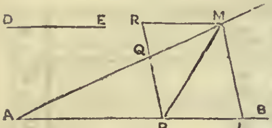


Fig. 20.

For because the angles at the base of an isosceles triangle are equal (Euc. I. 5), and that A Q P = R Q M (Euc. I. 15), and that A P Q = Q R M by construction, therefore angle M R Q = M Q R; therefore, by Euc. I. 6, M R = M Q. But since A M = A L, and A Q = A P, therefore, by Axiom III., M Q = P L; therefore also R M = P L (Euc. I. 28). Also, since angle A P Q = Q R M, therefore A L is parallel to R M (Euc. I. 27); therefore R M is equal and parallel to P L. Join P M, then the angle R M P = angle M P L (Euc. I. 29); also side R M = side P L, and side M P is common, therefore base R P = base M L—*i.e.*, M L = D E (Euc. I. 8), and A M = A L; therefore A M L is the triangle required. Q. E. F.

Proposition XXII.—If A B C (Fig. 21) be an isosceles triangle of vertex A, with B C the base produced to D, and if from centre C, at distance C A, a circle be described cutting B A produced in E, then exterior angle E C D shall be equal to three times angle A B C or A C B. For since C A, C E are radii of the same circle, angle C A E = angle C E A (Euc. I. 5); but exterior angle C A E equals two interior and opposite angles A B C and A C B = twice angle A C B (Euc. I. 32); therefore angle C E A equals twice angle A B C or A C B. But exterior angle E C D equals two interior and opposite angles A B C and A E C (Euc. I. 32) equals three times angle A B C or A C B. Q. E. D.

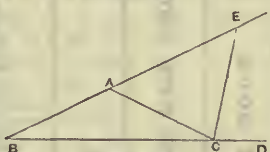


Fig. 21.

Proposition XXIII.—In the figure of Euc. I. 5, draw C L (Fig. 22) at right angles to C B, meeting B A produced in L, and prove A L = A C. Since the three angles of a triangle are together equal to two right angles (Euc. I. 32), and the angle A C L is a right angle, therefore the angles C B L, B L C of the triangle B C L are together equal to a right angle. But the angle A C B is equal to the angle A B C, therefore angle A C B with A L C is equal to a right angle. But A C B with A C L is equal to B C L, that is, to a right angle; therefore A C B with A C L is equal to A C B with A L C; therefore, taking away A C B, we have remainder A C L = remainder A L C; therefore A C = A L (Euc. I. 6). Q. E. D.

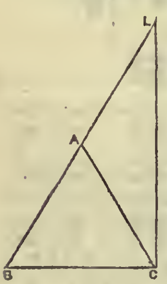


Fig. 2.

Proposition XXIV.—If in the figure of Euclid I. 5 the angles F B C, B C G (Fig. 23) be bisected by lines C O, B O, meeting in O, then O A shall bisect the angle B A C. Draw O L, O M, O N perpendicular to G C, C B, B F, then in the two triangles O L C, O N C, because the right angle O L C = right angle O N C, and angle L C O = angle N C O, each being by construction half the angle L C N, also side O C is common, therefore triangle O L C = triangle O N C (Euc. I. 26); therefore C L = C N, and O L = O N. Similarly, B M = B N, and O M = O N; but since O N B, O N C are right angles, and angles O C N, O B N are equal, being halves of the equal angles L C N, M B N, and side O N is common (Euc. I. 5), therefore the triangles O N B, O N C are equal; therefore C N = N B. But L C = C N, and M B = B N; therefore L C = B M. But A C = A B: therefore A L = A M; and O L, O M are equal, each being equal to O N. Therefore in the two triangles O A L, O A M, since O L, L A are equal to O M, M A, each to each, and O A is common, therefore the triangles are equal (Euc. I. 8); therefore angle O A L = angle O A M. Q. E. D.

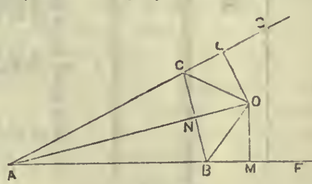


Fig. 23.

Note.—It will be observed in the figure that O N coincides with O A, but this is not assumed in the proof. This proposition will be proved in a future article for any triangle not isosceles.

Proposition XXV.—In the figure of Euc. I. 1, if the circles cut again in F (Fig. 24) and C A produced cut the circle in H, then H F is equal to A B. Join F A, F B, F C; then A B, A C, A F, A H, B C, B F are equal, being radii of equal circles. Hence A B C, A B F are equilateral triangles, and therefore also equiangular (Euc. I. 5, Cor.); but, by Euc. I. 32, the angles of a triangle are together equal to two right angles; therefore each angle of an equiangular triangle is equal to one-third of two right angles—*i.e.*, each of the angles C A B, B A F is equal to one-third of two right angles. Therefore angle C A F equals two-thirds of two right angles; hence, by Euclid I. 13, angle F A H is equal to one-third of two right angles; therefore angles A H F, A F H are together equal to two-thirds of two right angles (Euc. I. 3), but they are equal, since A H = A F; therefore each of them is equal to one-third of a right angle, hence the triangle A H F is equiangular, and therefore also equilateral (Euc. I. 6, Cor.); therefore H F is equal to H A, or equal to A B. Q. E. D.

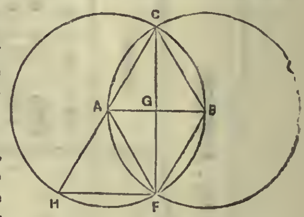


Fig. 24.

Proposition XXVI.—If in a triangle A B C (Fig. 25), B C be bisected in G, and A G joined, and the angle B A G be equal to the angle C A G, then B A shall be equal to C A. For if A B be not equal to A C, one of them must be greater. Let A B be the greater; from A B cut off A H equal to A C. Join C H, G H; then because A H = A C, and A G is common, also included angle G A H = included angle G A C, therefore base G H = G C (Euc. I. 4). But G C = G B, therefore G H = G B, and angle G H B = angle G B H (Euc. I. 5). Also since G H = G C, angle G C H = angle G H C (Euc. I. 5). Therefore angles G H C and G H B are together equal to G B H and G C H together—*i.e.*, angle B H C equals sum of B C H and C B H; but the three angles of the triangle are together equal to two right angles, therefore angle B H C, which is equal to half the sum of the three angles, is a right angle. Therefore, also, C H A is a right angle by Euc. I. 13; and since A H = A C by supposition, angle A C H = angle A H C (Euc. I. 5); therefore also A C H is a right angle—*i.e.*, two angles A C H, A H C of the triangle A C H are equal to two right angles, which is impossible by Euc. I. 17; hence A H is not equal to A C; and similarly for any other point, except B. Hence A B is equal to A C.

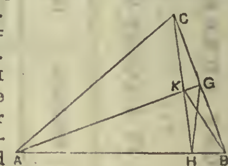


Fig. 25.

Note.—This kind of proof is called "Reductio ad absurdum."

Proposition XXVII.—Given two straight lines, A B, A C (Fig. 26), meeting in A, and another straight line, D, of limited length. Required to form a right-angled triangle, of which the base shall coincide with A C; one side shall coincide with A B, and the other side be equal to D.

From A draw A E at right angles to A B (Euc. I. 11), and from A E cut off A F, equal to D (Euc. I. 3); from F draw F G at right angles to A E, cutting A C in G (Euc. I. 11); from G draw G H perpendicular to A B (Euc. I. 12); then will A H G be the triangle required. For since G H A, H A F, A F G are right angles, A H G F is a rectangular parallelogram; hence in the two triangles F A G, A G H, because the angle F A G is equal to alternate angle A G H (Euc. I. 29), and right angle A F G equal to right angle A H G, also side A G is common, therefore the triangles are equal in every respect (Euc. I. 26). Therefore side A F = G H, but A F = D; therefore G H = D, and A H coincides with A B, and A G with A C, and A H G is a right angle; hence A H G is the triangle required. Q. E. F.

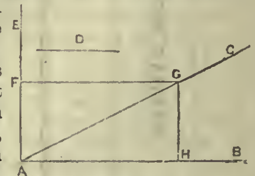


Fig. 26.

PROPOSITION XXVIII.—If, in the figure of Euc. I. 1, AB produced cut the circles again in D, E (Fig. 27), and the circles cut again in F, the figure CEFD shall be a rhombus, having each of the angles at C and F, half the angles at D and E.

Join AF, BF, CF; then because the angles CAB, CAD are equal to two right angles, and similarly CBA and CBE (Euc. I. 13), therefore angles CAB and CAD are equal to CBA and CBE. But CAB = CBA (Euc. I. 1), therefore remainder CAD = remainder CBE; and since AB, AC, AD, BC, BE are all equal, being radii of equal circles, therefore in the two triangles CAD, CBE, because sides CA, AD = sides CB, BE, each to each, and included angle CAD = included angle CBE, therefore base CD = base CE (Euc. I. 4). By an exactly similar process of reasoning, DF = FE, and because CB = BF, and BD is common, and included angles CBD, FBD are equal, each of them being the angle of an equilateral triangle, and therefore equal to one-third of two right angles (Euc. I. 32), therefore base CD equals base DF, similarly CE = EF; therefore CD, DF, FE, EC are equal, and CDFE is a rhombus. Again, because AC = AD, the angles ACD, ADC are equal (Euc. I. 5); but angle CAB is equal to the two interior and opposite angles ACD and ADC (Euc. I. 32), therefore the angle CAB is double either of the angles ACD or ADC. Similarly the angle CBA is double either of the angles BCE or BEC; therefore the angle ACB, which is equal to either of the angles CAB or ABC, is double either ACD or ADC, or BCE or BEC; hence ACB is equal to the sum of ACD and BCE, and is also equal to the sum of ADC and BEC; therefore the whole angle DCE is double ACB, and is therefore four times the angle CDE or CED; similarly, the angle DFE is double AFB, and is therefore four times the angle FDE or FED. But FDE or FED is equal to CDE or CED, hence either of the angles DCE or DFE is double either of the angles CDF or CEF. Q. E. D.

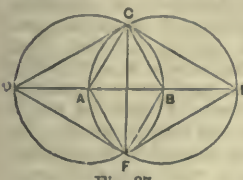


Fig. 27.

Our next article will extend as far as Euc. I. 40, and we shall give solutions of the following propositions :—

PROPOSITION XXIX.—To trisect a given right angle, that is, to divide it into three equal parts.

PROPOSITION XXX.—If two right-angled triangles have one side and the base in one equal to one side and the base in the other, each to each, they shall be equal in every respect

PROPOSITION XXXI.—The straight lines which bisect the angles of a triangle meet in a point.

PROPOSITION XXXII.—The straight lines drawn perpendicular to the sides of a triangle through their middle points meet in a point.

PROPOSITION XXXIII.—The straight lines which bisect one interior and two exterior angles of a triangle meet in a point.

PROPOSITION XXXIV.—If two triangles have one side, and one angle in the one equal to one side and one angle in the other, and likewise their areas equal, then shall also their other sides and angles be equal each to each.

PROPOSITION XXXV.—If the bases of two equal triangles be in the same straight line, and the line joining their vertices be parallel to this line, their bases will be equal.

PROPOSITION XXXVI.—In the figure of Euc. I. 5, if AC be bisected in H, and CG be equal to CA, then BG shall be equal to twice BH.

RECREATIVE NATURAL HISTORY.

SOME LAND, SEA AND FRESHWATER SHELLS, WORMS, AND TUBE-DWELLERS (*continued*).

FEW of our readers who have investigated the habits of the deeply-interesting and curious creatures found amongst the rocks and rock pools of our own coast, will have failed to notice the deep tubular excavations made in the rock by those accomplished and industrious borers, the Pholas family. In different localities we find two of these stone perforators (*Pholas dactylus* and *Saxicava rugosa*). The former of these we find prosecuting his labours both amongst the chalk rocks and red sandstone of the southern coast of England, whilst the latter, not content with attacking substances of an ordinary degree of hardness, proceeds to operate on the compact, hard limestone rock, cutting his way deeply into it, just as a skilful carpenter bores an augur-hole in a door-post. It is by shells of this kind that the huge blocks of stone used in building the Plymouth Breakwater and some of the new military works are slowly but surely being reduced to a species of stone honeycomb. Not only stone but solid and dense-grained timber is readily bored into by the pholades. We stated in our last paper on this subject that much difference of opinion and scientific argument had arisen on the subject of the boring powers of these curious creatures. Some philosophers have stoutly maintained that the animal secreted a fluid of "acid" reaction, which possessed the power of so acting on the constituents of wood, stone, amber, wax, and gum resins that they became sufficiently soft and disintegrated as to admit of the shell, together with the mollusk inhabiting it, passing freely into and through the substance acted on. Others have maintained that the minute rasp-like teeth, or asperities, with which shells of this kind are armed, being constantly brought to bear on the exposed surface of the stone at the bottom of the perforation, were alone the agents in force to deepen the tube. Another set of investigators have stated that the borders of the soft coating or mouth of the mollusk, aided by its short, stout foot, were the means employed. It has been also urged that the constant and decomposing action of minute currents of sea-water passing through the siphon-like tissues of the animal brought about the fretting action requisite to form a hole.

We have broken the pholas shells from stones of a sharp, sand grit, which would be found to grind the hardest steel rapidly away. These shells we have examined under a powerful lens. The asperities on them have been by us most carefully scrutinised, but without our being enabled to detect the slightest evidence of wear and tear by friction. Every minute point remained as sharp as a new needle, and bore no traces of having cut through a mass of stone thick enough to have destroyed the points of a dozen engraving tools. Then when two of these shell-coated miners so drive their galleries that they intersect each other, the more powerful workman of the two, ignoring the presence of his weaker fellow-labourer, works on, bores forwards, and not only tunnels the rock, but the shells and soft tissues of his neighbour, literally boring him through and through. We have never been able to detect by the ordinary tests any "acid" in the water thrown off from the siphon of the pholas.

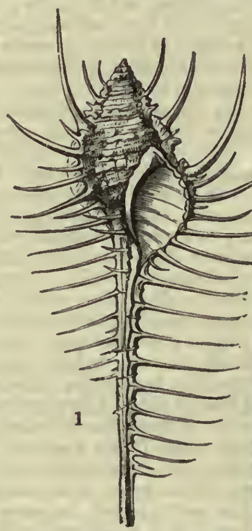
The rock-boring snails (*Helix saxicava*) before described by us, although forming deep tubular chambers in hard, dense rock, have no currents of sea-water to aid them, neither have they the same rasp-like and rounded character of shell. The ring-like mouth or portal of a snail-shell could but grind and wear down (supposing the file process to be that in force) in an uneven circle corresponding with the shell border.

To illustrate our point a little more clearly, let us place a common wine-glass or a metal thimble mouth downwards on a piece of soft Bath-brick, and then proceed to work it round until it penetrates the substance on which it is placed. On examination of our work, we shall find a groove corresponding to the edge of the circle of friction, and an even, table-like middle no deeper than the plane surface of the brick, which, as the groove deepened, would enter the mouth of the snail-shell, press up the inhabitant, and finally stop his boring operations altogether. We find, however, on examining a real snail-tube, that it is, although high and dry on land, formed much like that made by the pholas, and the bottom of the excavation, instead of being even, is cup-like in form, the centre, where no ring-shaped shell could touch, being the deepest point; and, curiously enough, the tracks made by the snails in going to and from their winter retreats, year after year, are of a distinctly grooved form. Two snails are not uncommonly found in the same tube, but, unlike the pholades, they never in any way interfere with each other.

It has been stated that a distinct acid reaction has, by the aid of litmus paper, been detected in the fluids given off by the boring snail. To this statement we attach but little importance. Visit a nest of black wood-ants, place a piece of slate in a split stick, hold it over the ant-hill, and then irritate the community; acid enough to act strongly on litmus paper will be at once deposited on the stone. And yet ants do not bore holes in rocks.

The composition of the secretions of living organisms is, in many instances, entirely beyond the powers of the most accomplished chemist either to imitate or correctly lay down. The silkworm spins for itself a cocoon, or capsule, in which to rest until the period for change into the moth stage arrives. Examine one of these cocoons, and reflect as to how a tiny, delicate creature like the moth of *Bombyx mori* could unassisted have forced its way through a texture so immensely strong as the tough and almost leather-like capsule in which it was so long sealed up. Unassisted, it must as surely have perished in its self-spun cell, as though locked up in some cavity of the solid rock, for no moth possesses the power of eating through such a wall as that which the larvæ can build. But here steps in to the aid of the imprisoned insect that beautiful, wise, and inscrutable Power which rules the universe and leaves nothing undone. The moth throws out a fluid, or secretion, which possesses the power of so softening the strong cement which bound the thousands of tough silk fibres together, that by a trifling effort they are thrust aside, and the little moth, soft as swan-down, with closely-folded wings, struggles into light and life. Could some chemist discover the nature of this marvellously active and potent solvent—for even the horn-like cocoons of the Tusseh worm in India (*Anthorea paphia*) yield immediately to it—an inestimable boon would be conferred on the winders of silk, whose great difficulty consists in so softening by artificial means the silk under treatment as to admit of its being reeled successfully.

Who shall say of what fell ingredients the powers of another description of cocoon are made up? Here we allude to the *Ngwa*, or poison-grub of the bushmen. This cocoon, instead of being formed from silk, is built up of fine earth or clay, and is buried in the earth. When required for poisoning arrows, it is dug up and broken open, when the juices exude. Should any of these enter a cut, scratch, or wound, agony of the most indescribable intensity is the result, and in the absence of the proper antidote, which, in the form of a plant (the *Cala he tel me*), is wisely placed by the Creator in the region of this baneful pupa-case, insanity, suicide, or both evils combined, would probably be the fate of the sufferer. In this case it is well that even Lucretia Borgia herself would have utterly failed to imitate the natural chemistry which has so fearfully endowed the African poison-grub. Reasoning thus, we say, place the juices of the sharp-spired murex (Fig. 1), and those of the smooth and painted porcelain shell (Fig. 2), in the hands of the most experienced chemist in the world, and we doubt his being able to point out the spine-forming qualities of the one, or their absence in the other. Therefore, we think, from the evidence before us, it is, to say the least of it, probable that these land and sea rock and timber borers possess the power of secreting a peculiar fluid which, like that of the silkworm moth, acts in a manner not to be imitated by artificial means.



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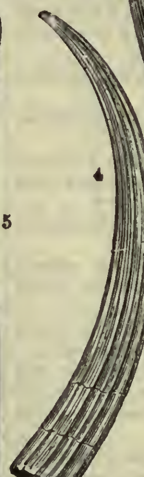


4

1. THE SHARP-SPIRED MUREX. 2. THE COWRY (CYPRÆA MONETA). 3. FINGER PHOLAS (PHOLAS DACTYLUS).

4. DENTALIUM MOTH SHELL OR TUSK SHELL (HYA-QUA). 5. THE RAZOR-FISH OR SOLEN.

Fig. 3 in the annexed illustration (reduced view) represents the common finger pholas (*Pholas dactylus*), as it is seen on breaking away the rock in which its tube is bored.

The dentalium-tusk shell, or *Hya-qua*, the subject of our illustration (Fig. 4), is an example of a tube-dweller bearing a single shell, unprotected by a rock gallery. This shell is remarkable as forming, so to speak, the connecting link between the true mollusks, as represented by ordinary shell-dwellers and the sea-worms (*Annelida*), examples of which are to be found on almost every oyster and crab shell brought to market.

The serpula is one of these. Both the dentalium and serpula are red-blooded creatures, but nevertheless do not belong to the same family. The dentalium stands, so to speak, on the border-land dividing the two great and curious families, *Mollusca* and *Annelida*. Dentalium shells of from an inch to an inch and a half in length are not by any means uncommon on our own coasts; but the true dentalium of commerce, the tusk-shell, or *Hya-qua*, is an inhabitant of warmer seas than ours, and grows to a much larger size than those found in British waters. Amongst the Indians of North-West America, this shell is used as a circulating medium, just as the *Cowry* is used by the inhabitants of India and the Eastern world. The commercial value of the dentalium is estimated according to its length when threaded on a string. Thus a cord of a given length which will hold ten of these shells is of less value than one which will only hold six; and so on. The manner in which the dentalium is captured by the Indians is both ingenious and curious. The habit of the shell when containing the living mollusk is to rest mouth upwards in the fine deposit at the bottom of the sea. Bearing this in mind, the crafty Indian provides himself with a long-handled implement, armed at the end with a number of sharpened fish-bones. Then, entering his canoe, he is paddled quietly along over the spots which experience has shown to be rich in the sought-for shells. Here, by constantly thrusting his bone-pointed spear downwards, he from time to time contrives to impale one or more dentalia. The pointed fish-bone, entering their open, tube-like mouths, penetrates their soft tissues, and holds them with sufficient firmness to admit of their being drawn into the canoe and shaken off.

The solen, or razor-fish as it is commonly called, is a bivalve shell commonly met with on nearly all sandy coasts at home and abroad. (Fig. 5.) The habits of this mollusk are not unlike those of the dentalium, but instead of confining itself to comparatively deep water, the razor-fish is found abundantly on the sand flats after the receding of the tide. A small heap of newly-raised sand serves to disclose its lurking-place, and a sharp-pointed and well-notched stick thrust adroitly from above downwards, just as an Esquimaux spears a seal in the ice, seldom fails to bring the solen to light. The would-be captor who heedlessly employs his finger in lieu of the stick will, in all probability, have cause to remember the razor-fish and its trenchant shells. These mollusks are in many localities used extensively as bait, and are, when crisply fried with bread-crumbs, a most appetising dish. There are numerous bivalve shells, not true tube-dwellers, which bury themselves in the sand. Of these we can have little to say in the present paper. There are other creatures dwelling in the sands of the sea-shore, without the protection afforded by shells, but a consideration of these must be reserved for a future lesson.

ELECTRICITY.—IV.

ILLUMINATING EFFECTS—INTERRUPTED CONDUCTORS—LEYDEN JAR.

Having now seen the way in which electricity can be obtained in large quantities, we have to observe what effects can be produced by it. If we place a brass ball in one end of the conductor, and hold the knuckle or another ball near to it, sparks will pass, which, if the machine be working well, will be seen to be forked and twisted about somewhat after the manner of a flash of lightning. The reason of this is supposed to be that the particles of dust floating in the air serve as conductors, and thus regulate the direction of the spark.

If we provide a series of conducting bodies placed a little distance apart, and allow the spark to pass along them, it will always choose the shortest path, and will be broken up into a number of short sparks between each conductor. A great number of brilliant and instructive experiments may be tried to illustrate this principle. Let a number of rather large shot be cut nearly through with a sharp knife, or procure a number of split shot, such as are prepared for use with fishing tackle, and fix them on a piece of sewing silk at distances of about one-eighth of an inch apart. Now hold a piece of this shot chain to the prime conductor, and the spark will be broken up into a number of short ones between each shot. If, however, we measure the sum of these intervals, we shall see that it is just about the distance over which the spark would pass if uninterrupted. When the machine is working well, seven or eight inches of this chain should be illuminated.

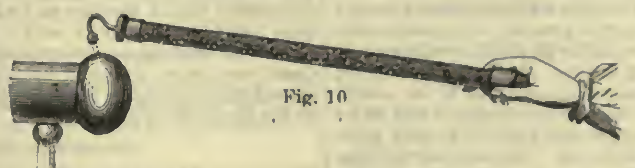


Fig. 10

Fig. 12.

Fig. 11.

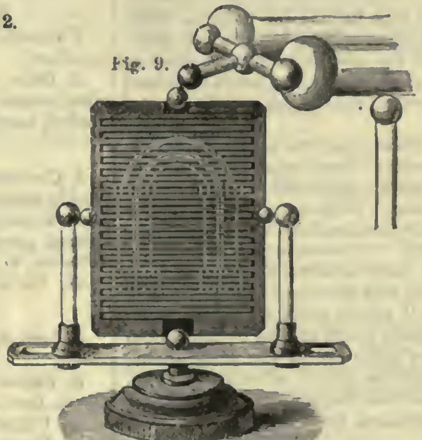


Fig. 9.

This experiment may be varied by threading on silk alternate beads of glass and metal, and a string of this kind becomes very prettily illuminated; or metal spangles or buttons may be sewn on to a piece of silk ribbon and treated in a similar way. In all these experiments silk must be used on account of its being a non-conductor. The spark only appears in the interval between the conductors, and hence, if cotton were employed, the electricity would pass quietly along without producing any luminous effect.

Another very pretty experiment may be tried in a similar way. Punch a number of small spangles of tinfoil. This may be done with a punch about one-eighth of an inch in diameter. As, however, the different layers of tinfoil are very apt to stick firmly together under the pressure caused by the blow, it is better to lay a sheet of paper between each thickness of the foil while cutting it. Now paste these spangles on a sheet of common window-glass, so as nearly to touch one another, and so arrange them as to form a device—as, for instance, a star or a cross. Bring strips of the tinfoil from each end to opposite sides of the glass. When it is dry, and the superfluous paste wiped off carefully, one of these strips may be held between the finger and thumb, and the other presented to the conductor; every interval will then be lighted up by the spark, and in a darkened room a very pretty effect will be produced. In making these devices, care will have to be taken in arranging the shape so that the nearest way for the spark shall be along the spangles, for if by darting across it has to traverse a shorter distance than the intervals between the spangles added together, it will be certain to do so. To guard against this, a part of the spangles have often to be placed on one side of the glass and the rest on the other, a strip of tinfoil passing over the edge to connect them. It is a good plan in making these devices to put them in a frame made of well-baked wood, and varnished with sealing-wax or shellac varnish. This is not, however, absolutely necessary, as a split bullet may be placed on one side to take the spark by, and the glass held carefully by the edge, a finger being placed against the other strip of foil.

If it be desired to make a device containing a word, it is better to dispense with the spangles, and paste parallel strips of tinfoil from end to end of the glass, at a distance of about three-quarters of an inch apart, and then paste a vertical strip at each end so as to connect the others. These strips should be about one-eighth of an inch wide, and should be very carefully rubbed down, as otherwise they are liable to come off afterwards. Now cut away the strips between the alternate bars, first at one end and then at the other, so that the electricity may pass from end to end by the top strip, back again by the next, and so on, thus traversing the whole length. Trace your word or device on paper, and, laying the glass over it wherever a line crosses one of the strips, make with a sharp knife two cross-cuts, like an X, and carefully pick out the small triangular pieces. You will thus have a narrow interval left, at which the spark will appear, and when the whole is completed, and the spark taken with a split bullet fixed on the upper edge, the device becomes clearly lit up. The illustration (Fig. 9) shows the way in which the sheet of glass may be mounted for the lecture-table if so desired.

If a number of the spangles be arranged spirally round a glass tube (Fig. 10), and a piece of wood, rounded carefully and covered with tinfoil, be placed at one end, sparks may be taken with it, and it will have a very pretty effect. Frequently the tube thus prepared is put inside another made of coloured glass, and in many ways the effect may, with a little ingenuity, be diversified. The principle of these experiments is an important one, as it explains the effects produced when lightning strikes a house or large building. If we examine any place thus struck, it will be seen that the electric fluid has leaped from one metal fastening or bar to another, displacing the stones or brickwork which lay in its path, and that its course was determined mainly by the position of these conductors.

If we take a number of balls of different substances mounted on wires, and, placing them successively in the conductor, draw sparks from them, we shall find that the colour varies with the substance used. From a brass ball it is almost white; if, however, we employ a ball of ivory, it will have a crimson tint; and when it is taken from a gilt surface, it has a greenish hue. The colour is also affected by the medium through which it passes: if the air be much rarefied it assumes a redder tint, while different gases impart different colours to it.

Now insert a pointed wire into the conductor, having darkened the room, and notice the effect produced.

A brush of light will be seen proceeding from the point, and no sparks can be taken from the conductor, for all the electricity is dissipated. In the same way, if a pointed wire be held near the conductor, the electricity will be silently drawn off. Instead, however, of a brush appearing at the end of the wire, a luminous star will be seen, the point being strongly negative. A similar star appears at the end of a wire inserted in the negative conductor, and thus the appearance of a star or a brush enables us to discriminate between positive and negative electricity. So powerful is the influence exerted by a point, that one, even at a distance of several feet, will seriously diminish the power of the machine.

Soon after the invention of the electrical machine, the idea of storing up the electricity suggested itself; and one of the early electricians, finding that water was a conductor, filled a bottle with it, and passed a wire through the cork, that by means of it he might cause the electricity to enter. Having held the end of this wire to his machine till he thought the bottle was full, he attempted to remove the rod lest the electricity should escape by it; but on doing so, to his intense alarm, he received a shock so violent that he kept his bed for a short time, and declared that nothing should ever induce him to repeat the experiment. The news of it, however, spread, and many others repeated it with various modifications; and thus the Leyden jar, so called from the place where the experiment was first tried, was constructed.

To make a Leyden jar (Fig. 11), take a wide-mouthed glass jar (one of those used by confectioners for sweets will answer well), and carefully coat it inside and outside with tinfoil to within about two or two and a-half inches of the top. Cut a large bung, or, better still, turn a cover of baked mahogany, to fit its mouth, and through this fix a piece of brass wire carrying a ball on its upper end. From the inner end of this wire let a short piece of chain reach to the bottom of the jar. In some jars the wire at the top may be bent over like a hook, so that they can be suspended from the conductor.

If the jar be now held with its knob close to the conductor, sparks will pass in for a little time till the jar becomes filled. Now set it down, and, taking a piece of wire bent into a curve, touch the outside of a jar with one end, and bring the other so as to touch the knob. A bright spark, accompanied by a loud crack, will at once be seen, showing that the jar has discharged itself.

For a small jar, one of the bottles that are used by chemists for holding quinine may be used, as they are usually made of thin glass. The shock from one of these will be as powerful as most people will care to take. With an ordinary narrow-mouthed bottle there is a difficulty, arising from the impossibility of coating it inside with tinfoil. To obviate this, it has been suggested to pour some thick paste into the bottle, turning it about so as to wet the interior, and then put in a number of brass or iron filings. These will adhere and form a conducting coating; but though a considerable shock may be obtained from a jar thus prepared, there is an objection to the plan, arising from the fact that the particles are not in absolute contact, and therefore, after the jar has been discharged, a second and even a third shock may be obtained from it, each, of course, much feebler than the first.

To take the shock, one hand should be placed against the outer coating, and the other, or a wire held in it, brought near the knob. Any number of persons can join hands, those at the ends of the chain touching the outside and the knob respectively, and the shock will be equally felt by all. Sometimes, when it is desired to discharge a large jar, or to send a shock through any substance, the jointed discharger represented in Fig. 12 will be found very useful. The handles are of glass, and thus prevent any portion of the shock being felt by the operator. The reason why, in discharging a jar with this, one knob should be brought into contact with the outer surface before the other touches the ball, is that if the spark passes against the side of the jar it may break it. As electricity always chooses the best conductors to pass along, it is not necessary for discharging a jar to have glass handles; a piece of wire may be used and held in the hand without any shock being felt. For many purposes, however, the insulating handles are a great advantage, and they can be made of gutta-percha instead of glass, if more convenient.

The Leyden jar is merely an illustration of the principle of induction already referred to. The glass is di-electric, and the metallic coatings serve to distribute the electricity over its surface. As soon as the interior becomes positively charged, it acts by induction on the exterior, driving off from it an amount of positive electricity nearly equal to that which it has received. Hence, if we suspend the jar from the conductor, or place it upon a common glass tumbler or other insulating support, we shall be able to take sparks from its exterior. If no means be provided for this electricity to escape, we shall be unable to charge the jar.

In their normal state the coatings contain a definite amount of electricity, and if there be an excess added to one side, the other must lose a corresponding amount. The spark and the shock are merely the effects by which the restoration of equilibrium between the two sides is manifested.

A striking illustration of this principle is seen if we place a number of jars so that the knob of one is connected with the outside of the next. This may be done by supporting them on their sides on insulating stands, or by laying them on pieces of glass. If now we connect the knob of the first with the conductor, and the outside of the last with the ground, each of the series will be charged, the electricity given off from one charging the next. The charge in the last will, however, be rather weaker than that in the first, owing to the thickness of the glass slightly interfering with the induction. This mode is called "charging by cascade;" and if the jars are afterwards placed together on an insulating substance, so that their outsides may touch, and a wire be so arranged as to connect all their knobs, a very powerful shock will be produced. Great care must, however, be taken in doing this to guard against the shock being accidentally taken, as it would certainly be too strong to be pleasant.

LESSONS IN LATIN.—XLII.

DEVIATIONS IN THE FOURTH CONJUGATION.

1. *Perfect in* -IVI *and* -UI; *Supine in* -TUM.

i. Sepelio, sepelire, sepelevi, sepultum, *bury, inter* (E. R. *sepulture*).

ii. Salio, salire, salui (no supine), *to leap* (E. R. *salient*). Compounds: silio, silire, silui, sultum; as, assilio, assilire, assilui, assultum, *to spring at.*

2. *Perfect in* -I; *Supine in* -TUM.

i. Comperio, comperire, compĕri, compertum, *to experience, to find by experience.*

ii. Reperio, reperire, repĕri, repertum, *to find.* Apĕrio has aperui, aperire, apertum, *to open* (E. R. *aperture*). Opĕrio and cŏŏpĕrio, *to cover*, have -rui, -rtum.

iii. Vĕnio, venire, vēni, ventum, *to come.*

3. *Perfect in* -SI; *Supine in* -TUM.

i. Amicio, amicire (amixi and amicui, both rare); amictum, *to clothe.*

ii. Farcio, farcire, farsi, fartum, *to stuff.* Compounds in fercio, fersi, fertum, as refercire, *to stuff quite fully.*

iii. Fulcio, fulcire, fulsi, fultum, *to prop, to support.*

iv. Haurio, haurire, hausi, haustum, *to draw up, drink.*

v. Sancio, sancire, sanxi, sancitum (more seldom sanctum; sanctus, -a, -um, as an adjective, *holy*), *to consecrate, confirm.*

vi. Sarcio, sarcire, sarsi, sartum, *to repair, make good, replace.*

vii. Sepio, sepire, sepsi, septum, *to hedge in.*

viii. Vincio, vincire, vinxi, vinctum, *to bind, put into chains.*

4. *Perfect in* -SI; *Supine in* -SUM.

i. Sentio, sentire, sensi, sensum, *to feel, to be of opinion.*

VOCABULARY.

Affluenter, *richly.*
Catena, -æ, f., *a chain.*
Cœtus, -ûs, m., *an assembly.*
Consentire, *to agree with, consent.*
Curatio, -onis, f., *healing.*
Desidero, 1, *to require.*
Desilire, *to leap apart, to open.*
Dissentire, *to disagree.*
Dispellĕre, *to drive out, dispel.*
Documentum, -i, *a proof.*
Dumetum, -i, n., *a place full of bushes.*
Exhaurire, *to exhaust.*
Explorator, -oris, m., *an explorer, spy.*
Indagāre, *to investigate.*
Ludibrium, -i, n., *scoffing, sport.*
Munificentia, -æ, f., *liberality.*
Parricidium, -i, n., *killing of a father, parricide*
Probe, *well.*
Rector, -oris, m., *a ruler, director.*
Transilire, *to jump over.*
Undĭque, *on all sides.*
Vepres, -is, m., *a briar.*

EXERCISE 161.—LATIN-ENGLISH

1. Regis sepulchro hæc verba inscripta sunt, "Probe vixit, imprŏbos vinxit, hostes vicit." 2. Hostes victi et catenis vincti in servitutem abducti sunt. 3. Imperium justis legĭbus fultum esse debet. 4. Rex, pace compositâ, rempublicam labefactam suâ virtute fulsit. 5. Virtus difficilis inventu est, rectorem ducemque desiderat. 6. Artes innu-

merabiles repertæ sunt, docente naturâ. 7. Vita, si undique referta bonis est, beata dicitur. 8. Homines urbes mœnibus sepserunt. 9. Occultæ inimicitiæ magis timendæ sunt quam apertæ. 10. Quis est tam miser ut non Dei munificentiam senserit? 11. Dei, induti specie humanâ, fabulas poetis suppeditaverunt, hominum autem vitam superstitione omni referserunt. 12. Continuis bellis reipublicæ spes exhaustæ sunt. 13. Quo quis affluentius voluptates undique hauserit, eo gravius ardenti usque sitiet. 14. Spero te mecum consensurum esse.

EXERCISE 162.—ENGLISH-LATIN.

1. The king, dying, said, "I have lived well; I have bound bad men; I have conquered enemies." 2. The soldier, being conquered, was put into chains. 3. They will be led away into slavery. 4. He props the falling republic. 5. He will prop the falling house. 6. The art of writing has been discovered. 7. They have opened the book. 8. My life has been with the good. 9. I fear hidden enemies. 10. Peace being arranged, I shall return home. 11. Happiness is difficult to be found. 12. The husbandmen have surrounded the meadow with hedges. 13. The plain is full of brambles and briars. 14. The spies are approaching. 15. Cæsar has learnt from the spies that the enemy are approaching. 16. The rising sun opens the day. 17. They have felt the goodness of God. 18. Didst thou make thy cloak with thine own hand? 19. I made with my own hand the cloak with which I am clothed.

CONSTRUCTION AND USAGES OF "AGO."

Ago is a verb used in a great variety of applications. So various are these applications that they may serve to throw light on the nature of language. *Ago* must be well understood by those who wish to be familiar with Latin.

Ago, agĕre, egi, actum, of the third conjugation, has for its radical or *root*-meaning the idea of setting in motion. Hence it is commonly given as denoting to *lead, drive, act.* But this is a very rough way of treating the subject. I will give the significations of the verb in the order in which they seem to have arisen.

1. *To lead*, as a shepherd :—

Agit, ut pastor, per devia rura capellas.—*Ovid.*

2. *To lead*, as a poem leads the mind :—

Poemata dulcia sunto et quocunque volent animum auditoris agunto.—*Horace.*

3. *To drive*, as men are driven out of a country :—

Multis millibus armatorum actis ex eâ regione in quam missus erat.—*Livy.*

4. With the reflective pronoun *to betake yourself*, in poetic diction :—

Quo agis te?—*Plautus.*

5. *To march* (in the passive voice) :—

Si citius agi vellet agmen.—*Livy*

6. *To plunder*, lay waste (with prædas) :—

Quà pergebat urbes, agros vastare, prædas agere.—*Sallust.*

7. *To hunt* :—

Ut cervum ardentes agerent canes.—*Virgil.*

8. *To move lifeless objects to and fro* :—

Celeriter vineis ad oppidum actis.—*Cæsar.*

9. *To steer* (with navis) :—

Navim agere ignarus navis timet.—*Horace.*

10. *To drive a chariot* (with currum) :—

Non agat hos currus?—*Ovid.*

11. *To levy a tax or tribute* (with vectigal) :—

Publicum vectigal in Asiâ egit.—*Suetonius.*

12. *To send forth* :—

Et spumas aget ore cruentas.—*Virgil.*

13. *To die* (with animam) :—

Nam et agere animam et efflare dicimus.—*Cicero.*

14. *To strike root* (with radices) :—

Robora suas radices in profundum agunt.—*Pliny.*

15. *To spring a leak, split, open* (with rimas) :—

Tabernæ rimas agunt.

The meanings already given imply a literal moving of the objects spoken of. Another series of meanings arises from the tropical or metaphorical use of the term; that is, where not the movement of sensible objects is denoted, but actions, etc., resembling those either in reality or in appearance.

16. To move, drive, or *induce* any one :—

Agricola in gloriam præceps agebatur.—*Tacitus.*

17. *To pursue, persecute* :—

Acerba fata Romanos agunt.—*Horace.*

18. *To plead* (with causam) :—

Hanc egit causam apud judices.—*Cicero.*

19. *To take an augury* (with augurium) :

Augures agere augurium dicuntur.—*Varro.*

20. *To play* (with fabulam); that is, personate a character. Hence a distinction between facere and agere :—

Potest aliquid facere et non agere; ut poeta facit fabulam et non agit: contra, actor agit et non facit; et sic a poetâ fabula fit non agitur; ab actore agitur, non fit.—*Varro.*

21. *To do, to be active, to be engaged generally* :—

Scipio Africanus solitus est dicere nunquam se plus agere quam quum nihil ageret.—*Cicero.*

This is explained by another version of the anecdote :—

Nunquam se minus otiosum esse quam quum esset otiosus.—*Cicero*

22. *To effect* :—

Nihil agis, dolor, quamvis sis molestus, nunquam te esse malum confitebor.—*Cicero.*

23. *To carry on, perform* :—

Delibera utrum colloqui malis, an per litteras agere, quas cogitas.—*Corn. Nepos.*

24. *To have in mind, consider* :—

Nescio quid mens mea majus agit.—*Ovid.*

25. *To acknowledge a favour* (with gratias) :—

Renunciate gratias regi me agere.—*Livy.*

26. *To spend time*, pass one's life, etc. :—

Pater cum esset infirmâ valetudine, hic fere ætatem egit in literis.—*Cicero.*

So, agere custodias, *to watch*; agere triumphum, *to triumph*, res agere, *to attend to business*; agere pœnitentiam, *to repent*, etc.

Quartum annum ago et octogesimum.—*Cicero.*

27. *To make war* (with bellum) :—

Qui longe aliâ ratione ac reliqui Galli bellum agere instituerunt.—*Cæsar.*

So, agere pacem, *to be at peace.*

28. *To treat of* (with de) :—

Recordare velim quæ ego de te in senatu egerim.—*Cicero.*

29. *To plead before, treat with, deal with* (with cum) :—

Cum populo agere est rogare quid populus suffragiis suis aut jubeat aut vetet.—*Gellius.*

30. *To accuse of anything* (with accusative of the person, and genitive of the thing) :—

Furti egit eos.—*Cicero.*

In the passive, it is used of the thing which is the matter at issue—"*the question is*," "the *point at issue* is."

Agitur populi Romani gloria, agitur salus sociorum.—*Cicero.*

31. *To deliver*, used of orators :—

Quæ sic ab illo acta esse constabat, oculis, voce, gestu, inimici ut lachrymas tenere non possent.—*Cicero.*

32. *To conduct yourself*, to act (with se, as, se agere) :—

Quanto ferocius ante se egerint, tanto cupidius insolitas voluptates hausisse.—*Tacitus.*

Agere gratias differs from referre gratias; the former signifies to feel gratitude, and the latter to manifest it. Observe that the plural gratias, not the singular gratiam, is used.

One or two conversational and idiomatic usages may be added :—

Quid agis, dulcissime rerum?—*Horace.*	Hoc agite!—*Plautus.*
How are you, my sweet fellow?	*Attend!*
Quid agitur?—*Plautus.*	Age, da veniam filiæ.—*Terence.*
How is it with you?	*Come, pardon thy daughter!*
	Age, sit ita factum!—*Cicero.*
	Well, be it so!

The instances given show that ago, like our own *do*, has the widest signification, and may be applied to almost any state of action, whether internal or external, whether of the mind or of the body. Herein it differs from facere, as our *make* differs from *do*; for facere is used in the particular sense of giving existence, form, or shape to some outward object. After the same manner it differs from gerere, which is applied to the conducting of anything, as the administration of a government.

KEY TO EXERCISES IN LESSONS IN LATIN.—XLI.

EXERCISE 155.—LATIN-ENGLISH.

1. It is known that the colonies of the Tyrians were spread throughout almost the entire circle of the lands. 2. Let us think that in death a haven and refuge have been prepared for us. 3. Whither I wish it were allowed me to be borne in full sail. 4. Hannibal was recalled from Italy to defend his native country. 5. Precepts profit nothing, as long as error is diffused over the mind. 6. We are all inflamed with a desire of living happily. 7. A great number of coins have been coined this year. 8. Grief lacerated, wasted, and entirely wore down my mind. 9. The letters of the epigram inscribed on the monument had been worn away by age. 10. The soldiers vigorously defended the city attacked by the enemies. 11. Formerly a vast

quantity of gold and silver was dug up in Spain. 12. The soldiers, seized with fury, stabbed their general. 13. The horse suddenly fell, and threw the consul off upon his head.

EXERCISE 156.—ENGLISH-LATIN.

1. Convertesne facultatem tuam dicendi ad patriæ perniciem? 2. Facultatem meam dicendi convertam ad omnium bonum. 3. Facultatem suam dicendi ad patriæ salutem conservationemque convertit. 4. Proditor deprehensus in conspectu civium necabitur. 5. Cave ne equus corruat, teque lapsum super caput effundat. 6. Militesne ducem confodient? 7. Hic liber vetustate exesus est. 8. Regina ingentem nummorum numerum procudet. 9. Nuntius animum meum laceravit. 10. Animus meus conspectu mortis mariti laceratus est. 11. Senes juvenesque vivendi cupiditate incendentur. 12. Non potes verum videre, quamdiu error tuæ menti offusus est. 13. In Italiam provectus est. 14. Ad illas provehentur oras. 15. Dux urbem fortiter defendit. 16. Urbs a civibus bene defendetur. 17. Britanniæ coloniæ toto orbe terrarum diffunduntur.

EXERCISE 157.—LATIN-ENGLISH.

1. It is necessary that you should both learn and confirm that which you have learnt by action. 2. Things ill-acquired depart ill. 3. As the swallows are present in the summer time, but retire driven off by the cold, so false friends are present in the prosperous period of life; but as soon as they see the winter of fortune, they all quickly depart. 4. It is uncertain what is about to happen. 5. What has fallen to the lot of each, that let each retain. 6. Alexander grieved that his old and guiltless friend Clitus had been killed by him. 7. To have faithfully learnt the liberal arts softens the manners (of men), and does not allow them to be barbarous. 8. Benefit attained through a friend does not gratify so much as the love itself of a friend. 9. Hannibal was not deceived (in thinking) that the enemy would carry on the affair more fiercely than advisedly. 10. From the time when money began to be in honour, the true honour of actions declined. 11. The ancient wood fell which no one cut down with iron. 12. Epaminondas is said to have played excellently on the lyre. 13. Cato narrates that the ancient Romans, at their feasts, sang the praises and virtues of illustrious men to the sound of the lute. 14. The signal is given to the companies, and the horns and trumpets have sounded.

EXERCISE 158.—ENGLISH-LATIN.

1. Gallina ovum pepĕrit. 2. Gallinæ ova pariunt. 3. Quot ova gallinæ tuæ in dies pariunt? 4. Mater tua filium pepĕrit. 5. Dux publicis ædificiis non parcet. 6. Miles, furore captus, ducem suum occīdit. 7. Putasne hostes ætate confectis parsuros esse? 8. Ignoro hostesne mulieribus infantibusque parsuri sint. 9. Induciæ viginti dierum pactæ cum hoste sunt. 10. Voces concinuerunt. 11. Signo dato, frater tuus cecĭnit ad fides clarorum virorum laudes. 12. Viginti millia militum nostrorum cæsa sunt.

EXERCISE 159.—LATIN-ENGLISH.

1. Take for granted that every day has shone upon you as the last. 2. The judges were so inflamed by the reply of Socrates that they condemned to death a most innocent man. 3. Reason, when it is grown up and perfected, is rightly named wisdom. 4. The question is, if a wise man has unknowingly received base for good coin, whether, when he has discovered it, he will pass it for good. 5. It is incredible to relate how easily the Romans and the aborigines have incorporated. 6. When money is coveted, and reason is not immediately applied to correct that desire, that evil enters the veins and clings to the vitals. 7. Endymion fell asleep, I know not when, on Latmus, a mountain in Caria, and has not yet awaked. 8. An orator should abstain from words which, on account of their age, have become obsolete. 9. Have you at length recovered from the disease under which you laboured so long? 10. My wound, which seemed to have already healed up, has now broken out afresh.

EXERCISE 160.—ENGLISH-LATIN.

1. Dies tibi illuxit supremus. 2. Dies fratri meo illuxitne supremus? 3. Stultis meis verbis pater exarsit. 4. Judices exardescere non debent. 5. Inter Romanos Carthaginesque terribile bellum exarsit. 6. Nostris hostibus omnia exoleverunt. 7. Illos adulterīnos nummos pro bonis accepisti? 8. Imprudens accepi. 9. Nunc id rescivi, nec eos pro bonis solvam. 10. Romani et aborigines brevi coaluerunt. 11. Endymion in monte obdormiscet. 12. In pulvino obdormivi. 13. Multa verba obsoleverunt, obsolescent multa verba. 14. Ardor meus non defervescet. 15. Vulnus recruduit. 16. Vulnera mea non consanuerunt. 17. Nescio an mei vulnera patris consanuerint.

RECREATIVE SCIENCE.—V.

THE REFLECTION OF LIGHT, AND DECEPTIONS WITH PLANE AND CONCAVE MIRRORS.—II.

THE decoration of the walls of dwelling-rooms is a matter of the greatest importance to those who have tasteful and elegant ideas, and like to see themselves surrounded with objects of beauty; and it is well known that with the best intentions, and the assistance of a well-filled purse, how frequently the effect of a room is destroyed by gaudily-framed engravings and oil-paintings that do not harmonise with the paper-hangings. There are very few, if any, optical contrivances which could be used for wall-decorations, and therefore the convex mirror becomes a special favourite, and is found hanging in many tastefully-decorated apartments. A room with a bow-window looking into a flower-garden, used perhaps as a library, and having only a plain paper on the walls, becomes enchanting when seen reflected in miniature within the frame of a circular convex mirror, which should have a plain oak frame with a few gilt stars upon it. Convex mirrors are spoilt by being mounted in shining gi frames; the reflection of the light from the glass is quite bri liant enough, and will make a room look light and cheerful tha might otherwise be condemned as a dull one. People often wonder why objects should be reduced when seen in a convex mirror; something has been done to explain this by Fig. 7 (page 249), and the next will demonstrate the manner in which the face of a person looking into a convex mirror is diminished.

One ray may be taken from the forehead (Fig. 8), and another from the chin—of course the rays reflected from the forehead and chin cover the whole of the mirror—but only a few can be reflected to the eye; thus the ray that falls at *c* enters the eye at *o*, which, transferring every image along that line in which it is reflected, sees the forehead in the line *o c n*; the same with the ray *a r* reflected to *o*, the line of vision will be *o r s*, and as the angle of vision is diminished, the face is reduced in size. The student may copy this diagram, and, by drawing other lines, try if any other rays can enter the eye

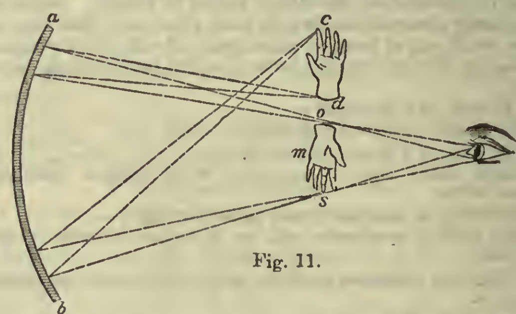


Fig. 11.

except those reflected from the part of the convex mirror included within *c r*.

The optical properties of a concave mirror are exactly the reverse of a convex one. The concave enlarges the appearance of objects. A small portion only of the surface of a convex mirror reflects at any one time to the eye the image presented before it, whilst a much larger surface of a concave mirror comes into use. This is well shown by the accompanying illustration (Fig. 9), reproduced from Walker's diagrams, published upwards of sixty years ago.

Rays issue from every part of the face upon all parts of the mirror, but it is only *a c* that can paint the forehead; that ray is reflected to the eye from *c*, and as everything is seen along that line in which the ray comes last to the eye, the mind puts the lines *a c* and *o c* together, and they make the line *o c d* the real distance which has been travelled by the ray from the forehead, and where the forehead will be seen; certainly rays issue from the forehead and all parts of the mirror, but then rays that fall on the mirror at *x* would be reflected to the chin uselessly, since, as the same author shrewdly observes, *we cannot see with the chin.* In short, it is only that particular place, *c*, which (by the law of the angle of incidence and reflection) can be reflected to the eye.

The ray from the chin that falls upon the mirror at *n*, will, by the same law, be reflected to the eye, and along the line *o n g* the chin is visible. The whole visage being seen under the angle *d o g*, must be greatly magnified.

The opposite properties of convex and concave mirrors are shown at once in Fig. 10, where the face of a man, A, looking into the convex surface of *a b* is reduced to that of a boy, and the face B, gazing into the concave surface, is enlarged to that of a giant.

Parallel rays converge to a focus when projected on to a concave mirror. If the hand is held before a concave mirror, and outside the focus, its inverted image is seen hanging in the air.

In Fig. 11 diverging rays proceeding from the hand *c d*, are made converging when they fall upon the mirror *a b*, and the inverted image is seen at *m*, the diverging rays *c d* being brought to a point at *o s*, where they cross and enter the eye.

It is in this manner that the concave mirror has been used, probably from the most ancient times, to produce illusory spectres, and by concealing the mirror, and illuminating the object properly, very amusing effects may be shown. Nearly every old work on optics gives a diagram and directions for using the concave mirror, of which Mr. Walker's is probably one of the best.

In Fig. 12 let *a* be the mirror, *d* the actor concealed by the cross partition, *c*, *e* a strong light, also concealed by the partition *i*. If *d* holds a book, or any other object, the light reflected from it will pass between the screens, or partitions, *c* and *i*, to the mirror, and be from thence reflected to *z*, where the image of the book will appear so tangible, that the spectator, looking through the opening *x*, will suppose he could take hold of it. The confederate, *d*, may actuate various moving figures, as flying birds, angels, demons, etc., the effects of which at *z* would be very surprising.

A concave mirror becomes a burning mirror when held in the sun. The heat at the focus is very powerful. It is not, however, supposed that this was the form of reflector used by Archimedes when he destroyed the fleet of Marcellus by concentrating the rays of the sun upon his ships. The celebrated Kircher went to Syracuse, and observed that the Roman ships could not have been at a less distance from the walls of the city than thirty-three paces; and, as the focus of a concave mirror is at the distance of half the radius, he calculated that the concave mirror used by Archimedes must have been a portion of a sphere of at least forty-six paces radius, and therefore most difficult, if not (in those days) impossible to construct. Vitellio states that Anthemius of Tralles, the engineer who lived in the time of the Emperor Justinian, was the first who proposed to make use of flat mirrors for burning. Hutton says the astonishing philosophico-military exploit of Archimedes has been recorded by Diodorus Siculus, Lucian, Dion, Zonaras, Galen, Anthemius, Tzetzes, and other ancient writers. The account of Tzetzes is so particular that it suggested to Father Kircher the specific method by which Archimedes effected his purpose. "*Archimedes*," says that author, "set fire to the fleet of Marcellus by a burning-glass, composed of small square mirrors, moving every way on hinges; and which, when placed in the sun's rays, reflected them on to the Roman fleet, so as to reduce it to ashes at the distance of a bow-shot." This account gained additional probability by the effect which Zonaras ascribes to the burning mirror of Proclus, by which he affirms that the fleet of Vitellius, when besieging Byzantium, now Constantinople, was utterly consumed. But perhaps no historical testimony could have gained belief to such extraordinary facts, if similar ones had not been seen in modern times. In the memoirs of the French Academy of Sciences for 1726, p. 172, we read of a plane mirror of twelve inches square reflecting the sun's rays to a concave mirror sixteen inches in diameter, in the focus of which bodies were burnt at the distance of 600 paces. The great naturalist Buffon constructed a burning apparatus by combining 168 pieces of looking-glass six inches by eight, so that he could, by mechanism connected with each, concentrate the rays of the sun to one focus; and by using 224 mirrors he was able to melt plates of silver at a distance of forty feet; with 112 mirrors he set fire to planks covered with wool at a distance of 138 feet; even with twelve mirrors combustibles could be inflamed at a distance of twenty feet.

It was with the concave mirror the ancients re-kindled the sacred fire, so carefully watched by the vestal virgins. Plutarch, in his life of Numa Pompilius, says that the instruments used for this purpose were dishes, which were placed opposite to the sun, and the combustible matter placed in the centre by which it is probable he meant the focus, conceiving that to be at the centre of the mirror's concavity.

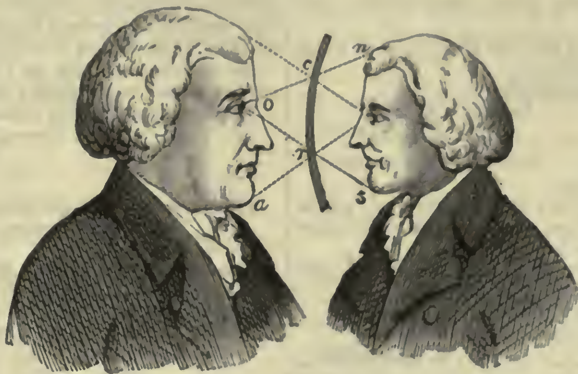


Fig. 8.

Fig. 10.

Fig. 9.

Fig. 12.

CORRESPONDENCE IN FRENCH.—VI.

22.—Letter in Reply to an Order for an Article which has been Sold.

Bremen, March 18th, 1882.

Messrs. Smith Brothers, London.

Gentlemen,—I regret extremely to have to inform you that the article in question has been sold to Mr. Barton, of your city. Perchance you might come to an understanding with him.

I have some pretty articles of a different kind (a list of which I subjoin) that might possibly suit you.

I am, Gentlemen,
Faithfully yours,
J. Lemaitre.

Bremen, le 18 *Mars* 1882.

Messieurs Smith Frères, à Londres.

Messieurs,—Je regrette infiniment de vous dire que l'article demandé a été vendu à M. Barton, de votre ville. Peut-être pourriez-vous vous entendre avec lui à cet effet.

J'ai de jolis objets d'un autre genre (dont je vous envoie une liste) qui, probablement, pourraient vous convenir.

Agréez, Messieurs,
l'assurance de ma parfaite considération,
J. Lemaitre.

23.—Letter Accompanying Invoice of Goods.

Cognac, May 10th, 1882.

Messrs. J. Ellison, Wine Merchants, London.

Gentlemen,—Agreeable to the order contained in yonr letter of the 15th of April, and in accordance with the prices and conditions laid down, I have bought for your account 20 tierces of brandy, 27 degrees, and forwarded them to your brother in Paris. Subjoined you will find the invoice amounting to:

30,760 fr., with which I debit you. In conformity with your wishes, I have drawn on your account, on Messrs. J. Lafitte of Paris, at three months, payable to my order, for the above amount.

I wrote to you on the subject of your account with me at length in my last, and have nothing more to add.

I remain, Sirs,
Your obedient servant,
Francis Martin.

Cognac, le 10 *Mai* 1882.

À Messieurs J. Ellison, Négociants en Vins, à Londres.

Messieurs,—En exécution de l'ordre contenu dans votre honorée du 15 Avril, j'ai acheté aux prix et conditions y fixés, pour votre compte, 20 tierçons eau-de-vie, 27 degrés, et je les ai expédiés à M. votre frère à Paris. Vous en trouverez ci-joint la facture s'élevant à:

30,760 francs, portés à votre débit. Pour me conformer à vos désirs, je viens de disposer pour votre compte, sur MM. J. Lafitte de Paris, une traite payable à mon ordre à trois mois pour la somme ci-dessus.

Je me suis étendu dans ma dernière au sujet de votre compte chez moi, et je n'ai rien à ajouter à mes observations.

J'ai l'honneur d'être, Messieurs,
Votre obéissant serviteur,
François Martin.

24.—Letter of Introduction, and of Credit.

Metz, January 15th, 1882.

Messrs. Armand Roubot & Co., London.

Gentlemen,—The bearer of this letter, Mons. F. Decretelle, of this city, is one of our oldest friends. He purposes visiting England, and we take the liberty of recommending him to your care.

Should M. Decretelle require some funds for travelling expenses, please to let him have all he wants, to the extent of £500, taking his draft on us at three days' sight. Subjoined we send you his signature.

If you can in any way further the ends for which he has undertaken this journey, we should feel greatly obliged.

We are at your service on similar occasions,
And remain, Gentlemen,
Yours truly,
Henry de la Tour and Son.

Metz, le 16 *Janvier* 1882.

Messieurs Armand Roubot et Cie, à Londres.

Messieurs,—Le porteur de cette lettre, Mons. F. Decretelle, de cette ville, est un de nos anciens amis. Il se propose de faire un voyage en Angleterre, et nous prenons la liberté de vous le recommander.

En cas où M. Decretelle aurait besoin de quelque argent pour ses dépenses de voyage, ayez la bonté de lui compter ce qu'il vous demandera, jusqu'à concurrence de £500 (nous disons cinq cents livres sterling) contre sa traite sur nous à trois jours de vue. Ci-joint nous vous donnons sa signature.

S'il vous est possible de l'aider à atteindre le but de son voyage, nous vous en serions très-reconnaissants.

Toujours dévoués à vos ordres en pareille occasion,
Nous vous saluons cordialement,
Henri de la Tour & Fils.

25.—Letter acknowledging Receipt and advising Payment of Bills.

Lyons, October 7th, 1881.

Messrs. Reilton, Sons & Co., Bradford.

Dear Sirs,—We duly received your favour of the 3rd inst. covering

fr.	200	per 12th	inst.	on St. Etienne.
,,	300	,, 15th	,,	
,,	1,200	,, 17th	,,	
,,	4,000	,, 19th	,,	
,,	375	,, 15th	,,	on Vienna.
,,	2,168	,, 14th	,,	on Grenoble.

with which we shall do the needful, placing the amounts to your credit under advice.

Please take note that the following bills have been duly paid:

fr.	700	25th	ultimo	on Grenoble.
,,	300	28th	,,	
,,	2,000	31st	,,	
,,	5,000	31st	,,	on St. Etienne.

which amounts we have placed to your credit.

Believe us, dear Sirs,
Yours truly,
M. Berthou & Co.

Lyon, le 7 *Octobre* 1881.

Messieurs Reilton Fils & Cie, à Bradford.

Chers Messieurs,—Nous avons bien reçu votre honorée du 3, couvrant

fr.	200	au 12	ct.	sur St. Étienne.
,,	300	,, 15	,,	
,,	1,200	,, 17	,,	
,,	4,000	,, 19	,,	
,,	375	,, 15	,,	sur Vienne.
,,	2,168	,, 14	,,	sur Grenoble.

dont nous soignerons le nécessaire à votre crédit sous avis.

Veuillez prendre note que les traites suivantes ont été dûment payées:

fr.	700	au 25	dernier	sur Grenoble.
,,	300	,, 28	,,	
,,	2,000	,, 31	,,	
,,	5,000	,, 31	,,	sur St. Étienne.

dont nous avons passé les montants à votre crédit.

Agréez, chers Messieurs,
nos salutations distinguées,
M. Berthou & Cie.

26.—Letter from an Agent advising Receipt of an Account, and his Operations therewith.

Paris, December 2nd, 1881.

To the Directors of the Western Banking Corporation (Limited), Manchester.

Gentlemen,—I have herewith the pleasure to inform you that I have this day received from Mr. Bernard the sum of fr. 250,000, which, according to your instructions, I have handed over to Messrs. Moullyn Bros., requesting them to remit it to you in short bills on London at the most favourable rate of exchange, or, if it should be more convenient to them, to transfer the above amount to your credit with one of their London correspondents.

I am, Gentlemen,
Your obedient servant,
Frederic Tourville.

Paris, le 2 Décembre 1881.

À Messieurs les Directeurs de la Western Banking Corporation (Limited), à Manchester.

Messieurs,—J'ai l'avantage de vous informer par la présente que j'ai reçu aujourd'hui de M. Bernard la somme de fr. 250,000, que, conformément à vos instructions, j'ai versée chez Messieurs Moullyn Frères, en les priant de vous la remettre en papier court sur Londres au meilleur change possible, ou, s'il entrait mieux dans la convenance de ces derniers, de faire transférer ce montant à votre crédit chez un de leurs correspondants de Londres.

Recevez, Messieurs, l'assurance
de ma parfaite estime,
FRÉDÉRIC TOURVILLE.

27.—LETTER REFUSING TO SUPPLY GOODS ON CREDIT.

London, January 17th, 1882.

Messrs. A. Perrin & Co., Paris.

In answer to your note, I beg to state that it is impossible for me to open any new accounts.

The price of the goods ordered is 570 francs.

If you will confirm the order, and, as is customary, accompany it by a bank-post bill on London, or a bill payable at sight on Paris, I will at once send the articles you desire to your agent.

Waiting your reply,
I have the honour to be,
Gentlemen,
Your obedient servant,
LEWIS PRATT.

Londres, le 17 Janvier 1882.

Messieurs A. Perrin & Cie, à Paris.

En réponse à votre lettre, j'ai l'honneur de vous informer que je ne puis ouvrir de nouveaux comptes.

Le prix des articles que vous me demandez est de 570 francs.

Si vous voulez bien m'en confirmer la demande, et l'accompagner comme d'usage de son solde en un mandat sur la banque de Londres ou un bon à vue sur Paris, je remettrai aussitôt chez votre commissionnaire les articles que vous désirez.

En attendant vos ordres,
J'ai l'honneur d'être,
Messieurs,
Votre obéissant serviteur
LEWIS PRATT.

28.—LETTER ACKNOWLEDGING RECEIPT OF REMITTANCES.

London, Jan. 23rd, 1882.

Messrs. Daniel Bros., Liverpool.

Gentlemen,—Your favour of the 7th inst. came duly to hand covering your remittances for

148 12 6 pro 18th February
225 6 0 „ 25th „
420 0 0 „ 5th March

£793 18 6 on London,

which we place to your credit under usual reserve.

We remain, Gentlemen,
Yours respectfully,
A. BROWNLOW & CO.

Londres, le 23 Janvier 1882.

Messieurs Daniel Frères, à Liverpool.

Messieurs,—Votre honorée en date du 7 courant nous est bien parvenue couvrant vos remises de

148 12 6 au 18 Février
225 6 0 „ 25 „
420 0 0 „ 5 Mars

£793 18 6 sur Londres,

que nous passons à votre crédit sous les réserves d'usage.

Recevez, Messieurs, nos salutations distiugnées,
A. BROWNLOW & CIE.

29.—LETTER ACKNOWLEDGING RECEIPT OF MONEY FROM AGENT.

Manchester. Dec. 12th, 1881.

Messrs. W. Carter & Co., Dublin.

Dear Sirs,—Without any of your favours to reply to, we herewith beg to inform you that we have to-day received from Messrs. Hawkes & Co., of your city, for your account, £4,200, which we place to your credit under to-morrow's date.

We are, dear Sirs,
Yours truly,
S. BARRETT & CO.

Manchester, 12 Décembre 1881.

Messieurs W. Carter et Cie, à Dublin.

Chers Messieurs,—Sans aucune des vôtres à répondre, nous avons l'avantage de vous informer par la présente que nous avons reçu aujourd'hui de Messieurs Hawkes et Cie, de votre ville, pour votre compte £4,200, que nous passons à votre crédit, valeur à demain.

Recevez, chers Messieurs,
Nos sincères salutations,
S. BARRETT & CIE.

30.—LETTER ABOUT NON-ACCEPTED BILLS.

Liverpool, Sept. 28th, 1881.

Messrs. Costenoble, Lewis & Co., San Francisco.

Gentlemen,—In answer to your favour of June the 26th, I return you the enclosed Bill on Smith Bros. of

Dollars 1,950, with the protest for non-acceptance, for the costs of which you will please to credit me with

Dollars 3.—I am in a similar position as yourselves, having also a bill in hand on the same Smith Bros. of

Dollars 1,428, drawn by Jones & Co. of your town, payable the 20th October, which he has also refused to accept, and which I enclose, with the protest, requesting you to exact a sufficient security from the drawers, and to inform me of the result. Begging you beforehand to excuse the trouble I am occasioning,

I have the honour to be, Gentlemen,
Your obedient servant,
LEWIS MARTIN.

Liverpool, le 28 Septembre 1881.

MM. Costenoble, Lewis et Cie, à San Francisco.

Messieurs,—En réponse à votre lettre du 26 Juin, je vous renvoie ci-inclus la lettre de change sur Smith Frères de

Doll. 1,950, avec son protêt, faute d'acceptation, dont il vous plaira de me créditer le coût de

Doll. 3.—Je suis dans le même cas que vous-mêmes, ayant aussi une lettre de change sur ces MM. Smith Frères de

Doll. 1,428, tirée par Jones et Cie, de votre ville, payable le 20 Octobre, dont il a aussi refusé l'acceptation, et que je vous envoie ci-incluse avec son protêt, en vous priant d'exiger une sûreté suffisante des tireurs et de m'informer du résultat. En vous demandant pardon d'avance de l'embarras que je vous cause,

J'ai l'honneur d'être, Messieurs,
Votre tout dévoué,
LEWIS MARTIN.

LESSONS IN ASTRONOMY.—V.

GENERAL APPEARANCE OF THE HEAVENS IN DIFFERENT LATITUDES—MERIDIAN—POLE STAR—GREAT AND LITTLE BEAR—PLANETS.

HAVING now given a brief sketch of the history of our science, and seen the way in which the most important discoveries in it have been effected, we must pass on to the more practical parts of the science. We shall, as may be expected, meet with a few difficulties as we advance, and there will be a few definitions and technical terms that it will be necessary for us to learn; but the tax thus imposed on the student will be no very heavy one, and the increasing interest which will be felt in the starry heavens will far more than make amends for any little trouble.

It is usually the best and simplest plan to acquire a general notion of the scope of any science before entering into its details—to know the problems which are proposed before we attempt their solution; and so it is best for us to become generally acquainted with some of the phenomena of the stars and planets before fully inquiring into the causes of those phenomena. To accomplish this, let the student on the first clear night seat himself at a window commanding an extensive view of the heavens; or, better still, let him go out in some place where his view of the sky is as extensive as possible, and watch for a short time the movements of the stars. If the night be dark and clear, comparatively few will at first be seen, as the pupil of the eye is contracted by the bright light of the room which has just been left. In a few minutes, however, the eye becomes accustomed to the light, and then the whole arch of heaven is seen to be thickly studded with stars. These differ very greatly in brightness and size, so that he will soon be able to fix on a few of the more conspicuous, and turn his main attention to them.

A compass should now be referred to, so as to ascertain the true north and south points, and an imaginary curve passing vertically overhead should be traced across the sky between these points. This line is called the *meridian;* and it will aid the student at first if some prominent objects, as, for instance, trees or buildings, can be fixed on to indicate permanently its position. Failing these, some poles may be placed in the ground. In observatories, one telescope is usually mounted on its axis in such a way that it can only be directed to parts of the sky bordering upon this line, and this is then known as the *transit instrument.* Its mode of construction and uses will be fully explained by-and-by.

If now the position of any bright star be noticed, as may be done by watching it against some fixed object, like the corner of a house or the trunk of a tree, we shall soon find that it appears to be in motion; and further observation will show that nearly all the stars appear to be similarly in motion, though the rates at which they travel seem to vary slightly.

Let us now face towards the south, and we shall soon see that the stars on our left hand—that is, towards the east—are rising higher and higher above the horizon; and if we could map out their courses, or imagine them to leave threads of light behind them, we should see that all these tracks would be arcs of circles, and would be parallel to one another.

These stars rise higher and higher till they come to the meridian, and here they are at their greatest elevation above the horizon. They then commence to descend towards the west, and it will be found that exactly the same time elapses between the rising of any star and its coming to the meridian that there is between this period and its setting in the west.

The point in the path of a star or planet on any given day which is most elevated above the horizon is called its *culminating point,* and this point is always on the meridian. Hence any of the heavenly bodies is said to culminate when it comes to the meridian of any place. The term *meridian* signifies mid-day, and the line is so called because, when the sun attains its greatest altitude and crosses the meridian of any place, it is mid-day there.

If now we look quite to the south, we shall find that the stars there only describe very small arcs, rising but a little way above the horizon, and setting again in a very short time not far from the same point, the highest altitude attained at any time not being more than a few degrees.

Now let us turn half round, so as to face the north instead of the south, and, as before, observe the stars. We shall soon be struck with the difference in the phenomena exhibited. We shall now see that some of the stars never set, but describe small circles, crossing the meridian twice in the course of the twenty-four hours. We cannot, however, trace them completely round their paths, as during a part of the time they are hidden from the naked eye by the brilliancy of the sun's light. Even by day, however, they may be seen with the aid of a good telescope, if the means are possessed of directing it to them. It is said, too, that at the bottom of a well or mine any bright stars which happen to be vertically over the mouth may be seen, and some have even seen stars during the day by looking up a chimney. In either case, the rays of the sun are to a great extent cut off by the walls or sides, and thus the faint light of the star reaches the eye. It is, of course, only the brighter stars that can be seen in this way, and as the number of stars of the first and second magnitudes visible at any one time does not exceed fifty, it will easily be understood that it will only be on rare occasions that these effects will be witnessed.

If now we look to a point on the meridian situated about fifty-one degrees above the horizon, or rather more than half-way from the horizon to the *zenith,* as the point directly over head is called, we shall find a star which appears not to move at all, but to remain constantly fixed in the same place, while all the others revolve around it. This star is called the *pole star,* and is well known, for before the discovery of the mariner's compass it was used by sailors as their guide, being situated due north. Very frequently, however, cloudy or dull weather would hide this star, sometimes for many days together, and hence they were unable to go far out of sight of land, and consequently navigation was but little practised in those days.

If the student does not know this star, it is important for him to find it at once, as it will be of great assistance to him in learning the names and positions of others. The difficulty which at first sight strikes us of learning the names of the constellations soon disappears if we become familiar with a few of the brighter ones, as by referring to them we shall soon be able to identify the rest. Further on in the course of these lessons we shall give illustrations of the position of the stars in the most important constellations. It will, however, be a great assistance to procure a complete set of maps of the stars, or, better still, a celestial globe; and a few hours' observation with the aid of either of these will soon enable us to find any star, or turn our attention to any part of the heavens which we may desire.

The constellation of the *Great Bear* (Ursa Major)—or, as it is sometimes called, *Charles' Wain,* or the *Plough*—is well known to most, it being a very conspicuous one, and one of those which never set in this latitude. There are a considerable number of stars in this constellation, but seven of them are especially bright, and are arranged as shown in the lower part of the accompanying figure. Four of them seem to form an irregular square, while the other three, situated in the tail of the Bear, are arranged in a curved line going from one of the corners of the square.

Careful examination on a clear night will show that the middle star of the tail is in reality double, consisting of two stars so close together as apparently almost to touch one another. They are called respectively Mizar and Alcor. A telescope reveals a similar fact with regard to the first star in the tail. We shall find as we further examine the sky many of these double stars, and a telescope often shows them to be of different colours, so that they are very beautiful objects.

The two stars in the quadrangle which are farthest from the tail are called "the Pointers," because, if a straight line be drawn on a map so as to join them, and then be prolonged to about five times the length, it will almost pass through the Pole Star, which is the star at the tip of the tail of the *Little Bear* (Ursa Minor). This constellation, which is shown in the upper part of the figure, is almost exactly the same shape as the one we have described, but it is turned in the opposite direction, and the stars in it are much fainter, the pole star being the brightest of them all.

We spoke of the pole star as remaining at rest; this is not, however, perfectly correct, as it is not situated exactly at the pole, but about one and a-half degrees from it, and hence it appears to describe a circle of about three degrees in diameter. This, however, is so small that it is only by the use of good instruments that we can ascertain the fact, and in ordinary use we may look upon the star as indicating the place of the pole or imaginary axis round which the whole starry concave appears to revolve.

As we shall have frequent occasion in our lessons to speak of degrees, it is as well for us to clearly understand at once what we mean by a degree, and the mode in which we may measure it. It is clearly necessary for us to have some means of measuring the apparent distances of the heavenly bodies from one another, and this can only be done by measuring the angle which imaginary lines drawn from them to our eyes subtend. If we think a moment, we shall see that it is in the same way that we form our estimate of the dimensions of ordinary objects around us, and hence, when we bring them nearer to the eye they appear larger, because the rays drawn from their extremes to the eye contain a larger angle. Now, we want some means of measuring and expressing in words the angle thus contained, and this we do by means of degrees and fractions of a degree.

A degree, then, is the 360th part of a circle—*i.e.,* if we draw a large circle on paper, and divide its circumference into 360 equal parts, and then draw straight lines from these divisions to the centre of the circle, the angle contained between any two adjacent lines will be just one degree. On any circle we can draw on paper these divisions will necessarily be very small; when, however, we deal with a globe of the size of the earth, we find that a degree at the equator measures about sixty-nine miles.

In a right angle there are, of course, ninety degrees, and if we make a triangle with three equal sides, each angle will contain just sixty degrees. A degree is divided into sixty parts, called *minutes;* each of these is divided into sixty parts, called *seconds;* and in more accurate observations each of these is again divided into sixty parts, which are called *thirds.* These divisions are usually expressed by the following signs—degrees (°), minutes (′), seconds (″), thirds (‴); thus—13° 28′ 5″ 12‴.

As a general guide to us in estimating approximately the distances of the stars, it will be useful to remember that the apparent diameter of the sun or moon is about half a degree, while the distance between the Pointers is about six degrees, and that between the pole and the Pointer nearer to it (Dubhe) is about twenty-four degrees. By means of a carefully graduated semicircle, we can easily measure any angle, and ascertain the number of degrees it contains.

We will not at present pursue our study of the constellations, but as soon as we have completed our general idea of the movements of the stars we will deal more particularly with those that are intimately associated with us as members of our system, and then return to consider the more remote stars.

As we continue to survey the heavens for several evenings, we shall soon discover that the stars remain in the same relative position with regard to one another. Just after the new moon, before its light is bright enough to obscure the light of the stars around it, we shall be able to observe its place among them. Let us carefully note this, and again examine the spot on the following evening. We shall now find that the moon seems to have been left behind by the stars, and instead of appearing in the same position as before, it is some twelve or thirteen degrees distant, and thus we learn that the moon has a motion independent of the rest of the stars.

On further observation, too, we shall detect one or two bright stars which in a similar way change their position, and hence are called *planets,* or wanderers (for such is the meaning of the word "planet"). Jupiter is the most conspicuous of these, and Venus—sometimes known as the Morning Star, and sometimes as the Evening Star, according to the time when it is visible—is another of them. These planets appear so bright on account of their comparative nearness to us; they are, however, very different from the fixed stars, as they do not shine by their own light, and are greatly inferior to them in point of size.

There is one other fact with regard to the general appearance of the sky which the student can likewise verify for himself. Having fixed upon any bright star, let him observe carefully on any evening the exact time of its passing the meridian, or of its disappearance behind some conspicuous object. Observe it again on the following evening, and again after the lapse of a few more days, and it will at once be found that the star is a little earlier every day in arriving at the place. Thus, if it be on the meridian at nine o'clock one day, it will be there about four minutes before nine on the next day, and so on.

It is owing to this that we see different constellations at different seasons of the year. Many of those which shine brightly on a winter's night are above the horizon in the summer during the daytime, and hence are invisible. In this way we see by far the larger portion of the stars at some time or other of the year; but just as those stars within about fifty degrees of the north pole never set to us, so those within a similar distance of the south pole never rise at all in our latitude, and hence are never seen.

This may easily be understood if the student possesses a celestial globe. He has only to elevate the north pole as many degrees above the horizon as his place of observation is north of the equator, and then, as he turns the globe on its axis, he will see that the circumpolar stars (as those round the north pole are called) are constantly above the horizon, while as he looks more towards the south pole, many only just rise for a short time and then set again, and those still nearer the pole will never appear above the horizon.

Among the most brilliant of the constellations thus hidden from us is the Southern Cross, and when travellers are going southward, the first appearance of this constellation is generally anxiously awaited. As the observer approaches the tropics, the pole star seems to sink lower and lower in the sky, and the number of stars which never set become less and less, till when he reaches the equator the pole is in the horizon, and *all* the stars are seen rising in the east, remaining visible exactly twelve hours, and then setting in the western horizon. They all appear likewise to travel in perfectly straight lines instead of in curves as they do in other latitudes, and hence the general appearance of the sky is very different from that seen in England.

Fig. 4.

By placing the artificial globe so that its axis is horizontal, and its pole in the horizon, we shall obtain a representation of these phenomena.

If now we could transfer ourselves to the poles, the whole scene would again vary. This has not yet been actually done, but some Arctic travellers have penetrated very nearly to the north pole, so that the movements of the stars as seen by them were almost exactly as we are about to describe.

No stars are now seen to rise or set, but all travel in circular paths parallel to the horizon around the pole star, which appears directly overhead. Hence it is clear that all the stars which are seen at any one time remain constantly visible, while one-half of the entire sky is constantly hidden from their view.

In a similar way, the changes of day and night, of such great importance to us, are unknown at the poles. At the commencement of their summer the sun is seen at first only partly elevated above the horizon, but travelling round to all parts of the sky in the twenty-four hours, while at the same time his altitude is slowly increasing; and thus he remains constantly visible for the space of six months, and then, for the remainder of the year, he never rises above the horizon. The year, therefore, consists of but a single day and night. The long night is however, greatly relieved by twilight, which continues about two months after the disappearance of the sun, and is seen a similar period before his rising. The Aurora Borealis or Northern Lights, likewise, is seen in great brilliancy.

The whole appearance of the Arctic sky is thus seen to be altogether different from that of ours. All these varied phenomena, however, will be found to admit of one simple explanation.

When we have thus been gazing on the stars and their ceaseless motions, many questions come crowding into the mind about their distances and sizes, the objects they serve, and the laws they obey. And then our thoughts go further still as we attempt to inquire what they are, and whether they, like our world, are inhabited. To some of these questions Astronomy furnishes the answers; and as to the rest, though it can give no direct information, it furnishes us with a number of facts on which we can base our speculations.

LESSONS IN ALGEBRA.—XXI.

BINOMIAL THEOREM.

189. To involve a *binomial* to a *high power* by actual multiplication is a *long* and *tedious process*. A much *easier* and *more expeditious* way to obtain the required power, is by means of what is called the *Binomial Theorem*. This ingenious and beautiful method was invented by Sir Isaac Newton, and was deemed of so great importance to mathematical investigation, that it was inscribed on his monument in Westminster Abbey.

To illustrate this thereon, let the pupil involve the binomial $a + b$, and the residual $a - b$, to the 2nd, 3rd, and 4th powers.

$$\begin{aligned} \text{Thus, } (a+b)^2 &= a^2 + 2ab + b^2. \\ (a+b)^3 &= a^3 + 3a^2b + 3ab^2 + b^3. \\ (a+b)^4 &= a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4. \\ \text{Also, } (a-b)^2 &= a^2 - 2ab + b^2. \\ (a-b)^3 &= a^3 - 3a^2b + 3ab^2 - b^3. \\ (a-b)^4 &= a^4 - 4a^3b + 6a^2b^2 - 4ab^3 + b^4. \end{aligned}$$

By a careful inspection of the several parts of the preceding operation, the following particulars will be observed to be applicable to each power, especially if carried out to a greater number of powers.

1. By counting the terms, it will be found that their *number* in each power, is *greater* by 1 than the *index* of that power; thus, in the 3rd power the number of terms is 4; in the 4th power it is 5, and so on.

2. If we examine the signs, we shall perceive, when both terms of the binomial are *positive*, that all the signs in every power are +; but when the quantity is a *residual*, all the *odd* terms, reckoning from the left, have the sign +, and all the *even* terms have the sign —. Thus in the 4th power, the signs of the *first*, *third*, and *fifth* terms are +, while those of the *second* and *fourth* are —.

3. As to the *indices*, it will be seen that the index of the first term, or the *leading quantity** in each power, always begins with the index of the *proposed power*, and *decreases* by 1 in each successive term towards the right, till we come to the last term, from which the letter itself is excluded. Thus in $(a + b)^4$ the indices of the leading quantity a are 4, 3, 2, 1.

4. The index of the *following* quantity begins with 1 in the second term, and *increases* regularly by 1 to the *last* term, whose index, like that of the first, is the index of the *required power*. Thus, in $(a + b)^4$ the indices of the following quantity b are 1, 2, 3, 4.

5. We also perceive that the sum of the indices is the *same* in *each* term of any given power; and this sum is equal to the *index* of that power. Thus, the sum of the indices in each of the terms of the 4th power is 4.

6. As to the *co-efficients* of the several terms, that of the *first* and *last* terms in each power is 1; the co-efficient of the *second* and *next* to the last terms is the *index* of the required power. Thus, in the 3rd power, the co-efficient of the second and next to the last terms is 3; and in the same terms in the 4th power, it is 4, etc.

It is to be observed, also, that the co-efficients *increase* in a regular manner through the *first half* of the terms, and then *decrease* at the same rate through the last half. Thus,

In the 4th power they are	1,	4,	6,	4,	1,		
In the 6th power they are	1,	6,	15,	20,	15,	6,	1.

7. The co-efficients of any two terms equally distant from the extremes, are *equal* to each other. Thus, in the 4th power, the second co-efficient from each extreme is 4; in the 6th power, the second co-efficient from each extreme is 6; and the third is 15.

8. The sum of all the co-efficients in each power is equal to the number 2 raised to that power. Thus, $(2)^4 = 16$; also, the sum of the co-efficients in the 4th power is 16, and $(2)^6 = 64$; so the sum of the co-efficients in the 6th power is 64.

190. If we involve *any other binomial, or residual, to any required power whatever*, we shall find the foregoing principles *true in all cases*, and applicable to all examples. Hence we may safely conclude that they are *universal principles*, and may be employed in raising all binomials to any required power. They are the *basis* or *elements* of what is called the *Binomial Theorem*.

The *Binomial Theorem* may be, therefore, defined *a general method of involving binomial quantities to any proposed power*. It is comprised in the following general rule:—

1. SIGNS.—*If both terms of the binomial have the sign +, all the signs in every power will be +; but if the given quantity is a residual, all the odd terms in each power, reckoning from the left, will have the sign +, and the even terms —*

2. INDICES.—*The index of the first term or leading quantity must always be the index of the required power; and this decreases regularly by 1 through the other terms. The index of the following quantity begins with 1 in the second term, and increases regularly by 1 through the others.*

3. CO-EFFICIENTS.—*The co-efficient of the first term is 1; that of the second is equal to the index of the power; and, universally, if the co-efficient of any term be multiplied by the index of the leading quantity in that term, and divided by the index of the following quantity increased by 1, it will give the co-efficient of the succeeding term.*

4. NUMBER OF TERMS.—*The number of terms will always be one greater than the power required.*

In algebraic characters, the theorem is expressed thus—

$$(a+b)^n = a^n + na^{n-1}b + n.\frac{n-1}{2}a^{n-2}b^2 + n.\frac{n-1}{2}.\frac{n-2}{3}a^{n-3}b^3 + \text{etc.}$$

It is here supposed that the *terms* of the binomial have no other co-efficients or exponents than 1; but other binomials may be reduced to this form by substitution.

EXAMPLES.

1. What is the 6th power of $x + y$

Here, the terms without the co-efficients are x^6, x^5y, x^4y^2, x^3y^3, x^2y^4, xy^5, y^6. And the co-efficients, by the rule, are

$$1,\ 6,\ \frac{6 \times 5}{2},\ \frac{15 \times 4}{3},\ \frac{20 \times 3}{4},\ 6,\ 1.$$

or $\quad 1,\ 6,\ 15,\ 20,\ 15,\ 6,\ 1.$

Now, prefixing these co-efficients to the several terms, and observing the rule of signs, we have the power required as follows:—

$$x^6 + 6x^5y + 15x^4y^2 + 20x^3y^3 + 15x^2y^4 + 6xy^5 + y^6. \quad \textit{Ans.}$$

2. What is the 5th power of $x^2 + 3y^2$?

Here, substituting a for x^2, and b for $3y^2$, we have $(a + b)^5 = a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4 + b^5$.

And restoring the values of a and b, we have $(x^2 + 3y^2)^5 = x^{10} + 15x^8y^2 + 90x^6y^4 + 270x^4y^6 + 405x^2y^8 + 243y^{10}$.

191. When one of the terms of a binomial is a *unit*, it is generally omitted in the power, except in the first or last term; because every power of 1 is 1; and this, when it is a factor, has no effect upon the quantity with which it is connected.

EXAMPLE.—Find the cube of $(x + 1)$. *Ans.* $x^3 + 3x^2 \times 1 + 3x \times 1^2 + 1^3$, or $x^3 + 3x^2 + 3x + 1$.

192. The insertion of the powers of 1 is of no use, unless it be to preserve the *exponents* of both the leading and the following quantity in each term, for the purpose of finding the co-efficients. But this will be unnecessary if we bear in mind that the *sum* of the two exponents in each term is equal to the index of the power. So that, if we have the exponent of the *leading* quantity, we may know that of the *following* quantity, and *vice versa*.

193. The binomial theorem may also be applied to quantities consisting of *more than two terms*. By substitution, several terms may be reduced to two; and when the compound expressions are restored, such of them as have exponents may be separately expanded.

EXAMPLE.—What is the cube of $a + b + c$?

Here, substituting h for $(b + c)$, we have $a + (b + c) = a + h$. And, by the theorem, $(a + h)^3 = a^3 + 3a^2h + 3ah^2 + h^3$.

Now, restoring the value of h, we have $(a + b + c)^3 = a^3 + 3a^2 \times (b + c) + 3a \times (b + c)^2 + (b + c)^3$.

The last two terms contain powers of $(b + c)$; but these may be separately involved, and the whole expanded.

194. Binomials, in which one of the terms is a fraction, may be involved by actual multiplication, or by reducing the given quantity to an improper fraction, and then involving the fraction. It may also be done by substitution.

* The first letter of a binomial is called the *leading* quantity, and the other the *following* quantity.

Examples.—Find the squares of $x + \frac{1}{2}$; and of $x - \frac{1}{2}$.

$$\begin{array}{ll} \text{Here, } x + \frac{1}{2} & \qquad \text{Also, } x - \frac{1}{2} \\ \underline{\quad x + \frac{1}{2}} & \qquad \underline{\quad x - \frac{1}{2}} \\ x^2 + \frac{1}{2}x & \qquad x^2 - \frac{1}{2}x \\ \underline{\quad + \frac{1}{2}x + \frac{1}{4}} & \qquad \underline{\quad - \frac{1}{2}x + \frac{1}{4}} \\ x^2 + x + \frac{1}{4} & \qquad x^2 - x + \frac{1}{4}. \end{array}$$

Otherwise, reducing the mixed quantities to improper fractions, we have $x + \frac{1}{2} = \frac{2x+1}{2}$; and $x - \frac{1}{2} = \frac{2x-1}{2}$. Whence, $\left(\frac{2x+1}{2}\right)^2 = \frac{4x^2+4x+1}{4}$; and $\left(\frac{2x-1}{2}\right)^2 = \frac{4x^2-4x+1}{4}$; or $x^2 + x + \frac{1}{4}$, and $x^2 - x + \frac{1}{4}$, as before.

Exercise 34.

1. What is the 5th power of $(d + h)$?
2. What is the nth power of $(b + y)$?
3. What is the 6th power of $(3x + 2y)$?
4. What is the 2nd power of $(a - b)$?
5. What is the 3rd power of $(a - b)$?
6. What is the 4th power of $(a - b)$?
7. What is the 6th power of $(x - y)$?
8. What is the nth power of $(a - b)$?
9. What is the 4th power of $(a - 1)$?
10. What is the 6th power of $(1 - y)$?
11. What is the nth power of $(1 + x)$?
12. Find the square of $a + \frac{2}{3}$.
13. Find the square of $x - \frac{b}{2}$.
14. Find the square of $-\frac{b}{m} + 3xy$.
15. Find the square of $-\frac{6}{7} + 2abc$.

Exercise 35.

1. Expand $(x + y)^3$.
2. Expand $(a + b)^4$.
3. Expand $(a - b)^6$.
4. Expand $(x + y)^3$.
5. Expand $(x - y)^6$.
6. Expand $(m + n)^7$.
7. Expand $(a + b)^8$.
8. Expand $(x + y)^{10}$.
9. Expand $(x - y)^{13}$.
10. Expand $(a - b)^7$.
11. Expand $(a + b)^5$.
12. Expand $(2 + x)^3$.
13. Expand $(a - bx + c)^3$.
14. Expand $(a + 3bc)^3$.
15. Expand $(2ab - x)^4$.
16. Expand $(4ab + 5c^2)^2$
17. Expand $(3x - 6y)^3$.
18. Expand $(5a + 3d)^3$.

KEY TO EXERCISES IN LESSONS IN ALGEBRA.

Exercise 31.

1. $27x^3$.
2. $256y^8$.
3. $128c^7$.
4. $b^3m^3x^3$.
5. $a^nd^ny^n$.
6. $d^4h^4y^4$.
7. $64b^3$.
8. $6^na^nd^n$.
9. $216m^3y^3$.
10. $a^{12}b^3$.
11. $64a^6x^3$.
12. $1296a^{12}x^8d^8$.
13. $(a + b)^{10}$.
14. $(a + b)^{3n}$.
15. $(x - y)^{mn}$.
16. $(x + y)^{2n}$.
17. a^6b^3.
18. $a^3b^3h^{12}$.

Exercise 32.

1. $\frac{1}{a^3}, \frac{1}{a^3}, \frac{1}{a^2}$.
2. $\frac{8x^3r^6}{27y^3}$.
3. $\frac{x^{3n}r^n}{a^ny^{mn}}$
4. $\frac{a^6(d + m)^2}{(x + 1)^6}$.
5. $a^2 - 2ab + b^2$.
6. $a^3 + 3a^2 + 3a + 1$.
7. $a^2 + 2ab + 2ah + b^2 + 2bh + h^2$.
8. $a^2 + 4ad + 6a + 4d^2 + 12d + 9$.
9. $b^4 + 8b^3 + 24b^2 + 32b + 16$.
10. $x^5 + 5x^4 + 10x^3 + 10x^2 + 5x + 1$.
11. $1 - 6b + 15b^2 - 20b^3 + 15b^4 - 6b^5 + b^6$.

Exercise 33.

1. $4a^2 + b^2 + 4ab$.
2. $h^2 + 1 + 2h$.
3. $a^2b^2 + c^2d^2 + 2abcd$.
4. $36y^2 + 9 + 36y$.
5. $9d^2 + h^2 - 6dh$.
6. $a^2 + 1 - 2a$.

MECHANICS.—XXIV.

IMPACT—CENTRIFUGAL FORCE—THE PENDULUM—CENTRE OF OSCILLATION.

When two bodies strike one another, they touch first in some one or more points, and the motion of these is usually communicated to the whole body. Thus, when a carpenter strikes a nail with his hammer, it only touches part of the head, but the momentum acquired by this part is shared by the whole. If, however, the blow be not true, the head alone may receive the motion, and fly off by itself, leaving the rest unmoved.

Sometimes, especially if the body struck be soft or brittle, and the velocity of the other be great, there is no time for the motion to be thus shared, and then the shape of the mass is altered, or the part struck flies off as a chip. A homely illustration of this is afforded by a simple experiment which all may try.

Balance a small piece of card on one of the fingers of the left hand, and lay a shilling on the top of it. By a sudden blow with the finger and thumb of the other hand the card may be jerked away without moving the shilling. Care must, however, be taken to strike the card exactly in the direction of its surface, as if it be tilted up or down the shilling will, of course, be jerked off. After a few trials, however, you may be pretty certain of success. The explanation is, that the motion of the card is so rapid that it has moved quite away before it has had time to communicate its motion to the shilling.

There are many other familiar examples of this, some of which verge on the marvellous.

If a bullet be fired at a door set half open, it will pass through the panel without shutting the door or moving it on its hinges. We may even go further, and, instead of a bullet, put a tallow candle into the gun and fire it at the door, it will be found to pass through instead of being smashed against it, as we should naturally expect. The velocity of the particles of tallow is so great that they have passed through the door before they have time to alter their relative position. So, if we fire a ball at a window, it will pass through the pane without cracking it, merely making a clean round hole. If, however, the bullet be nearly spent, or its velocity be not sufficiently great, the glass will be shivered to pieces.

This, too, explains why a good skater will glide swiftly over ice far too thin to sustain his weight. His motion is so rapid, that before the ice has time to yield he has passed on to another portion of it. We see, then, that a certain amount of time is required for any motion to be imparted from one body to another.

CENTRIFUGAL FORCE.

If a lump of metal or other heavy substance be fastened to a piece of string, and then swung round and round, we shall find that the string is stretched with a strain which varies in proportion to the speed with which the body revolves. This strain is called centrifugal force, and is merely one of the results of the first law of motion.

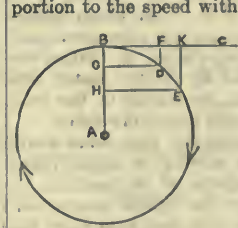


Fig. 104.

Let B (Fig. 104) represent a body revolving round a centre A, and confined by the string A B; its tendency at every instant is to continue in the same line in which it is travelling at that instant, that is, to fly off at a tangent, as along B C. We can easily prove that this is the case, for if, when whirling a sling, we suddenly cut the cord or leave the end free, the stone will fly off in a straight line.

Suppose D to be the point which the stone has reached at the end of one second, then B D will represent the space passed over, and therefore the velocity of B. This we can resolve into two parts, B F acting along the tangent B C, and B G acting along the direction of the cord. The former represents the velocity the stone has acquired, the latter is the force exerted by the string to keep it moving in a circle; this, therefore, represents the centrifugal force. We can thus easily see that the greater the velocity with which B moves, the greater will be the strain on the cord. If, for example, the velocity be so much increased that at the end of one second B is at E instead of D, the tension of the cord will be represented by B H instead of B G. As, however, this tension always acts in a direction at right angles to the motion of the body, no velocity is destroyed, the only alteration being in its direction.

We constantly meet with illustrations of the action of this force. A can filled with water may be swung round the head without a drop being spilt. When the can is at its highest point, and therefore mouth downwards, the water is attracted towards the earth; but this attraction is more than overcome by the centrifugal force, and hence it remains in the can as if it were a solid. So, too, when rapidly turning a corner or running round the inside of a ring, we lean inwards. The body has a tendency to move onwards in its previous direction, the feet are, however, compelled to move in another, and thus the head and body are thrown outward; to obviate this we lean in the contrary way. For the same reason, in a curve on a railway the inner rails are lower than the outer, so that the carriage inclines inwards, and thus removes the danger of its upsetting or tearing up the rails. A carriage is not unfrequently upset in this way while rapidly turning a corner.

If a glass of water be placed on a small whirling table so that it can be rapidly turned, the water will leave the centre and rise towards the edges; it may even be scattered over the sides if the rotation be rapid enough. The same effect is see if we rapidly stir a cup of tea, the level at the sides being above that at the centre.

A practical application of these principles is seen in the centrifugal drying machine. This consists of a large hollow cylinder, the bottom of which is perforated by a number of holes. The linen is put into this, and it is then made to rotate rapidly. In this way it is closely pressed against the sides, and the water is given off and runs away through the holes in the cylinder. Linen can thus be rendered almost dry in a very short space of time. Another useful application of this force is seen in the "governors" of a steam-engine. These consist of two heavy balls suspended by rods, and when the speed of the engine is increased beyond the proper degree they fly apart, and in so doing raise a loose collar below them, and by a series of levers partly close the throttle valve, and thus diminish the supply of steam.

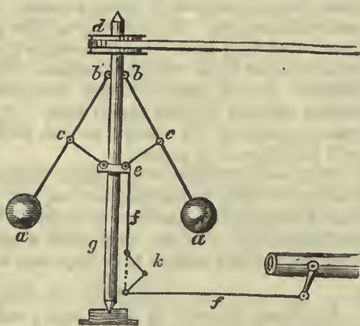


Fig. 105.

In Fig. 105 *a*, *a* represent the balls suspended by rods, which are hinged at *b* to the vertical shaft *g*. Motion is imparted to this by means of a strap, which passes round the shaft of the fly-wheel, or some other convenient part of the engine, and then round the driving-pulley, *d*. When the engine is moving too rapidly the balls fly further apart, and by so doing raise the runner, *e*. This, by means of the bent lever, *k*, works the rods, *f*, and thus partly closes the valve.

Were it not for some such arrangement as this, there would be great danger of the engine at times moving so rapidly, that the fly-wheel would from the momentum of its particles be shivered to pieces. These balls keep the speed nearly uniform; for if it diminishes much they fall, and thus open the throttle-valve to a greater extent and allow more steam to pass.

The laws of centrifugal force are important, because they help to explain the motions of the heavenly bodies. The planets, when first made, were started from the hand of their Creator with a certain velocity. This produces a constant tendency to fly off at a tangent from their orbits. They are, however, restrained by another force, and that is the universal attraction of all bodies for each other. Gravity is but one manifestation of this: the earth draws the small bodies to it merely on account of its superior weight, and for the same reason the sun attracts all the planets; or, to speak more accurately, all are attracted to the common centre of gravity of our own solar system, which is situated very near to the sun.

This attraction, then, constantly deflects the planets from the line in which they would otherwise move, and as a result of these two forces they describe ellipses, in one focus of which the sun is situated. As this motion is through space, and not through a resisting medium like the air, the retarding forces which diminish the motion of bodies near the earth do not affect them, and hence they move with undiminished speed. This speed, however, varies with their distance from the sun, and the following rule, discovered by Kepler, shows the relation that exists between the speed and the distance:—*The straight line drawn from the planet to the sun always describes equal areas in equal times.* This law partly depends on another, which teaches us that the attraction of any body for another diminishes with the square of the distance. If, for instance, we remove a body to double the distance, the attraction is $\frac{1}{4}$, if to three times the distance, it is only $\frac{1}{9}$, and so on. This is an experimental law, though by analogy with light we can easily see why it should be so. If we take a piece of board, and having cut out of it a piece a foot square, hold the board at any distance from a bright light, and place a screen behind it at twice the distance from the light, the illuminated space on the screen will measure 2 feet each way, or 4 feet in all. The light is thus spread over four times the area, and therefore the illumination at any point is only one-fourth as great.

Similarly, if the distance of the screen from the light be three times as great as that of the board, a space of 9 square feet will be illuminated, and each part will have one-ninth of the brilliancy.

From this we see that when a planet is in the part of its orbit most remote from the sun, it is attracted less powerfully, and therefore its velocity must be less than when nearer the sun, or else it would fly out of its path.

THE PENDULUM.

We must now notice this very important instrument, so valuable to us, not only as a regulating power for clocks, but also for calculating the force of gravity and its variations in different places.

A simple pendulum is one all the weight of which is collected at a single point. Such a one can, of course, only exist theoretically; but we may obtain a near approach to it by suspending a small ball of some heavy substance, as lead or platinum, by a very fine string.

A common pendulum is called *compound*, for the weight is divided throughout it, and it may therefore be considered as a number of simple pendulums connected together, so that all swing at the same rate. All are familiar with its action, but many do not know why it is used as a regulator.

When a pendulum hangs freely, *all its oscillations*, if not of wide extent, *occupy exactly the same time.* If the pendulum be made to swing in a cycloidal curve, instead of an arc of a circle, then from whatever part of the arc it falls it always takes exactly the same time. This remarkable property is called the isochronism of the pendulum, this term being derived from two Greek words, meaning "equal" and "time." Galileo was the first to discover this law, and it is said his attention was called to it by observing a chandelier in a cathedral. By some cause it had been set swinging, and he noticed that however long the arc, it appeared to swing in exactly the same time. He accordingly tried some experiments on his return home, and found that such was the case.

In Fig. 106 let O represent the point of suspension. When O C is vertical the force of gravity is exactly overcome by the tension of the cord, and thus the pendulum serves as a plumb-line, for if C be raised above the lowest point it will swing backwards and forwards till it settles at that point. Now raise C to A. The same two forces act upon it, namely, tension along A O and the force of gravity acting vertically downwards along A X. Produce O A to Y, and draw A Z a tangent to the arc. We can now resolve the force of gravity into two, acting along A Y and A Z. The former of these will be overcome by the tension of the string, the other part acting along A Z will cause the pendulum to move towards C. On arriving there it will have acquired a velocity which will carry it on over an arc nearly equal to C A, and thus it will continue to oscillate till its motion is stopped by the resistance it meets with. If we now draw a line through Y parallel to A Z, Y X will represent the portion of gravity which produces motion in the pendulum, and A Y that which produces tension in the cord; and it is clear that the smaller the arc A C, the less will Y X be, and therefore the less the velocity of the pendulum. This velocity is found to decrease in the same proportion of the

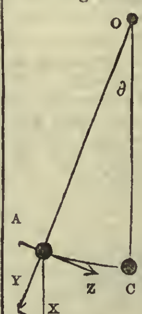


Fig. 106.

*

length of the arc, and this accounts for the vibrations occupying equal times.

Now as the force which moves the pendulum is the resolved part of gravity, it clearly increases or decreases with that force, and thus the vibrations afford us a means of measuring the force of gravity and comparing its power at different parts of the earth. At the equator it is least, the diameter there being greatest, and a part of the force, which is reckoned at $\frac{1}{289}$, being overcome by the centrifugal force produced by the earth's rotation. A pendulum will, therefore, make fewer vibrations there than it will as we move towards the poles. The times of oscillation vary, then, at different parts of the earth's surface.

We find, too, that the time of oscillation depends upon the length of the pendulum, a longer pendulum making less vibrations in any given time than a short one. The rule about this is as follows:—

The time of oscillation increases in the same ratio as the square root of the length of the pendulum.

If we take three pendulnms whose lengths are in the proportion of 1, 4, and 9—say, for example, 6 inches, 2 feet, and 4 feet 6 inches, respectively—we shall find that while the long one makes one vibration, that two feet long will make two, and the shortest, three. In the latitude of London, a pendulum to beat seconds mnst have a length of 39·13 inches; at the equator, the length must only be 39·01 inches.

In the compound pendulum all parts must swing at exactly the same rate; but by what we have seen, those nearer the point of suspension have a tendency to swing more rapidly, and thns to accelerate the motion of those below, while those at the extreme end exert just the contrary influence. Now there is evidently some point where the particles are as much retarded by those below as accelerated by those above, and this point mnst move at the same rate as if it were free. We might, in fact, have all the weight collected at this spot without altering in any degree the rate of oscillation.

This point is called the "centre of oscillation," and when we speak of a pendulnm of any length—as *e.g.*, 39·13 inches—we measure from this point to that of suspension. This centre of oscillation is always below the centre of gravity. However mnch we alter the weight of the pendulum, provided we make no difference in the position of this point, the time of oscillation remains exactly the same. The rate of vibration, then, is not at all affected by the nature or weight of the pendulum, but depends alone upon its length. We see, thus, the way in which we can regulate the speed; we can either raise the bob by means of a small nut, as is usually done, or we can have a smaller weight sliding on the rod, and raise or lower this. In either case, the effect produced is the same—the position of the centre of oscillation is moved, and thus the length altered. When the pendulum rod is made of metal, as it usually is, it varies in length with the alterations of temperature, being lengthened by heat and contracted by cold, and thns a source of irregularity is introduced which would be very objectionable. This difficulty is met by what is called the compensation pendnlnm. In one form of this the bob consists of a cnp of mercury. When the rod lengthens by the heat and lowers the centre of oscillation, the mercury expands and rises, and its bulk is so arranged that this expansion raises the centre in exactly the same degree as the expansion of the rod depresses it. In large church clocks the pendulum rod is frequently made of wood, and thus this difficulty is avoided.

Another compensating pendulnm is composed of parallel bars of brass and zinc, so arranged that by their joint alterations in length the position of the bob remains unaltered.

The balance wheel of a watch acts on the same principle as the pendulum, its vibrations being isochronous.

When a pendulnm is made to swing by itself it soon comes to rest; and even if every care be taken to remove the air and rednce the friction, it will not continne in motion more than abont twenty-fonr honrs. A maintaining force is therefore needed, when it is employed as a measurer of time. This is snpplied by the spring or weight of the clock. The pendnlum rod works in a fork which is attached to the anchor and pallets. These catch in the teeth of the escapement wheel, and allow it at each oscillation to move forward half a tooth, and then again stop it. The motion of the escapement wheel is thns at each stoppage transferred to the pendulum, and keeps it in vibration. A train of wheels connects this escapement with the hands.

We have now acquired a general acquaintance with the more important facts of Mechanics. The subject is far from exhausted, but we must leave you to follow it up in books specially devoted to it, or in the pages of "The Technical Edncator," the companion work to this. Our attention will now be turned to the other branches of Natural Philosophy, all of which are of great interest and importance. The next branch we shall take up is Hydrostatics, which has been claimed by many as a branch of Mechanics, but is more accurately considered as a separate science.

LESSONS IN GERMAN.—LI.

§ 8.—GENDER OF COMPOUNDS AND FOREIGN WORDS.

(1.) Compounds in general adopt the gender of their last component; as:—

Die Hofkirche (from Hof, court *or* yard, and Kirche, church), court church.

Der Kirchhof, the chnrchyard.

Der Eichbaum (from die Eiche, the oak, and der Baum, tree), the oak tree.

Die Windmühle (from der Wind, the wind, and die Mühle, mill), the windmill.

Das Rathhaus (from der Rath, council, and das Haus, house), the council-house.

(2.) Foreign words, for the most part, when taken into the German language, retain their original gender. Those, however, that have become fairly Germanised often take a different gender, as they take a different form; thus, *Corpus* (the body), which in Latin is *neuter*, becomes in German der Körper, which is *masculine*.

§ 9.—DERIVATION OF NOUNS.

(1.) To what has been already said (§ 2. [3]) concerning the derivation of nouns, we add here, before entering npon the subject of Declension, a brief view of the *secondary derivatives*, which are made by *significant* suffixes. For the sake of the learner we subjoin a list of the leading snffixes of this class; putting in brackets the equivalent English terminations, explaining severally their force and use, and illustrating the whole by suitable examples.

§ 10.—SUFFIXES USED IN FORMING NOUNS.

SUFFIXES.	ENGLISH EQUIVALENTS.	MEANING.
-er	[*er*, *ier* or *yer*, *zen*]	designates (*male*) *persons*; also *agents* or *instruments*.
-ing, or -ling	[*ling*, *aster*]	denotes (often *contemptuously*) *persons*, *animals*, and *things*.
-in	[*ess*, *ix*]	designates (*female*) *persons*.
-ei	[*y*, *ry*, *ary*, *ery*, *ory*]	indicates the *act*, *practice*, or *place of business*.
-ung	[*ing*, *ure*, *ion*]	signifies the *act* or the *continuing to act*.
-e	[*ness*, *ity*, *th*]	denote *qualities* or *attributes*
-heit	[*ness*, *ity*, *th*]	
-keit	[*ness*, *ity*, *th*]	
-schaft	[*ship*, *hood*, *ity*]	express *rank*, *grade*, *office*; also, a *number of things taken collectively*.
-thum	[*dom*, *hood*, *ity*]	
-sal	[*ude*, *cy*]	denote the *state* or *condition*; sometimes the *result*.
-sel	[*ude*, *cy*]	
-niß	[*ness*, *cy*]	
-chen	[*kin*, *ule*, *et*, *let*]	indicate *diminutiveness*.
-lein	[*kin*, *ule*, *et*, *let*]	

§ 11.—EXAMPLES.

SUFFIXES.	NOUNS.
-er	Sänger, a singer; Bürger, a citizen; Säger, a sawyer: Schneider, a tailor; Römer, a Roman; Leipziger, a resident of Leipzig; Wiener, a Viennese.
-ling	Häuptling, a captain; Flüchtling, a fugitive; Miethling, a hireling; Dichterling, a poetaster; Hänfling, a linnet Schößling, a shoot or sprig.

-in	Gräfin, a countess; Heldin, a heroine; Königin, a queen; Professorin, a professor's wife; Löwin, a lioness.
-ei	Dieberei, thievery; Heuchelei, hypocrisy; Fischerei, fishery; Brauerei, brewery.
-ung	Belehrung, teaching, *i.e.*, the *act* of teaching; Erbauung, the building, *or* erecting, edification; Krönung, the crowning, *or* coronation; Sitzung, the sitting, *or* session.
-e -heit -keit	Güte, goodness; Stärke, strength; Krankheit, sickness; Dummheit, stupidity; Heiligkeit, holiness; Feuchtigkeit, humidity.
-schaft -thum	Freundschaft, friendship; Priesterschaft, priesthood, that is, the *body* of the priests; Bereitschaft, readiness; Heidenthum, heathendom, heathenism; Christenthum, Christianity; Eigenthum, property.
-sal -sel -niß	Mühsal, the *state* of being in trouble, distress; Häcksel, that which has *resulted* from hacking and cutting, that is, cuttings (of straw); Bedürfniß, the *state* of being in want, necessity; Gleichniß, simile, parable.
-lein -chen	Büchlein, a *little* book; Knäblein, a *little* boy; Stühlchen, a *little* chair; Eichen, a *little* egg.

Appellatives derived from the names of places and countries have the termination er, as :—Der Londoner, the Londoner. Names of countries, like Sachsen, Saxony; Preußen, Prussia, etc., being originally the names of the people, not of the countries, cannot take er.

Nouns derived from the name of a city or town are often used indeclinably as adjectives; as :—Das Leipziger Bier, the Leipzig beer. Gen. Des Leipziger Biers, of the Leipzig beer.

(1.) It must be observed, in forming derivatives of the order illustrated above, that when a, o, u, or au, is contained in the radical part, it is modified into ä, ö, ü, or äu, upon receiving a suffix containing the vowel i or e; as:—Er, el, ling, in, ig, ing, chen lein, e, niß, and sel; as in the case of Hündin (from Hund), Bürger (from Burg), and others of the like kind.

(2.) Often, moreover, in forming secondary derivatives certain *euphonic* letters are inserted between the suffix and the word to which it is added; as, ig in Feuchtigkeit, humidity. Other letters employed in this way are en, n, and t. These euphonic parts are easily distinguished from those having an influence on the meaning, by merely resolving the derivative into its elements.

(3.) Here, too, may be noted the particle ge, which, being prefixed to certain primary words, form a class of nouns denoting either *frequency* of action, or a *collection* of things. These words, also, most commonly suffix the letter e; as :—Gerede, constant talk; Geheul, continuous howling; Gebirge, a range of mountains, etc.

§ 12.—DECLENSION OF COMMON NOUNS.

(1.) In German there are two declensions, distinguished as the *Old* and the *New*. The characteristic of each is the termination of the genitive singular. In the former, the genitive is formed from the nominative by adding es or s; when the genitive is otherwise formed, the noun is of the New Declension.

(2.) To the Old Declension belong almost all masculine and neuter nouns; that is, by far the greater part of all the nouns in the language.

(3.) In both declensions, the nominative, genitive, and accusative plural are alike in form; while the dative terminates always in the letter n. Unless, therefore, the word declined already ends in that letter, it is, in the dative, uniformly assumed.

(4.) All *feminine* nouns are invariable in the singular; in the plural, they are, for the most part, inflected according to the New Declension.

(5.) In compounds, the *last* word only is subjected to the variations of declension.

§ 13.—THE OLD DECLENSION.

TERMINATIONS.

	Singular.	*Plural.*
Nom.	-.	-e.
Gen.	-es *or* s.	-e.
Dat.	-e (*or like Nominative*).	-en.
Acc.	-.	-e.

In the genitive singular the e is frequently omitted before s, when the elision does not cause an unpleasant sound; as :—Des Königs, of the king; des Monats, of the month; des Jahrs, of the year. Also, the e of the dative is often dropped; as, dem König, to the king; and is never used when a preposition stands before the substantive without an article, pronoun, or adjective preceding; as :—Mit Beifall, with approbation; mit Sturm, by storm; mit Fleiß, on purpose; von Silber, of silver.

EXAMPLES.

	Singular.	*Plural.*
Nom.	Der Berg, the mountain.	Die Berge, the mountains.
Gen.	Des Berges, of the mountain.	Der Berge, of the mountains.
Dat.	Dem Berge, to the mountain.	Den Bergen, to the mountains.
Acc.	Den Berg, the mountain.	Die Berge, the mountains.

(1.) Some nouns of this declension take the letter r after e in all cases of the plural, and assume the Umlaut, if the radical vowel be capable of it. (Sect. II. 12. Ae, etc.)

EXAMPLES.

	Singular.	*Plural.*
Nom.	Das Dorf, the village.	Die Dörfer, the villages.
Gen.	Des Dorfes, of the village.	Der Dörfer, of the villages.
Dat.	Dem Dorfe, to the village.	Den Dörfern, to the villages.
Acc.	Das Dorf, the village.	Die Dörfer, the villages.
Nom.	Das Lied, the song.	Die Lieder, the songs.
Gen.	Des Liedes, of the song.	Der Lieder, of the songs.
Dat.	Dem Liede, to the song.	Den Liedern, to the songs.
Acc.	Das Lied, the song.	Die Lieder, the songs.

The nouns of this form (e+r) in the plural, among which are all substantives ending in thum (as, der Reichthum, riches), are for the most part neuters; as :—

Aas, carrion.	Gespenst, spectre.	Lied, song.
Amt, office.	Gewand, garment.	Loch, hole.
Bad, bath.	Glas, glass.	Mahl, meal.
Band, ribbon.	Glied, member.	Maul, mouth.
Bild, picture.	Grab, grave.	Nest, nest.
Blatt, leaf.	Gras, grass.	Pfand, pledge.
Brett, board.	Gut, good, estate.	Rad, wheel.
Buch, book.	Haupt, head.	Reis, twig.
Dach, roof.	Haus, house.	Rind, cattle.
Ding, thing (little).	Holz, wood.	Schild, sign-board.
Dorf, village.	Horn, horn.	Schloß, castle.
Ei, egg.	Huhn, hen.	Schwert, sword.
Fach, compartment.	Kalb, calf.	Thal, valley.
Faß, vat, tub.	Kind, child.	Tuch, cloth, shawl.
Feld, field.	Kleid, dress.	Volk, people.
Geld, money.	Korn, grain.	Wamms, doublet.
Gemach, apartment.	Kraut, herb.	Weib, woman.
Gemüth, mind.	Lamm, lamb.	Wort, word (in a dictionary).
Geschlecht, species.	Land, land.	
Gesicht, face.	Licht, light.	

The following nouns of this form are masculine :—

Bösewicht, villain	Mann, man.	Strauß, nosegay.
Dorn, thorn.	Mund, mouth.	Vormund, guardian.
Geist, spirit.	Ort, place.	Wald, forest.
Gott, God.	Rand, margin.	Wurm, worm.
Leib, body.		

(2.) Most nouns of this declension, whose radical vowel is a, o, u, or au, assume, in the plural, the Umlaut. Thus, Hand, Sohn, Buch, Haus, make their plurals as follows :—

EXAMPLES.

	Feminine.	*Masculine.*
Nom.	Die Hände, the hands.	Die Söhne, the sons.
Gen.	Der Hände, of the hands.	Der Söhne, of the sons.
Dat.	Den Händen, to the hands.	Den Söhnen, to the sons
Acc.	Die Hände, the hands.	Die Söhne, the sons.
	Neuter.	*Neuter.*
Nom.	Die Bücher, the books.	Die Häuser, the houses.
Gen.	Der Bücher, of the books.	Der Häuser, of the houses.
Dat.	Den Büchern, to the books.	Den Häusern, to the houses.
Acc.	Die Bücher, the books.	Die Häuser, the houses.

The words in which the Umlaut thus occurs are, chiefly—1, primitive nouns of the masculine gender; 2, feminines which have their plural in e, as also Mutter and Tochter; 3, neuter primitives having their plural in (e + r) er; 4, and lastly, nouns adding the diminutive terminations chen and lein.

(3.) Nouns ending in el, en, er, chen, and lein, reject the vowel e of inflection in all cases, both singular and plural; so that those in el and er merely affix s to the genitive singular and n to the dative plural, while those in en, chen, and lein assume nothing beyond the s in the genitive singular.

EXAMPLES.

	Singular.	*Plural.*
Nom.	Der Vogel, the bird.	Die Vögel, the birds.
Gen.	Des Vogels, of the bird.	Der Vögel, of the birds.
Dat.	Dem Vogel, to the bird.	Den Vögeln, to the birds.
Acc.	Den Vogel, the bird.	Die Vögel, the birds.
Nom.	Der Degen, the sword.	Die Degen, the swords.
Gen.	Des Degens, of the sword.	Der Degen, of the swords.
Dat.	Dem Degen, to the sword.	Den Degen, to the swords.
Acc.	Den Degen, the sword.	Die Degen, the swords.
Nom.	Der Bürger, the citizen.	Die Bürger, the citizens.
Gen.	Des Bürgers, of the citizen.	Der Bürger, of the citizens.
Dat.	Dem Bürger, to the citizen.	Den Bürgern, to the citizens.
Acc.	Den Bürger, the citizen.	Die Bürger, the citizens.
Nom.	Das Büchlein, the little book.	Die Büchlein, the little books.
Gen.	Des Büchleins, of the little book.	Der Büchlein, of the little books.
Dat.	Dem Büchlein, to the little book.	Den Büchlein, to the little books.
Acc.	Das Büchlein, the little book.	Die Büchlein, the little books.
Nom.	Das Söhnchen, the little son.	Die Söhnchen, the little sons.
Gen.	Des Söhnchens, of the little son.	Der Söhnchen, of the little sons.
Dat.	Dem Söhnchen, to the little son.	Den Söhnchen, to the little sons.
Acc.	Das Söhnchen, the little son.	Die Söhnchen, the little sons.

(4.) Some *feminine* nouns are, in the plural, varied according to this declension; especially those ending in the suffix niß.

EXAMPLES.

	Singular.	*Plural.*
Nom.	Die Maus, the mouse.	Die Mäuse, the mice.
Gen.	Der Maus, of the mouse.	Der Mäuse, of the mice.
Dat.	Der Maus, to the mouse.	Den Mäusen, to the mice.
Acc.	Die Maus, the mouse.	Die Mäuse, the mice.
Nom.	Die Kenntniß, the knowledge.	Die Kenntnisse.
Gen.	Der Kenntniß, of the knowledge.	Der Kenntnisse.
Dat.	Der Kenntniß, to the knowledge.	Den Kenntnissen.
Acc.	Die Kenntniß, the knowledge.	Die Kenntnisse.

To this class belong the nouns in the following list:—

Angst, anguish.	Hand, hand.	Nacht, night.
Armbrust, crossbow.	Haut, skin.	Nath, seam.
Ausflucht, evasion.	Kluft, gulf.	Noth, distress.
Art, axe.	Kraft, force.	Nuß, nut.
Bank, bench.	Kuh, cow.	Sau, sow.
Braut, bride.	Kunst, art.	Schnur, string.
Brust, breast.	Laus, louse.	Stadt, city.
Faust, fist.	Luft, air.	Wand, wall.
Frucht, fruit.	Lust, delight.	Wulst, pad.
Gans, goose.	Macht, power.	Wurst, sausage.
Geschwulst, swelling.	Magd, maidservant.	Zunft, guild.
Gruft, tomb.	Maus, mouse.	Zusammenkunft, meeting.

KEY TO EXERCISES IN LESSONS IN GERMAN.

EXERCISE 142 (Vol. III., page 90)

1. It was an agreeable hour, was it not, my friend? 2. Yes, that it was, and I shall not very soon forget it. 3. The neighbour was also at the feast, was he not? 4. Yes, he was there, and very merry. 5. It is surely very late, is it not? 6. No, it is still early. 7. It is not all true what people say, is it? 8. No, one cannot believe them in everything. 9. I have already waited an hour for him, and yet he does not make his appearance. 10. We are waiting for the waiter who is waiting upon us. 11. I will wait upon you this afternoon, if you please. 12. May I help you to a cup of tea or coffee? 13. I thank you for (your offer of) tea; but, if you please, I will take a cup of coffee. 14. The princes who were present at the coronation of the German emperors at Aix-la-Chapelle waited at table. 15. In vain have I called his attention to it; he only follows his own caprices. 16. The teacher reminded the scholars how admirably and excellently God has regulated everything in the world. 17. The judge in vain asked him why he had committed this crime; the accused had nothing to reply to it. 18. I have received the letter, but I do not know what reply to make to it. 19. I should know what to say if I were in your place. 20. The men of whom you are speaking are not exactly the best representatives of the country. 21. I allowed my tongue free play, and related the injustice that had been done to me. 22. He spoke freely, and, in his animation, said more than he should have done. 23. The accuser did not allow the accused to speak, but continued with his accusations without listening to the excuses. 24. The noise drowned the voice of the speaker, and did not allow him to be understood.

EXERCISE 143 (Vol. III., page 90).

1. Ihr Freund, welchen wir vorgestern sahen, ist krank, nicht wahr? 2. Es war ein angenehmer Abend, nicht wahr, mein Freund? 3. Ja, das war es, und nie werde ich das Vergnügen vergessen, welches wir hatten. 4. Nicht wahr, Ihr Herr Bruder war auch da? 5. Es ist noch früh, nicht wahr? 6. Nein, es ist sehr spät, und wir müssen gehen. 7. Ich habe schon eine Stunde auf meinen Freund gewartet, aber er ist noch nicht gekommen. 8. Ich warte auf unsern Diener. 9. Warten Sie nicht auf ihn, ich habe ihn soeben ausgeschickt. 10. Als ich in London ankam, ging ich gleich zu meinem Freunde, an welchen ich Empfehlungsbriefe hatte, und machte ihm meine Aufwartung. 11. Darf ich Ihnen mit einer Tasse Chocolate aufwarten? 12. Ich danke Ihnen. 13. Werden Sie uns nicht besuchen, ehe Sie nach dem Continente reisen? 14. Ja, ich werde Ihnen meine Aufwartung machen. 15. Darf ich Ihnen mit einem Glase Bier aufwarten? 16. Ich danke Ihnen, ich trinke nie Bier. 17. Ich habe die Neuigkeit gehört, weiß aber nicht, was ich dazu sagen soll. 18. Sie sprechen Französisch und Deutsch, nicht wahr?

EXERCISE 144 (Vol. III., page 90).

1. It grieves me to see so many people unhappy. 2. The wound pains him more and more every day. 3. Nothing grieves one more than to be mistaken by people whose love and esteem one wishes to obtain. 4. I am sorry that I have offended him. 5. Parting and avoiding gives pain, says an old German national song. 6. My head aches. 7. It grieves me to the heart not to be able to assist him. 8. What is the matter, my friend? why so sad? 9. Nothing ails me, except that I am a little out of humour. 10. Are you ill? 11. Yes, I am a little indisposed. 12. What ails you? 13. I have a head-ache. 14. You are rich and respected, and yet you are dejected; what ails you? 15. I am in want of much "contentment and tranquillity of mind." 16. All my friends who had promised to come were there, one alone excepted. 17. All men are subject to commit errors (literally, all men fail). 18. My brother missed the way again; instead of coming into my house, he went into that of my neighbour. 19. He repented of his words, and promised that he would never say so again. 20. When this happened, I was not at home. 21. This quarrel took place near to my dwelling. 22. I have only to add little to what has been already said. 23. She sent a short letter with this present. 24. He did me this mischief intentionally, therefore I cannot pardon him.

EXERCISE 145 (Vol. III., page 91).

1. Es schmerzt einen Vater, von der Gottlosigkeit seines Sohnes zu hören. 2. Nichts schmerzt mehr, als unschuldig angeklagt zu sein. 3. Es schmerzt mich, daß man so viele Menschen gefunden hat, die durch den letzten Sturm umgekommen sind. 4. Es thut mir leid, daß Sie mich nicht zu Hause gefunden haben. 5. Die Wunde, welche der Soldat in dem Streite erhielt, schmerzt ihn. 6. Was fehlt Ihnen, mein Freund? 7. O! nichts besonderes. 8. Sie sehen sehr krank aus, was fehlt Ihnen? 9. Ich bin nicht wohl, ich habe mir weh gethan. 10. Er ist aus dem Fenster gefallen. 11. Es fehlt diesem Knaben an Verstand. 12. Sie sind von mir beleidigt worden; es thut mir leid, denn ich achte Sie sehr. 13. Es darf Ihnen nicht an Muth fehlen, um dem Streite mit Ihrem Feinde entgegen zu gehen. 14. Es fehlt mir an Geduld, den Erfolg dieser Sache abzuwarten.

EXERCISE 146 (Vol. III., page 91).

1. Since I arrived here, many things have occurred already. 2. Since he committed this deed, all peace seems to have forsaken him. 3. From the time he left, I have not had a thoroughly happy hour. 4. Since this time one has heard nothing of him. 5. I left my parental house at ten years of age. 6. I have not felt myself quite well since yesterday. 7. Since the death of his parents he has been roving in foreign lands, destitute of home. 8. Since he has become conscious of himself, he is quite a different person. 9. He dressed himself with all haste. 10. In his hurry he forgot to put on his boots, and ran off in his slippers. 11. His clothes were wet through, consequently he was obliged to change his dress. 12. This morning he did not put on his hat, but his cap. 13. The servant did not as usual help his master to put on his cloak, but the latter put it on himself. 14. Do not forget to put on your cloak; it is very cold and stormy. 15. Please put on my cloak and hat, as I have already got my thick fur gloves on. 16. He climbed up the highest tree, that he might be able to see the king. 17. He was in great haste, that he might not miss the starting of the

stage-coach. 18. He told me this, that it might be an example to me. 19. The scholar excused himself by saying, that he had had no time to learn his exercise. 20. In great states hundreds must starve, in order that one may gormandise and revel: tens of thousands are oppressed and hunted to death, that one crowned fool or philosopher may gratify his whims.

LESSONS IN FRENCH.—LX.

§ 48.—PARADIGMS OF THE AUXILIARY VERBS (*continued*).

(3.) AVOIR, *TO HAVE*,—INTERROGATIVELY.

INDICATIVE MOOD.

SIMPLE TENSES. COMPOUND TENSES.

PRESENT.		PAST INDEFINITE.		
Ai-je?	*have I?*	Ai-je eu?	*have I*	
As-tu?	*hast thou?*	As-tu eu?	*hast thou*	
A-t-il?*	*has he?*	A-t-il eu?	*has he*	
A-t-on?*	*has one?*	A-t-on eu?	*has one*	*had?*
Avons-nous?	*have we?*	Avons-nous eu	*have we*	
Avez-vous?	*have you?*	Avez-vous eu?	*have you*	
Ont-ils?	*have they?*	Ont-ils eu?	*have they*	

IMPERFECT.		PLUPERFECT.		
Avais-je?	*had I?*	Avais-je eu?	*had I*	
Avais-tu?	*hadst thou?*	Avais-tu eu?	*hadst thou*	
Avait-il?	*had he?*	Avait-il eu?	*had he*	
Avait-on?	*had one?*	Avait-on eu?	*had one*	*had?*
Avions-nous?	*had we?*	Avions-nous eu?	*had we*	
Aviez-vous?	*had you?*	Aviez-vous eu?	*had you*	
Avaient-ils?	*had they?*	Avaient-ils eu?	*had they*	

PAST DEFINITE.		PAST ANTERIOR.		
Eus-je?	*had I?*	Eus-je eu?	*had I*	
Eus-tu?	*hadst thou?*	Eus-tu eu?	*hadst thou*	
Eut-il?	*had he?*	Eut-il eu?	*had he*	
Eut-on?	*had one?*	Eut-on eu?	*had one*	*had?*
Eûmes-nous?	*had we?*	Eûmes-nous eu?	*had we*	
Eûtes-vous?	*had you?*	Eûtes-vous eu?	*had you*	
Eurent-ils?	*had they?*	Eurent-ils eu?	*had they*	

FUTURE.		FUTURE ANTERIOR.		
Aurai-je?	*shall I have?*	Aurai-je eu?	*shall I*	
Auras-tu?	*wilt thou have?*	Auras-tu eu?	*wilt thou*	
Aura-t-il?	*will he have?*	Aura-t-il eu?	*will he*	
Aura-t-on?	*will one have?*	Aura-t-on eu?	*will one*	*have had?*
Aurons-nous?	*shall we have?*	Aurons-nous eu?	*shall we*	
Aurez-vous?	*will you have?*	Aurez-vous eu?	*will you*	
Auront-ils?	*will they have?*	Auront-ils eu?	*will they*	

CONDITIONAL MOOD.

PRESENT.		PAST.		
Aurais-je?	*should I have?*	Aurais-je eu?	*should I*	
Aurais-tu?	*wouldst thou have?*	Aurais-tu eu?	*wouldst thou*	
Aurait-il?	*would he have?*	Aurait-il eu?	*would he*	
Aurait-on?	*would one have?*	Aurait-on eu?	*would one*	*have had?*
Aurions-nous?	*should we have?*	Aurions-nous eu?	*should we*	
Auriez-vous?	*would you have?*	Auriez-vous eu?	*would you*	
Auraient-ils?	*would they have?*	Auraient-ils eu?	*would they*	

(4.) AVOIR, *TO HAVE*,—NEGATIVELY AND INTERROGATIVELY.

INDICATIVE MOOD.

SIMPLE TENSES. COMPOUND TENSES.

PRESENT.		PAST INDEFINITE.		
N'ai-je pas?	*have I not?*	N'ai-je pas eu?	*have I*	
N'as-tu pas?	*hast thou not?*	N'as-tu pas eu?	*hast thou*	
N'a-t-il pas?	*has he not?*	N'a-t-il pas eu?	*has he*	
N'a-t-on pas?	*has one not?*	N'a-t-on pas eu?	*has one*	*not had?*
N'avons-nous pas?	*have we not?*	N'avons-nous pas eu?	*have we*	
N'avez-vous pas?	*have you not?*	N'avez-vous pas eu?	*have you*	
N'ont-ils pas?	*have they not?*	N'ont-ils pas eu?	*have they*	

IMPERFECT.		PLUPERFECT.		
N'avais-je pas?	*had I not?*	N'avais-je pas eu?	*had I*	
N'avais-tu pas?	*hadst thou not?*	N'avais-tu pas eu?	*hadst thou*	
N'avait-il pas?	*had he not?*	N'avait-il pas eu?	*had he*	
N'avait-on pas?	*had one not?*	N'avait-on pas eu?	*had one*	*not had?*
N'avions-nous pas?	*had we not?*	N'avions-nous pas eu?	*had we*	
N'aviez-vous pas?	*had you not?*	N'aviez-vous pas eu?	*had you*	
N'avaient-ils pas?	*had they not?*	N'avaient-ils pas eu?	*had they*	

* See Sect. 2 (6).

PAST DEFINITE.		PAST ANTERIOR.		
N'eus-je pas?	*had I not?*	N'eus-je pas eu?	*had I*	
N'eus-tu pas?	*hadst thou not?*	N'eus-tu pas eu?	*hadst thou*	
N'eut-il pas?	*had he not?*	N'eut-il pas eu?	*had he*	
N'eut-on pas?	*had one not?*	N'eut-on pas eu?	*had one*	*not had?*
N'eûmes-nous pas?	*had we not?*	N'eûmes-nous pas eu?	*had we*	
N'eûtes-vous pas?	*had you not?*	N'eûtes-vous pas eu?	*had you*	
N'eurent-ils pas?	*had they not?*	N'eurent-ils pas eu?	*had they*	

FUTURE.			FUTURE ANTERIOR.		
N'aurai-je pas?	*shall I*		N'aurai-je pas eu?	*shall I*	
N'auras-tu pas?	*wilt thou*		N'auras-tu pas eu?	*wilt thou*	
N'aura-t-il pas?	*will he*		N'aura-t-il pas eu?	*will he*	
N'aura-t-on pas?	*will one*	*not have?*	N'aura-t-on pas eu?	*will one*	*not have had?*
N'aurons-nous pas?	*shall we*		N'aurons-nous pas eu?	*shall we*	
N'aurez-vous pas?	*will you*		N'aurez-vous pas eu?	*will you*	
N'auront-ils pas?	*will they*		N'auront-ils pas eu?	*will they*	

CONDITIONAL MOOD.

PRESENT.			PAST.		
N'aurais-je pas?	*should I*		N'aurais-je pas eu?	*should I*	
N'aurais-tu pas?	*wouldst thou*		N'aurais-tu pas eu?	*wouldst thou*	
N'aurait-il pas?	*would he*		N'aurait-il pas eu?	*would he*	
N'aurait-on pas?	*would one*		N'aurait-on pas eu?	*would one*	
N'aurions-nous pas?	*should we*	*not have?*	N'aurions-nous pas eu?	*should we*	*not have had?*
N'auriez-vous pas?	*would you*		N'auriez-vous pas eu?	*would you*	
N'auraient-ils pas?	*would they*		N'auraient-ils pas eu?	*would they*	

(5.) ÊTRE, *TO BE*,—AFFIRMATIVELY.

INFINITIVE MOOD.

PRESENT.		PAST.	
Être,	*to be.*	Avoir été,	*to have been.*

PARTICIPLES.

PRESENT.		COMPOUND.	
Étant,	*being.*	Ayant été,	*having been.*

PAST.

Été, *been.*

INDICATIVE MOOD.

SIMPLE TENSES. COMPOUND TENSES.

PRESENT.		PAST INDEFINITE.	
Je suis,	*I am.*	J'ai été,	*I have been.*
Tu es,	*thou art.*	Tu as été,	*thou hast been.*
Il est,	*he is.*	Il a été,	*he has been.*
On est,	*one is.*	On a été,	*one has been.*
Nous sommes,	*we are.*	Nous avons été,	*we have been.*
Vous êtes,	*ye* or *you are.*	Vous avez été,	*you have been.*
Ils sont,	*they are.*	Ils ont été,	*they have been.*

IMPERFECT.		PLUPERFECT.	
J'étais,	*I was* or *used to be.*	J'avais été,	*I had been.*
Tu étais,	*thou wast.*	Tu avais été,	*thou hadst been.*
Il était,	*he was.*	Il avait été,	*he had been.*
On était,	*one was.*	On avait été,	*one had been.*
Nous étions,	*we were.*	Nous avions été,	*we had been.*
Vous étiez,	*you were.*	Vous aviez été,	*you had been.*
Ils étaient,	*they were.*	Ils avaient été,	*they had been.*

PAST INDEFINITE.		PAST ANTERIOR.	
Je fus,	*I was.*	J'eus été,	*I had been.*
Tu fus,	*thou wast.*	Tu eus été,	*thou hadst been.*
Il fut,	*he was.*	Il eut été,	*he had been.*
On fut,	*one was.*	On eut été,	*one had been.*
Nous fûmes,	*we were.*	Nous eûmes été,	*we had been.*
Vous fûtes,	*you were.*	Vous eûtes été,	*you had been.*
Ils furent,	*they were.*	Ils eurent été,	*they had been.*

FUTURE.		FUTURE ANTERIOR.		
Je serai,	*I shall be.*	J'aurai été,	*I shall*	
Tu seras,	*thou wilt be.*	Tu auras été,	*thou wilt*	
Il sera,	*he will be.*	Il aura été,	*he will*	
On sera,	*one will be.*	On aura été,	*one will*	*have been.*
Nous serons,	*we shall be.*	Nous aurons été,	*we shall*	
Vous serez,	*you will be.*	Vous aurez été,	*you will*	
Ils seront,	*they will be.*	Ils auront été,	*they will*	

CONDITIONAL MOOD.

PRESENT.		PAST.		
Je serais,	*I should be.*	J'aurais été,	*I should*	
Tu serais,	*thou wouldst be.*	Tu aurais été,	*thou wouldst*	
Il serait,	*he would be.*	Il aurait été,	*he would*	
On serait,	*one would be.*	On aurait été,	*one would*	*have been.*
Nous serions,	*we should be.*	Nous aurions été,	*we should*	
Vous seriez,	*you would be.*	Vous auriez été,	*you would*	
Ils seraient,	*they would be.*	Ils auraient été,	*they would*	

*

NATURAL HISTORY OF COMMERCE.

CHAPTER III. (*continued*).

THE EFFECTS OF GEOLOGY ON THE INDUSTRY OF THE BRITISH PEOPLE (*continued*).

Relation of Geology to Agriculture (*continued*)—Influence of certain Constituents of Rocks on the Growth of Plants—Inorganic Matter in various species of Plants—Comparison between other Countries and parts of Great Britain—General Summary of Minerals and Metals exported and produced in 1867.

Influence of certain Constituents of Rocks on the Growth of Plants.

Rocks may be viewed under a threefold aspect—siliceous, argillaceous, and calcareous. Siliceous rocks of soft nature produce light soils, which are the least productive; whilst the hard, intractable grits form little soil, because they are difficult to decompose, and that little is to a great extent barren. The slaty rocks present the same superficial aspects as those of the hard grits; but the soft argillaceous soils, from their power of retaining water, are heavy, and are usually laid out into permanent pasture-lands. The pure calcareous strata, as chalk, though forming soils ranking amongst our richest, are not to be compared with those resulting from the disintegration of the less pure.

(*a*) *Inorganic Constituents of Plants.*

A plant is compounded of two sets of constituents, the organic and inorganic; the former is derived from water and the atmosphere, whilst the latter is obtained from the soil. Now the quantity of inorganic food required by different vegetables is greater or less according to their nature; and if a soil be of such a kind that it can yield only a small quantity of this inorganic food, then those plants only will grow well upon it for which this small supply will prove sufficient. Thus trees may grow where arable crops often fail to thrive, because many of the former require and contain comparatively little inorganic matter.

TABLE OF THE PROPORTION OF INORGANIC MATTER IN 1,000 LBS. OF THE FOLLOWING SUBSTANCES.

	lbs.		lbs.		lbs.
Wheat, about	20	Oak Wood	2	Peas	50
Oats	40	Pine Wood	1½ to 3	Turnips	5 to 8
Barley	30	Wheat Straw	50	Ash Wood	1 to 6
Beans	30	Oat ,,	60	Elm Wood	19
Clover	90	Barley ,,	50	Elm Leaves	100

Meadow Hay, 50 to 100 lbs.

From the above table it appears that the quantity of inorganic matter varies in different parts of the same plants—as for example, the straw of our crops contains more ash than the grain. In trees and plants the leaves are richer in inorganic matter than the wood or stalk.

The quality of the ashes of plants varies with the same conditions by which its quantity is affected. The more commonly occurring mineral substances in them are—phosphates of lime, soda, potash, and magnesia; carbonates of soda and lime; chlorides of potassium and sodium; sulphates of soda and potash; iron and silica.

TABLE OF THE QUANTITY OF INORGANIC MATTER IN VARIOUS SPECIES OF PLANTS.

	Wheat.	Barley.	Oats.	Rye.	Indian Corn.	Beans.	Linseed.	Potato.	Turnip.
Potash	237	136	262	220	325 (Potash and Soda)	336	245	557	419
Soda	91	81	—	116		106	34	19	51
Lime	28	26	60	49	14	58	147	20	136
Magnesia	120	75	100	103	162	80	99	53	53
Oxide of Iron	7	15	4	13	3	6	19	5	13
Phosphoric Acid	500	390	438	495	449	380	381	126	76
Sulphuric Acid	3	1	105	9	28	10	9	136	136
Silica	12	273	27	4	14	12	57	42	79
Chlorine	—	tr.	3	—	2	7	3	42	36
	998	997	999	1009	997	995	994	1000	999

We conclude from the foregoing that a crop of wheat will extract from the soil certain ingredients, while beans and potatoes will extract others. Hence a piece of land may suit one kind of crop, and not another. Hence, also, two successive crops of different kinds may grow well where it would greatly injure the soil to take two in succession of the same kind. It is also evident from the above table that the cereals contain phosphates, and that there is much potash in potatoes and turnips; while beans, and most leguminous plants, contain lime.

As the straw of cereal plants contains comparatively little of some of the ingredients found in the ear, such as lime, magnesia, and phosphoric acid—the straw and husk being especially rich in silica—so the roots may in certain plants and in certain soils succeed in fully nourishing the straw, while they cannot fructify the ear; or the very reverse of this may occur.

(*b.*) *Sources of the Inorganic Constituents of Plants and the Agricultural Capabilities of Soils derived from various Geological Epochs.*

As the inorganic compounds are derived from the soil or from manure supplied to it, the adaptation of certain crops to given land will be dependent upon the chemical composition of the rock from which the soil is derived. Soils derived from rocks devoid of phosphates cannot produce cereals, whilst soils derived from the decomposition of rocks that contain the inorganic constituents of cereals are necessarily the best adapted for the growth of such crops.

Dr. Daubeny experimented upon the relative amount of phosphoric acid obtained from barley sown in pulverised samples of various strata of different geological epochs, and he found that whatever the age of the rock might be, provided it belonged to a series in which organic remains were present, phosphoric acid was one of the constituents of the rock. On the other hand, phosphoric acid was absent in certain slates which lie below the oldest rocks in which organic remains have been detected—such, for instance, as those of Nant Francon, Llanberis, near Bangor, to the north of Dolgelly; schist taken from the foot of Snowdon; mica-schist from Loch Lomond; and certain specimens from the Longmynd Mountains.

The reclamation of those great tracts of land, the peat-bogs in Ireland, for the purposes of agriculture has occupied a very large amount of attention; but the progress of chemistry in later years has divested the question of much of the paramount importance that was formerly attached to it; for now that by the researches of Liebig and others the true principles of the growth of agricultural crops are understood, it is well known that, even if thoroughly drained, peat will not supply the materials necessary for the production of food, and that the cost of introducing those materials in the form of manures, if applied to land in better condition occupying the same area, will yield greater and more profitable returns.

An examination of the chemical components of the following rocks, the soils of which form our finest corn-growing lands, will show the practical advantage of geological and chemical knowledge, and explain the great difference in the respective producing powers of such soils:—

	Infer. Oolite	Great Oolite.	Cornbrash.
Carbonate of Lime	89·20	95·346	89·195
Magnesia	·34	·739	·771
Sulphate of Lime	·09	·204	·241
Alumina	4·14	1·422	2·978
Phosphoric Acid	·06	·124	·177
Soluble Silica	2·75	1·016	1·231
Insoluble Silica	3·27	·533	4·827
	99·85	99·384	99·420

These analyses show that phosphoric acid and sulphate of lime—two important chemical substances in the growth of crops—greatly predominate in the cornbrash, and are in excess in the great oolite above the inferior oolite. The yield of corn, in bushels, of a fair average crop grown upon an acre, will be seen to be proportionate to the amount of these chemical substances in the soil; the one containing the largest amount of these salts affording regularly the largest crop:—

	Infer. Oolite.	Great Oolite.	Cornbrash.
Wheat (bushels)	15 to 20	20 to 25	25 to 30
Barley ,,	25 ,, 30	30 ,, 35	40 ,, 45
Oats ,,	25 ,, 30	35 ,, 40	45 ,, 50

The average of rent, which may be gathered from the following table, varies in accordance:—

Inferior Oolite	7s. to 20s. the acre.
Great Oolite	14s. ,, 25s. ,,
Cornbrash	20s. ,, 40s. ,,

IV. *Comparison between other Countries and parts of Great Britain.*

With a geological map before him, the reader will now be able to infer from the physical features presented by any country the industrial pursuits of the people occupying it. We present a few examples:—

Since the rocks of *Normandy* and *Picardy* are identical with those of our midland and southern counties—being of oolitic and cretaceous age—we should infer that the inhabitants are agricultural, the chalk tracts being occupied by pasturage, the limestone of the oolitic strata forming arable soils, whilst its clays are growing a variety of crops.

Belgium is an equivalent to South Wales or to the Staffordshire district, its four southern provinces being constituted of rocks of the carboniferous age, and presenting an association of coal, iron, and limestone, such as we have ascertained to prevail in the English areas now mentioned. The aggregate of all mining and metal industries recorded for 1860 was £10,751,000; the principal products of its mines are iron-ore, blende, calamine, galena, and coal.

Switzerland, the mountain country *par excellence* of Europe, with its metamorphic rocks, might be inferred to be a repetition of the phenomena which obtain in North Wales; but it is otherwise, for these granitic and gneissic rocks are but metamorphosed oolitic and newer strata; and as we have shown that deposits of these formations are usually unproductive in minerals, Switzerland, if our generalisations are correct, can never be a mining country, and, from its mountainous character, it can only be a pastoral one.

Saxony presents, in its rock masses and its mineral wealth, similar conditions to those which prevail in Devon and Cornwall.

Norway, from an agricultural point of view, is to Northern Europe what the Highlands of Scotland are to Great Britain; its rocks, however, contain some of the richest deposits of iron ore in the world.

GENERAL SUMMARY OF THE MINERALS RAISED AND METALS PRODUCED IN GREAT BRITAIN AND IRELAND IN 1867, EXTRACTED FROM THE "MINING RECORDS."

Minerals.	Quantities.	Value.
	Tons.	£
Coal	104,500,480	26,125,145
Iron Ore	10,021,058	3,210,098
Tin Ore	13,649	694,734
Copper Ore	158,544	699,693
Lead Ore	93,432	1,158,066
Zinc Ore	13,489	41,340
Total Value		£31,929,076

Minerals.	Quantities.	Value.
	Tons.	£
Brought forward Total Value		31,929,076
Iron Pyrites	116,889	67,453
Gold Quartz	3,241	5,320
Nickel Ore	2	14
Arsenic (*partly estimated*)	2,255	4,112
Gossans, etc.	5,482	5,808
Wolfram	10	62
Manganese	808	3,232
Barytes	11,107	7,807
Coprolites	37,000	70,300
Salt	1,394,939	836,963
Clays, *fine* and *fire*	1,179,300	589,650
Earthy Minerals not returned (*estimated*)	—	650,000
Total Value of the Minerals produced in the United Kingdom		£34,169,797

METALS OBTAINED FROM THE ABOVE ORES.

Metals.	Quantities.	Value.
	Tons.	£
Iron	4,761,023	11,902,557
Tin	8,700	799,203
Copper	10,233	831,761
Lead	68,440	1,337,509
Zinc	3,750	79,693
	Ounces.	
Silver	805,394	215,400
Gold	1,520	5,890
Value of other Metals (*estimated*)	—	15,000
Total Value of Metals	—	£15,187,013

ABSOLUTE TOTAL VALUE OF THE METALS AND COAL AND OTHER MINERALS PRODUCED IN 1867.

	£
Value of the Metals produced from the Mines of the United Kingdom	15,137,013
Value of Coal	26,125,145
Other Minerals, not smelted, Salt, Clay, etc.	2,167,934
	£43,430,092

GENERAL SUMMARY OF COAL EXPORTED FROM THE UNITED KINGDOM IN 1867, DISTINGUISHING THE COAL-FIELDS FROM WHICH EXPORTED, AND THE COUNTRIES TO WHICH SENT, AS COMPARED WITH THE TOTAL EXPORTS FOR 1866.

Countries.	Northern Ports.	Yorkshire.	Lancashire.	Western.	Scotch.	Ship'd from London.	Total 1867.	Total 1866.
	Tons.	Tons.	Tons	Tons.	Tons.	Tons.	Tons.	Tons.
France	920,477	81,900	30,310	848.927	67,243	626	1,949,483	1,898,125
Denmark	432,278	55,438	116	42,563	82,828	1,236	614,451	618,206
Norway	103,704	17,913	—	4,776	70,918	—	197,311	166,884
Sweden	219,453	21,336	—	2,010	15,440	270	258,509	253,026
Russia	388,851	45,981	6,942	55,506	45,500	1,220	544,000	520,014
Austria	41,971	104	9,406	26,610	3,626	1,300	83,017	76,102
Germany	687,261	30,358	—	34,338	39,954	—	791,906	724,121
Prussia	323,219	40,133	—	14,434	54,124	4,024	435,934	430,015
Holland	248,137	5,572	146	2,467	4,205	—	260,527	235,284
Belgium	129,667	16,563	900	2,742	5,716	—	155,588	64,843
Spain	124,249	16,710	20,918	211,033	8,451	220	381,581	424,433
Portugal	68,750	2,309	7,743	45,359	12,742	1,115	138,018	147,147
Italy	188,657	9,762	14,163	158,920	47,358	—	418,860	521,760
Mediter'n	77,209	2,437	27,768	242,886	15,536	—	365,836	389,021
Greece	8,614	328	5,197	22,063	2,138	150	38,490	29,642
Turkey	85,308	4,723	6,071	137,408	7,878	2,920	244,308	234,565
Africa	235,411	6,717	15,444	244,680	15,290	5,540	523,082	408,788
Australia	2,667	120	2,444	1,656	50	1,578	8,515	18,356
E. Indies	287,625	5,148	317,061	290,422	59,557	30,473	990,286	660,086
W. Indies	40,768	2,998	53,791	249,512	76,880	5,349	429,298	438,193
N. America	77,369	8,756	65,398	68,093	56,349	1,211	277,176	312,272
S. America	51,474	2,507	92,689	324,453	55,824	8,960	535,907	687,446
Islands:—								
Channel	62,363	1,467	1,397	5,785	1,936	—	72,948	67,748
Heligoland	—	—	—	—	—	—	—	128
Iceland	928	—	235	190	1,377	—	2,730	1,595
Azores	618	373	445	3,747	135	493	5,811	2,931
Canaries	241	—	—	6,823	—	842	7,906	11,317
Madeira	4,085	—	—	—	12,028	733	16,846	11,054
Ascension	1,253	—	—	5,491	—	—	6,744	4,747
St. Helena	1,036	—	—	—	—	719	1,755	811
Falkland	—	—	—	645	—	70	715	2,491
N. Zealand	—	—	—	—	2,720	1,24[illegible]	3,969	6,615
Sandwich	150	—	120	—	—	50	320	35
Society	—	—	—	—	—	—	—	80
Totals	4,813,793	379,640	678,704	3,053,539	765,803	70,348	9,761,827	9,367,831

LESSONS IN BOOKKEEPING.—XXX.

We have now laid before our students the principles of Bookkeeping, both in relation to Home and Foreign trade. If they have diligently accompanied us to the end, they possess as clear and as good a knowledge of the subject as they will obtain from a treatise. What they now want is practice, for "practice makes perfect." A few months in an office under an able bookkeeper will fix our instructions upon their minds, and also give them an insight into the practical working of the science of Bookkeeping.

There are differences of practice in nearly every counting-house. These are variations in some minute particulars, in no way affecting the main principles of the subject, but due entirely to the exigencies of the particular trade, business, or profession. Of course we cannot enlarge upon these variations, as they are so very numerous.

We have thought it advisable to supply another Memoranda of Transactions for the use of those students who may wish for further practice in keeping accounts. The transactions with the Bank are excluded, as in the Memoranda of Foreign Trade (see Vol. III., pages 100 and 132). We have only given the quantities to prices, without stating the actual amount of the purchase or sale. Separate accounts may be opened simply for coffee, tea, and sugar, or for the different kinds of each, as the student may think fit.

MEMORANDA OF THE TRANSACTIONS

OF MESSRS. EVANS AND HAYWARD, TEA, COFFEE, AND SUGAR MERCHANTS.

188-.

Jan. 1.—Deposited Capital in City Bank—J. Evans £1,500, and J. Hayward £1,500. Bought of L. Solomons, Office Furniture, etc., £48 10s.; F. Parsons, Account Books, Stationery, etc., £7 10s.

Jan. 2.—Paid L. Solomons and F. Parsons. Bought of J. Allport, *Tea*: Congou, good, 15 chests = 1,200 lbs., @ 1s. 10d. per lb.; Congou, finest, 12 chests = 960 lbs., @ 3s.; Souchong, 10 chests = 800 lbs., @ 2s. 8d.; Hyson, 15 chests = 1,050 lbs., @ 2s. 4d. Bought of Bayley and Co., *Coffee*: Jamaica, good, 3 tierces = 21 cwt., @ 82s. per cwt.; Mocha, ungarbled, 6 bales = 12 cwt. @ 75s.; Costa Rica, 10 bags = 15 cwt., @ 63s. (Less 2½ %). Bought of Reed and Co., *Sugar*: West India, 5 tierces = 40 cwt., @ 37s. per cwt.; Brazil, 2 hhds. = 30 cwt., @ 22s. 6d.; Bengal, 4 hhds. = 72 cwt., @ 40s. Paid W. Collins and E. George, Travelling Expenses, £7 7s. each.

Jan. 3.—Accepted Bills as follows:—Drawn by J. Allport, No. 1, due @ 1 mo., one-half of acc.; No. 2, due @ 2 mos., balance of acc. Drawn by Bayley and Co., No. 3, due @ 1 mo. Drawn by Reed and Co., No. 4, due @ 2 mos., one-half of acc.; No. 5, due @ 3 mos., balance of acc.

Jan. 4.—Drew out of Cash, Petty Cash, £10. J. Evans, Private acc., £25. J. Hayward, Private acc., £20. Sold to Kebble and Williams (for Cash in a week), *Coffee*: Costa Rica, 4 bags = 6 cwt., @ 70s.; *Sugar*: Brazil, 1 hhd. = 15 cwt., @ 27s. 6d.; *Tea*: Congou, good, 3 chests = 240 lbs., @ 1s. 11d., (Less 2½%).

Jan. 5.—Sold to Clayton and Co., *Sugar*: Bengal, 2 hhds. = 36 cwt. @ 46s. 3d. Received Cash same time. Sold to Lumley and Co., *Coffee*: Jamaica, good, 2 tierces = 14 cwt., at 90s.; *Tea*: Congou, finest, 8 chests = 640 lbs., @ 3s. 2d.; *Sugar*: W. India, 2 tierces = 16 cwt., @ 45s. 6d. Drew Bill No. 1 on Lumley and Co., due @ 1 mo. Sold to Mason and Co., *Coffee*: Mocha, ungarbled, 4 bales = 8 cwt., @ 82s. 3d.; *Tea*: Souchong, 4 chests = 320 lbs. @ 2s. 9d.

Jan. 6.—Received Cash from Mason and Co. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

Jan. 8.—Bought of Durrant and Co., *Tea*: Congou, good, 20 chests = 1,600 lbs., @ 1s. 8d.; Congou, finest, 20 chests = 1,600 lbs., @ 2s. 8d.; Souchong, 10 chests = 800 lbs., @ 2s. 6d.; Hyson, 10 chests = 700 lbs., @ 2s. 3d. (Less 2½%). Bought of J. Allport, *Tea*: Gunpowder, 20 chests = 1,600 lbs., @ 2s. 10d. (Less 2½%).

Jan. 9.—Accepted Bills:—Drawn by Durrant and Co., No. 6, due @ 2 mos., £250; No. 7, due @ 3 mos., balance of acc. Drawn by J. Allport, No. 8, due @ 3 mos. Sold to Wardlaw and Co., *Tea*: Congou, good, 10 chests = 800 lbs., @ 2s.; Gunpowder, 6 chests = 480 lbs., @ 3s. Sold to Freeman and Dale, *Tea*: Congou, finest, 12 chests = 960 lbs., @ 2s. 9d.; Hyson, 15 chests = 1,050 lbs., @ 2s. 5d.; *Sugar*: W. India, 20 cwt. @ 44s.; Bengal, 24 cwt., @ 47s. 3d.

Jan. 10.—Drew Bills:—No. 2, on Wardlaw and Co., due at 1 mo.; No. 3, on Freeman and Dale, due @ 1 mo., £200; No. 4, on do., due @ 2 mos., bal. of acc. Bought of J. Gilbertson, *Coffee*: Rio, 12 Robins = 18 cwt., @ 40s.; Mocha, garbled, 6 bales = 15 cwt., @ 95s.; Jamaica, fine, 3 tierces = 21 cwt., @ 110s. (Less 2½% for Cash in a fortnight). Sold to Jenkins Bros., *Coffee*: Rio, 12 cwt., @ 47s.; *Tea*: Congou, good, 10 chests = 800 lbs., @ 1s. 9d.

Jan. 11.—Received Cash from Kebble and Williams and Jenkins Bros. Lent Noble and Hoare £500 for 1 month at 5%.

Jan. 12.—Sold to Owen and Co., *Tea*: Congou, finest, 4 chests = 320 lbs., @ 3s. 2d.; Gunpowder, 14 chests = 1,120 lbs., @ 2s. 11d.

Jan. 13.—Received 3 Bills from Owen and Co.:—No. 5, due 17th inst., £100; No. 6, due 24th inst., one-half of bal.; No. 7, due 30th inst., balance. Bought of J. Allport, *Tea*: Gunpowder, 50 chests = 4,000 lbs., @ 2s. 6d. Drew out of Cash, J. Evans, Private acc., £[illegible]; J. Hayward, Private acc., £10. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

Jan. 15.—Accepted 2 Bills, drawn by J. Allport:—No. 9, due @ 2 mos., £250; No. 10, due @ 3 mos., £250. Sold to Kebble and Williams, *Coffee*: Jamaica, good, 1 tierce = 7 cwt., @ 90s.; Jamaica, fine, 2 tierces = 14 cwt., @ 118s.; Mocha, garbled, 6 bales = 15 cwt., @ 102s. Sold to Thompson and Co., *Tea*: Gunpowder, 10 chests = 800 lbs., @ 2s. 7d.

Jan. 16.—Received Bills:—No. 8, from Kebble and Williams, due 2nd Feb.; No. 9, from Thompson and Co., due 27th Jan.

Jan. 17.—Received Cash for Bill No. 5.

Jan. 18.—Sold to Hunter and Co., *Tea*: Congou, good, 10 chests = 800 lbs., @ 1s. 9d. (for Cash on 27th).

Jan. 19.—Sold to Wardlaw and Co., *Tea*: Congou, finest, 8 chests = 640 lbs., @ 2s. 9d. Sold to Mason and Co., *Tea*: Souchong, 6 chests = 480 lbs., @ 2s. 10d.

Jan. 20.—Drew Bills:—No. 10, on Wardlaw and Co., due @ 1 mo.; No. 11, on Mason and Co., due @ 1 mo. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

Jan. 22.—Sold to J. Tilley, *Coffee*: Mocha, ungarbled, 2 bales = 4 cwt., @ 83s.; Costa Rica, 6 bags = 9 cwt., @ 70s.; Rio, 4 Robins = 6 cwt., @ 47s. 6d. Sold to H. Meredith, *Coffee*: Jamaica, fine, 1 tierce = 7 cwt., @ 118s.; *Sugar*: W. India, 4 cwt., @ 45s.; Brazil, 5 cwt., @ 28s.

Jan. 23.—Received Cash from J. Tilley and H. Meredith.

Jan. 24.—Received Cash for Bill No. 6. Paid J. Gilbertson. Sold to Allatson and Co., *Tea*: Gunpowder, 20 chests = 1,600 lbs., @ 2s. 7d. Drew Bill No. 12 on Allatson and Co., due @ 1 mo.

Jan. 25.—Sold to F. Notley, *Tea*: Hyson, 10 chests = 700 lbs., @ 2s. 5d. Sold to Pickford and Green, *Sugar*: Bengal, 12 cwt., @ 50s.

Jan. 26.—Bought of Bayley and Co., *Coffee*: Jamaica, good, 10 tierces = 70 cwt., @ 80s.; Mocha, ungarbled, 10 bales = 20 cwt., @ 73s.; Costa Rica, 10 bags = 15 cwt., @ 60s.; Mocha, garbled, 14 bales = 21 cwt., @ 94s. (Less 2½ % for Cash in a month). Drew Bill No. 13 on F. Notley, due @ 1 mo. Received Cash from Pickford and Green.

Jan. 27.—Received Cash from Hunter and Co., and Cash for Bill No. 9. Bought of Keene and Ross, *Tea*: Congou, good, 50 chests = 4,000 lbs., @ 1s. 6d.; Hyson, 10 chests = 700 lbs., @ 2s.; Souchong, 20 chests = 1,600 lbs., @ 2s. 3d. Sold to E. Davey, *Coffee*: Jamaica, good, 3 tierces = 21 cwt., @ 89s.; *Tea*: Congou, good, 10 chests = 800 lbs., @ 1s. 8d. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

Jan. 29.—Accepted a Bill drawn by Keene and Ross, No. 11, due @ 3 mos. Drew Bill No. 14 on E. Davey, due @ 2 mos. Sold to Jenkins Bros., *Tea*: Congou, good, 2 chests = 160 lbs., @ 1s. 11d. Received Cash same time.

Jan. 30.—Bought of J. Vavasseur, *Tea*: Congou, finest, 20 chests = 1,600 lbs., @ 2s. 6d. Received Cash for Bill No. 7. Bought of H. Bateman and Son (Less 5% for Cash in a week), *Coffee*: Rio, 12 Robins = 18 cwt., @ 38s.; Jamaica, fine, 3 tierces = 21 cwt., @ 105s. Bought of Wingram and Sons, *Sugar*: W. India, 5 tierces = 40 cwt., @ 34s.; Brazil, 2 hhds. = 30 cwt., @ 21s. Bengal, 3 hhds. = 54 cwt., @ 38s.

Jan. 31.—Accepted Bills:—No. 12, drawn by J. Vavasseur, due @ 2 mos.; No. 13, drawn by Wingram and Sons, due @ 3 mos. Sold to Mears and Fry, *Coffee*: Jamaica, good, 2 tierces = 14 cwt., @ 89s. 6d.; Mocha, ungarbled, 5 bales = 10 cwt., @ 81s.; *Sugar*: Brazil, 10 cwt., @ 29s. Sold to Clayton and Co., *Sugar*: Bengal, 1 hhd., 18 cwt., @ 47s.; W. India, 2 tierces = 16 cwt., @ 44s.

Feb. 1.—Received Bills: No. 15, from Mears and Fry, due 12th Feb.; No. 16, from Clayton and Co., due 15th Feb. Sold to Marchmont and Co., *Tea*: Congou, good, 10 chests = 800 lbs., @ 1s. 7d.; Congou, finest, 6 chests = 480 lbs., @ 2s. 7½d.; *Coffee*: Mocha, garbled, 8 bales = 12 cwt., @ 102s. Paid Salaries, including Travellers, £60.

Feb. 2.—Drew Bill on Marchmont and Co., No. 17, due at 1 mo. Received Cash for Bill No. 16. Sold to A. Ledbrooke, *Tea*: Gunpowder, 15 chests = 1,200 lbs., @ 2s. 7½ l.; Hyson, 4 chests, 280 lbs., @ 2s. 1½d.; Souchong, 10 chests = 800 lbs., @ 2s. 7½d.

Feb. 3.—Drew 2 Bills on A. Ledbrooke: No. 18, due @ 1 mo., one-half of acc.; No. 19, due @ 2 mos., balance. Drew out of Cash, Petty Cash, £10; J. Hayward, Private acc., £25; J. Evans, Private acc., £25. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

Feb. 5.—Sold to J. Tilley, *Coffee*: Costa Rica, 5 bags = 7½ cwt., @ 68s. 9d.; Rio, 8 Robins = 12 cwt., @ 47s.; Jamaica, fine, 1 tierce = 7 cwt., @ 115s.

Feb. 6.—Received Bill No. 20 from J. Tilley, due 27th Feb. Paid H. Bateman and Son. Paid Bills Nos. 1 and 3.

Feb. 7.—Sold to North and Co., *Sugar:* W. India, 3 tierces = 24 cwt., @ 44s. 6d.; Brazil, 2 hhds. = 30 cwt., @ 29s. 3d.; Bengal, 2 hhds., = 36 cwt., @ 46s.

Feb. 8.—Drew 2 Bills on North and Co.:—No. 21, due @ 1 mo., £100; No. 22, due @ 2 mos., for balance. Received Cash for Bill No. 1.

Feb. 9.—Effected by W. Lloyd, on account of J. Fitzgerald, Berbice, an Insurance on £1,050, on 30 tierces of Coffee, valued at £35 per tierce, from Berbice to London, per Neptune, at 3 per cent. premium; Policy £3 10s.; our Commission on do., ½ per cent.

Feb. 10.—Sold to Duncan and Forbes, *Coffee:* Jamaica, good, 5 tierces = 35 cwt., @ 88s.; Mocha, garbled, 6 bales = 9 cwt., @ 103s. Received Cash from Noble and Hoare, in repayment of loan, with interest @ 5%. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

Feb. 12.—Received Cash for Bill No. 15. Sold to Hunter and Co., *Tea:* Congou, good, 10 chests = 800 lbs., @ 1s. 7½d.; Congou, finest, 9 chests = 720 lbs., @ 2s. 7½d.; Gunpowder, 5 chests = 400 lbs., @ 2s. 7d. Bought of J. Allport, *Tea:* Gunpowder, 50 chests = 4,000 lbs., @ 2s. 6d. (Less 2½%). Bought of Bayley and Co., *Coffee:* Jamaica, good, 10 tierces = 70 cwt., @ 78s.; Mocha, garbled, 20 bales = 30 cwt., @ 91s. Bought of Reed and Co., *Sugar:* W. India, 10 tierces = 80 cwt., @ 32s.; Brazil, 4 hhds. = 60 cwt., @ 20s.; Bengal, 5 hhds. = 90 cwt., @ 35s.

Feb. 13.—Received Cash for Bills Nos. 2 and 3. Received Cash from Hunter and Co. on acc., £100. Drew Bill No. 23 on Hunter and Co., due @ 1 mo. for the balance of their acc. Accepted Bills:—No. 14, drawn by J. Allport, due @ 3 mos.; No. 15, drawn by Bayley and Co., due @ 3 mos., £200; No. 16, do., due @ 4 mos. for bal.; No. 17, drawn by Reed and Co., due @ 4 mos.

Feb. 14.—Sold to Winter and Co., *Tea:* Souchong, 2 chests = 160 lbs., @ 2s. 5d.; Hyson, 3 chests = 210 lbs., @ 2s. 2d.; *Coffee:* Rio, 4 Robins = 6 cwt., @ 47s. Received Cash same time. Sold to F. Notley, *Tea:* Congou, good, 10 chests = 800 lbs., @ 1s. 7½d.; Congou, finest, 5 chests = 400 lbs., @ 2s. 7½d.

Feb. 15.—Received Cash for Bill No. 16. Drew Bill No. 24 on F. Notley, due @ 1 mo. Sold to H. Paton, *Tea:* Congou, good, 10 chests = 800 lbs., @ 1s. 8d. Sold to Fox and Co., *Tea:* Souchong, 8 chests = 640 lbs., @ 2s. 4½d.; Hyson, 3 chests = 210 lbs., @ 2s. 1½d.

Feb. 16.—Sold to Edwards and Co., *Coffee:* Mocha, ungarbled, 5 bales = 10 cwt., @ 82s.; Costa Rica, 5 bags = 7½ cwt., @ 70s. Sold to H. Meredith, *Coffee:* Jamaica, fine, 2 tierces = 14 cwt., @ 114s. Bought of Keene and Ross, *Tea:* Congou, good, 50 chests = 4,000 lbs., @ 1s. 5d.; Congou, finest, 50 chests = 4,000 lbs., @ 2s. 4d. Bought of J. Vavasseur, *Tea:* Souchong, 25 chests = 2,000 lbs., @ 2s. 2d.; Hyson, 20 chests = 1,400 lbs., @ 2s.

Feb. 17.—Received Cash from Fox and Co. Drew out of Cash, Petty Cash, £10; J. Evans, Private acc., £10; J. Hayward, Private acc., £10. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

Feb. 19.—Accepted Bills:—No. 18, drawn by Keene and Ross, due @ 3 mos., one-half of acc.; No. 19, do., due @ 4 mos., balance of acc.; No. 20, drawn by J. Vavasseur, due @ 3 mos. Received Cash from H. Paton; Bills, No. 25, from Edwards and Co., due 26th Feb.; No. 26, from H. Meredith, due 5th March.

Feb. 20.—Sold to Dean and Son, *Tea:* Congou, good, 10 chests = 800 lbs., @ 1s. 6½d. Sold to G. Finlan, *Tea:* Souchong, 10 chests = 800 lbs., @ 2s. 5d. Sold to N. Reynolds, *Tea:* Gunpowder, 5 chests = 400 lbs., @ 2s. 8d. Bought of J. Gilbertson, *Coffee:* Mocha, ungarbled, 20 bales = 40 cwt., @ 72s.; Costa Rica, 20 bags = 30 cwt., @ 60s.; Rio, 20 Robins = 30 cwt., @ 37s. Bought of H. Bateman and Son, *Coffee:* Jamaica, fine, 10 tierces = 70 cwt., @ 102s.

Feb. 21.—Sold to F. Nicholls, *Tea:* Congou, finest, 10 chests = 800 lbs., @ 2s. 6d.; Hyson, 2 chests = 140 lbs., @ 2s. 2d. Sold to Atkins and Fry, *Coffee:* Jamaica, good, 1 tierce = 7 cwt., @ 87s.; *Sugar:* W. India, 1 tierce = 8 cwt., @ 40s. Sold to Wardlaw and Co., *Tea:* Congou, good, 10 chests = 800 lbs., @ 1s. 6½d.; Congou, finest, 5 chests = 400 lbs., @ 2s. 6d. Sold to Mears and Fry, *Coffee:* Mocha, ungarbled, 5 bales = 10 cwt., @ 80s.; Costa Rica, 6 bags = 9 cwt., @ 70s.

LESSONS IN GEOLOGY.—XIV.

We now enter upon the fossiliferous strata. Hitherto, all attempts to discover signs of organic remains in the igneous and metamorphic rocks have failed, and this fact at present rises as a well-defined wall of demarcation, separating all the lower rocks from the first great system, the Silurian. Before we enter upon that well-defined series of rocks, so ably described by Sir Roderick Murchison in his "Siluria," we must notice a small group which occupies an intermediate position between the metamorphic system and the Silurian.

This sub-system, if we may so use the word, has been described as existing in England, in Bohemia, and in Canada. The Bohemian and English rocks are of the same period, whereas the Canadian group are more closely connected with the metamorphic rocks. Since they are largely developed in North Wales, the term "*Cambrian*" has been applied to them, as Cambria was the ancient name of that part of the Principality. The American rocks of this group have been studied chiefly by Sir W. E. Logan, and from the fact that their chief development occurs in the neighbourhood of the St. Lawrence, they have been termed *Laurentian.* This sub-system is thus tabulated:—

CAMBRIAN GROUP.

1. Upper Cambrian rocks (the primordial zone of Barrande).
2. Lower Cambrian rocks (Longmynd group).

LAURENTIAN GROUP.

1. Upper Laurentian.	2. Lower Laurentian.

The *Laurentian Rocks* are known to occupy an area of 200,000 square miles, and frequently they attain a thickness of 30,000 feet, the upper group being 10,000 and the lower 20,000. The rocks are stratified, yet crystalline gneiss, mica-schist, quartzite, and limestone are all represented. As yet, the upper group has afforded no fossils; whereas, in 1859, Sir W. Logan discovered an organic remain in the lower Laurentian. This is the oldest fossil as yet discovered. It appears to be a foraminifer, and bears a similarity to the well-known nummulite; it has been called the *Eozoon Canadense.*

The *Lower Cambrian* or *Longmynd* group is composed of sandstones, which are found in the Longmynd hills to be some 6,000 feet thick, and of the Llanberis slates. The sandstones are often rippled, proving that once they were the shores of a sea which were left dry at low water. The rocks bear evidence of the existence of myriads of annelides, of which there appear to be four or five species. The slates are about 3,000 feet thick, and are developed on the coast of Ireland, directly opposite Anglesea. Here are found the oldest fossils in Europe, two zoophytes to which Professor E. Forbes gave the name of *Oldhamia.* In Fig. 28 and Fig. 29 are drawn the two species, *Oldhamia antiqua* and *O. radiata.* The whole thickness of the Longmynd group is about 10,000 feet.

The *Upper Cambrian* contains the *Tremadoc slates,* which lie upon the *Lingula flags,* these latter being 6,000 feet thick, while the slates are but 2,000. The group bears evidence of a great advance in life, both as to the number of species as well as their superior development. That remarkable crustacean, the *Trilobite,* so characteristic of the Silurian system, begins to appear; while in the upper part of the group the *Bellerophon orthoceratite* and the *Theca* find representatives.

Mons. Barrande in 1846 gave to the world his laborious researches on the geology of Bohemia, which he had studied for ten years. The result is, that these Bohemian strata have been found to correspond with the Cambrian. Barrande termed the lowest group "Primordial," because he believed that in these rocks the earliest indications of life were found; but, as this is not the case, the term is gradually becoming obsolete. Many geologists hold that the Cambrian rocks were deposited at a time when the first creations of life took place upon the earth. But suppose that the metamorphic action had extended through the Silurian and Devonian strata, obliterating all traces of organic remains, then the carboniferous system would have been the first in which fossils were found; and in Ireland there is a large area, covered by sandstones which belong to this period, utterly destitute of fossils. It would have been argued that at the time of the deposition of these sandstones there was no life upon the earth, and that the creation of life took place at a subsequent period. How fallacious would the reasoning prove! And it may be that the Cambrians occupy much the same position as the yellow sandstones of Ireland in our supposition. The metamorphic rocks beneath may have once been very fossiliferous strata, which have undergone a total alteration and all traces of organisms obliterated, and for some reason or other the Cambrian group were deposited in such a position as to preclude the burying of many organic remains. Yet it must be confessed that this supposition is hardly credible; because, had the carboniferous strata, as above supposed, been the first to contain fossils, we should have suddenly found ourselves in the midst of a highly-developed flora and fauna, whereas in the Cambrians only very low types of life are found. The Oldhamia, for example, for a long time was believed to be of a vegetable origin. Every appearance seems to indicate that this period was the dawn of life. Yet it may have been otherwise.

THE SILURIAN SYSTEM.

We now enter npon the true sedimentary strata. The metamorphic action has not penetrated to this system, and the beds are preserved to ns in the condition in which they were deposited, save that they have been tilted and upheaved by igneous agency from beneath. The term *Silurian* was selected by Sir R. Murchison because the system is typically exhibited in North Wales, throughout the territory anciently occupied by the tribe of the *Silures*. They are most favourably placed for examination, since they have been "set on edge," so that as you walk along a line in an easterly or westerly direction, you pass over the exposed edges of the successive strata. The different series of the system and their snb-divisions are as follow:—

UPPER SILURIAN ROCKS.

I. *Ludlow Series.*—1, Downtown sandstones; 2, Aymestry limestones; 3, Lower Ludlow shales.

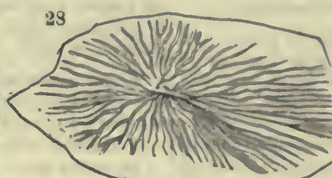
II. *Wenlock Series.*—1, Wenlock limestone; 2, Wenlock shale; 3, Woolhope limestone; 4, Upper Llandovery grits and shales.

LOWER SILURIAN ROCKS.

III. *Llandeilo Series.*—1, Lower Llandovery sandstones and slates; 2, Caradoc sandstones; 3, Bala beds; 4, Llandeilo and Lingula flags; 5, "Bottom rocks."

LOWER SILURIAN ROCKS.

Sir Charles Lyell adds a third division to the Silurian strata, which he terms the *Middle Siluria*, and in it he places the npper and lower Llandovery series, which consists of the Tarannon shales, the May Hill sandstone, Pentamerus limestone, and the Llandovery slates, the aggregate measuring about 2,600 feet in thickness; but, as a very definite line of division is wanting, we have divided the middle Silurian between the npper and lower.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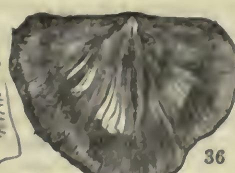
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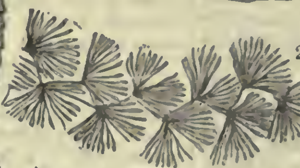
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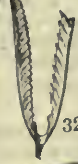
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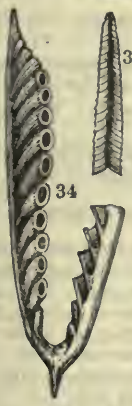
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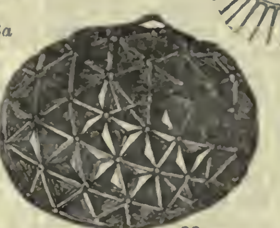
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The *Llandeilo series* is so named from a town in Carmarthenshire, about which the rocks are exhibited, where they reach a thickness of nearly 1,500 feet. Here we meet plentifully with fossils; in snch abundance, indeed, do some species occur—as the *graptolites*—that some geologists ascribe the dark colour of the slates which lie on the top of the series to the carbon derived from these animals.

But the most characteristic fossil of the Silurian period is the *trilobite* (Fig. 30), a crustacean with which those early seas must have swarmed. They evidently had a jointed body, and probably could spring like our shrimps. There are many varieties, each bed of the system possessing some, if not peculiar to itself, yet which predominates in that locality. However much they may differ in other respects, they have all one feature in common—they are all three-lobed, hence their name; that is, their body is divided into three lobes by the penetration of a ridge down the centre; this is very evident from the figures. The trilobite possessed a wonderful eye; indeed, it seems a pyramid of eyes, so that it could survey the waters on all sides of it, above as well as around. This highly-developed eye is an argument against Darwin's theory of development, for in the very earliest of the fossiliferous strata we should surely find very crude organs, the nncouth fore-elders of those highly-organised senses which the animals of our epoch of life possess; and yet it is not so, for one of the very earliest creatures possesses as fine an eye as any which has succeeded it, a very plain indication of the power of a Creator. The trilobite, which is found chiefly in the Llandeilo rocks, is the *Asaphus tyrannus* (Fig. 31), and is therefore considered characteristic of these beds. The *Ogygia Buchii* is also a feature of the period. The trilobites have been closely examined by M. Barrande, who discovered that they underwent metamorphoses as our present crustaceans. He traced them, from their escape from the egg, through all their changes until they arrived at the adult form; and, as these changes are many, it is not to be wondered at that frequent mistakes are made in supposing a fossil which is only a young trilobite to be something else.

The *Graptolites* are Hydrozoa, and they appear in very different forms, some of which are represented in our illustration. The didymograpsus (Figs. 32 and 32*a*) and diplograpsus (Figs. 33 and 33*a*) do not appear above the lower Siluria. In Fig. 34 the didymograpsus is enlarged. Arms are extruded out of the lateral tubes, which were joined to the main trunk of the graptolite, which was in the long tnbe out of which the short arms branch.

In Fig. 35 is represented another of the hydrozoa of the lower Siluria—the *Rastrites peregrinus*, having spines projecting from it like the teeth of a rake.

Resting upon the Llandeilo series are the *Caradoc sandstones* and *Bala beds*. These, not including the trap rocks which are interstratified with them, attain the thickness of 9,000 feet. Caer Caradoc, where the sandstone shows itself, is a mountain in Shropshire. The rock is very shelly, and contains many fossils. The *Trinucleus Caractaci* is found throughont this sandstone; it is a beantiful trilobite, which has six rings in the thorax, the three bosses very prominent, and two long continuations of the head, which will be figured in some of the upper Silnrian trilobites. The *Strophomena grandis* (Fig. 36) and the *Orthis vespertilio* (Fig. 37) are also characteristic fossils of the Caradoc beds. At Bala, in Merionethshire, a limestone of this age occurs very fossiliferous. In it the trilobite life reaches its maximum. It yields fossil star-fish, and the *Echinosphærites balticus* (Fig. 38) and others of the *Cystidæ* lately classed with the *Radiata*. The mouth of the creature was at the top, and it was fixed to the rock by a stem which was attached at the opposite side to the mouth; but this stem is never found still adhering. The Bala limestone is about 30 feet thick.

Lower Llandovery Beds are grey and brown grits and conglomerates with dark shales. They occupy the whole of Cardiganshire and parts of Glamorgan and Radnor. They contain many fossils common to the Bala beds beneath and to the upper Silurian above. They are about 1,000 feet thick.

Of the life of the lower Silurian we may thus sum up. Of that of the flora we are ignorant, save with regard to a few sea-weeds. Of the fauna several classes have representatives. These seem to appear simultaneously, and all indicate that the rocks in which they are embedded are of marine formation. The lower Silurian fossils belong to the classes Zoophyta, Brachiopoda, Conchifera, Gasteropoda, Cephalopoda, Echinodermata, Annelida, and Crustacea.

LESSONS IN ENGLISH.—XLI.

NOUNS: THEIR ORIGIN AND CLASSES (*continued*).

PROPER nouns may be distinguished as names of places and names of persons. Names of places were originally descriptive; they described the places to which they were assigned. The Bible furnishes such names in abundance: for instance, a place in the Wilderness of Sinai was denominated Kibroth-hattaavah, that is, *graves of lust*, from an historical event recorded in the book of Numbers xi. 34. Names of places have, to the unlearned, ceased to be descriptive, because the terms have lost their meaning. Those who would know the meaning of the names in English topography must study the Teutonic and the Celtic languages, which contain the original elements out of which those names were formed. Some instances have been given—I add two or three. *Orc*, the name given to the Orkney islands in the Welsh Triads, signifies that which is *extreme*, so that Orkney is the extreme or last country, the Ultima Thule. *Ramsgate* means the gate or pass leading into Ram, or Ruim, the British name for the Isle of Thanet. *Canterbury* is a corruption of the Anglo-Saxon *Cantwara byrig*, the forts or strongholds of the Cantware, that is, the men of Kent. *Cant* itself comes from *Caint*, which, in Welsh, means a plain or open country; and it was probably the old Welsh name for the slip of open land lying between the Weald and the Thames. The word *Winchester* is a *hybrid*, that is, a *cross* between the British and the Latin. *Chester* is the Latin Castra, *a camp*, and denotes a Roman station. It is frequent in our names of places; *e.g.*, Man*chester*, Dor*chester*, *Chester*. The first syllable *Win* is the Welsh *Gwent*, which like *Caint* (probably the same word) signifies an open country. It seems to have been a name given to several districts in this island. *Monmouthshire* is still called *Gwent* by the Welsh, and was called *Went* by our English chroniclers as late as the 10th century. The Welsh name *Gwent* was softened by the Anglo-Saxons into *Winte*, whence came *Winceaster*, or *Winchester*.

Names of places, as being proper nouns, are distinctive as well as descriptive. Thus *Paris* is the capital of the French empire. But is there another Paris in the world? The descendants of British colonists, who settled years ago in North America, have unsparingly given the names belonging to *the old country* to places of recent foundation in *the new country*. In so doing they have caused many of our names of places to lose their distinctiveness. The name *Boston* once denoted the town in Lincolnshire so called. The name was distinctive. Another *Boston* has sprung up in Massachusetts. Now, then, when we use the term, we are obliged to add some distinctive epithet, and call the one *Boston in England*, and the other *Boston in the United States*. Unless such an epithet is added, confusion must ensue. I have known a letter travel over a large part of England in search of the right *Broughton*, where lived the person for whom it was intended.

I subjoin some examples of the meaning of names of places in England.

Names of towns ending in MOUTH *and* FORD.—Instances: Ply*mouth*, Tyne*mouth*, Yar*mouth*, Ports*mouth*; Ox*ford*, Strat*ford*, Rom*ford*, Sal*ford*.

The ending *mouth* denotes the *mouth of a river*, or the point where a river falls into the sea; thus Tyne*mouth* is the mouth of the river Tyne. Ports*mouth*, the mouth of the Port, originally denoting the projecting land forming the narrow opening by which ships pass from the sea (*Spithead*) into the harbour. *Ford*, the German *furt*, signifies the part of a river or stream, which, from its being shallow, may be *forded*, or passed dry-foot.

Names of towns ending in CHESTER, CASTER, CESTER.—Instances: Dor*chester*, Por*chester*, Lan*caster*, Don*caster*, Glou*cester*, Wor*cester*, Lei*cester*, Ciren*cester*.

These endings come from either the Roman *castra* or the Saxon *caester*, according as the one or the other may be considered as the original word; not improbably the Saxon *caester* is a derivative from the Latin *castra* or *castrum*. Castrum in Latin, as caester in Saxon, denotes a *fort*, a *fortification*, a *castle*, an *encampment*; hence a *military settlement*, and so a town or city; for many of our towns were at the first military settlements.

Names of towns and villages ending in WICH *or* WICK.—Instances: Green*wich*, Wool*wich*, Har*wich*, Nor*wich*, Nant*wich*, Ber*wick*, Kes*wick*.

Wich or *wick* denotes an inlet or creek formed by the bend of a river; then the land so enclosed, and then the collection of abodes fixed there; and so a *fortification*, a *village*, or *town*.

The ending SHIRE.—Instances: York*shire*, Cardigan*shire*, Devon*shire*, Lanca*shire*, Che*shire*.

Shire, connected with the German scheren (Saxon, scir), to *cut*, to *cut off*, to *divide*, denotes *a division of a country*, *a large district*; thus, York*shire* is the district which belongs to the city of York, and of which that city is the (provincial) capital.

The ending SEX.—Instances: Es*sex*, Middle*sex*, Sus*sex*, Wes*sex*.

Sex is the remainder of the old Saxon term Seaxe, Saxe (German, Sachse), signifying *Saxons*; so that Sussex means the south Saxons, etc.

The endings BOROUGH, BURG (*German*, BURG, *a castle*), BURY.—Instances: Peter*borough*, Queen*borough*, Edin*burgh*, Sud*bury*, *Bury*.

Borough, softened into *burg* and *bury*, is the German *burg* (Greek, purg), *a fortified place*, *a town*; *borough*, considered as a municipality, is a derived and comparatively recent application. *Burg* or *bury* also signifies a *bosom*, that is, a *vale* environed with hills; hence the use of the word in relation to places situated as is Bury in Lancashire.

The ending or prefix HAM.—Instances: High*am*, *Ham*pstead, *Ham*pton, Oak*ham*.

Ham, still continued as a separate word in the diminutive *hamlet*, denotes a *dwelling*, and hence a *village*.

The ending MINSTER.—Instances: West*minster*, Ex*minster*, War*minster*.

Minster is a Saxon word signifying a *monastery* or settlement of monks; hence its application to some of our cathedrals; as *York Minster*.

THE ARTICLES.

The word *article*, coming from the Latin artus, *a joint*, is in form a diminutive (articula), and, according to its etymology or derivation, signifies *a little joint*. The articles may have been called "little joints," because of their smallness as articulations, or because, being small, they, as limiting the application of nouns, are the points or pivots on which discourse turns.

The article *the* does not essentially differ from what is called the demonstrative pronoun *this*, for "the man" and "this man" are phrases of kindred import. Indeed, *the* appears to be an abbreviated form of *this* (from the Saxon, *thes*, as in *these*), being softened down from *this* into *thic* (*thic* is still common among the peasantry of the south), and *thae* Scotch into *the*. In the Anglo-Saxon, the article *the* is connected in origin as well as signification with *this* and *that* (that).

The article *an* (*a* before a consonant), the same with the German *ein*, the Greek *en*, the Latin *unus*, the French *un*, and the Scotch *ane* (*ae*), in all of which the *n* is a radical letter, denotes *unity*.

From these etymological statements we are led to the exact import of the articles. In English there are two articles. Of these the one—namely, *the*—is called the definite article; the other—namely, *an*—is called the indefinite article. The indefinite article points out one object, as *an apple*, *a man*, thus limiting the noun to a single object of its kind. Such a limitation at first sight seems very definite; but *an* or *a*, while it indicates *one*, leaves it uncertain, that is undetermined (or indefinite), what *one* is meant. The office of determining what object is meant belongs to the definite or determining article *the*. For example, "I saw *a* man." "What man?" "*The* man whom you and I met yesterday."

A has the same origin as *one*. But *a* differs from *one*: "a man" and "one man" do not signify exactly the same. *A* man is one man as contrasted with *the* man, that is, some particular man; and *one* man is *a* man as contrasted with *many* men. *A* simply indicates one of a class of objects, *e.g.*, *a* book, *a* horse, *a* needle; *one* indicates a single object as the opposite of several. These statements may be illustrated in an example: "I bought *a* book." "Yes, but not *the* book you wanted." "I bought *one* book." "Indeed! I thought you had bought many." "No, I bought but one."

The differs from *this* as being less demonstrative without being less definite. *The* declares, *this* points out; *the* is the declaration of the tongue, *this* is the declaration of the finger. "I have sold *the* table." "*The* table! what table?"—"*The* table you mentioned." "What! *this* table?"—"Yes."

The undergoes no change by inflection, remaining the same whether the noun is singular or plural, masculine or feminine, the subject or the object.

An, for the sake of euphony, drops the *n* before a consonant, or consonantal sound; thus we say *an* empire and *a* kingdom.

By a "consonantal sound" I mean a sound which has more or less the force of a consonant. Thus *h* when aspirated, as in *h*orse, is a consonantal sound. *U* (pronounced *you*) as in university, is a consonantal sound. Consequently we say "*a* horse," "*a* university," as well as "*a* tiger," "*a* school." I give a list of

WORDS, THE INITIAL LETTER OF WHICH HAS A CONSONANTAL SOUND.

A European.	A universal (custom).	A usurper.
A ewer.	A university.	A utilitarian.
A uniform.	A usage.	A utopian (theory).
A union.	A use.	A humorous (story).
A unit.	A useful (instrument).	A humour.
A unitarian.	A usual (hour).	A horseman.
A united (company).	A usurer.	

So we also say "such a one" and "a once beloved friend." *An* is required before what is called a silent *h*, that is *h* which is not aspirated; for example:—

An BEFORE WORDS BEGINNING WITH A SILENT *h*.

An heir.	An hospital?	An honest (man).
An herb?	An hostler.	An humble (friend).
An honour.	An hour.	An honourable (man).

In regard to some of these words usage is not strict or uniform. In those that I have marked with a note of interrogation, the initial *h* is aspirated by some authorities, whose practice in this particular seems to be increasing in prevalence. When the *h* is aspirated, of course not the full form *an*, but the shortened form *a*, is required.

The adjectives formed from some nouns in which the *h* is aspirated, drop the aspirate, and so take *an* instead of *a*; thus we say, "*a* history," but "*an* historical narrative;" "*a* heretic," but "*an* heretical book."

A common noun, when taken in its widest sense, admits no article; for example:—

"The proper study of mankind is *man*."—*Pope*.

A noun is also without the article when it is used in a general sense, and in cases when the word *some* may be supplied; as:—

"To buy *food* are thy servants come."—*Genesis*.

A may denote a class, and *the* may denote the particular class; as:—

"*A* bird which I saw in America sang the sweetest of all the songs I have ever heard." "What bird?"—"*The* yet unnamed species described in my new work."

A, though denoting a single object, may stand before a noun of multitude, provided the idea of unity predominates; thus we say "*a* hundred men," that is "*a* band of a hundred men," a hundred men considered as a total. So "*a* few days" means a certain indefinite period. There is a difference between "few people" and "*a* few people;" "few people" says that the people in question were not numerous; "*a* few people" declares that there was present a company, in opposition to their being present no persons at all; *e.g.*, "few people were at the play." "Few? None." "Oh, I beg your pardon, there was *a* few."

A, prefixed to the name of an eminent personage, denotes one of a class; thus, "*a* Nero" is a person as cruel as the emperor so called. *The* is also used before such names in the plural number; *e.g.*, "*The* Neros, thank God, are not numerous."

The is put before a noun in the singular, when a particular species is intended; as, "*The* horse is a noble animal." The meaning would be wholly changed by converting the singular noun into a plural one; as, "*The* horses are noble animals," that is, the horses in question.

A, the article, must not be confounded with *a*, the old preposition or particle; for example:—

"They go a begging to a bankrupt's door."—*Dryden*.

Nor must *an*, the other form of *a*, be confounded with *an*, the old conjunction; for example:—

"Nay, *an* thou'lt mouthe, I'll rant as well as thou."—*Shakspeare*.

In such phrases as "four miles *an* hour," "twenty leagues *a* day," a doubt has been expressed whether the *an* and the *a* are the article or the preposition. I incline to the opinion that *an*, *a*, in such cases is the article. This seems probable from the fact that *an*, not *a*, stands before a noun beginning with a vowel, or an *h* not pronounced; for the preposition *a* is invariable; for example:—

"Every one cut off a piece and fell a eating."

The meaning of "four miles *an* hour" is not "four miles *on* or *in* hour," which has no sense, but four miles in *an* hour, that is, four miles in *one* hour, four miles *each* or *every* hour, the article being used distributively, as in the phrase "a guinea *a* head," that is, a guinea to *every* head or person.

The form "*a* many" is found in Shakspeare:—

"A care-craz'd mother of *a* many children."

"A many" is still very common in the north of England in instances where it is now more usual to say "*a* great many." "Many *a*," as in

"Full *many a* gem of purest ray serene,"

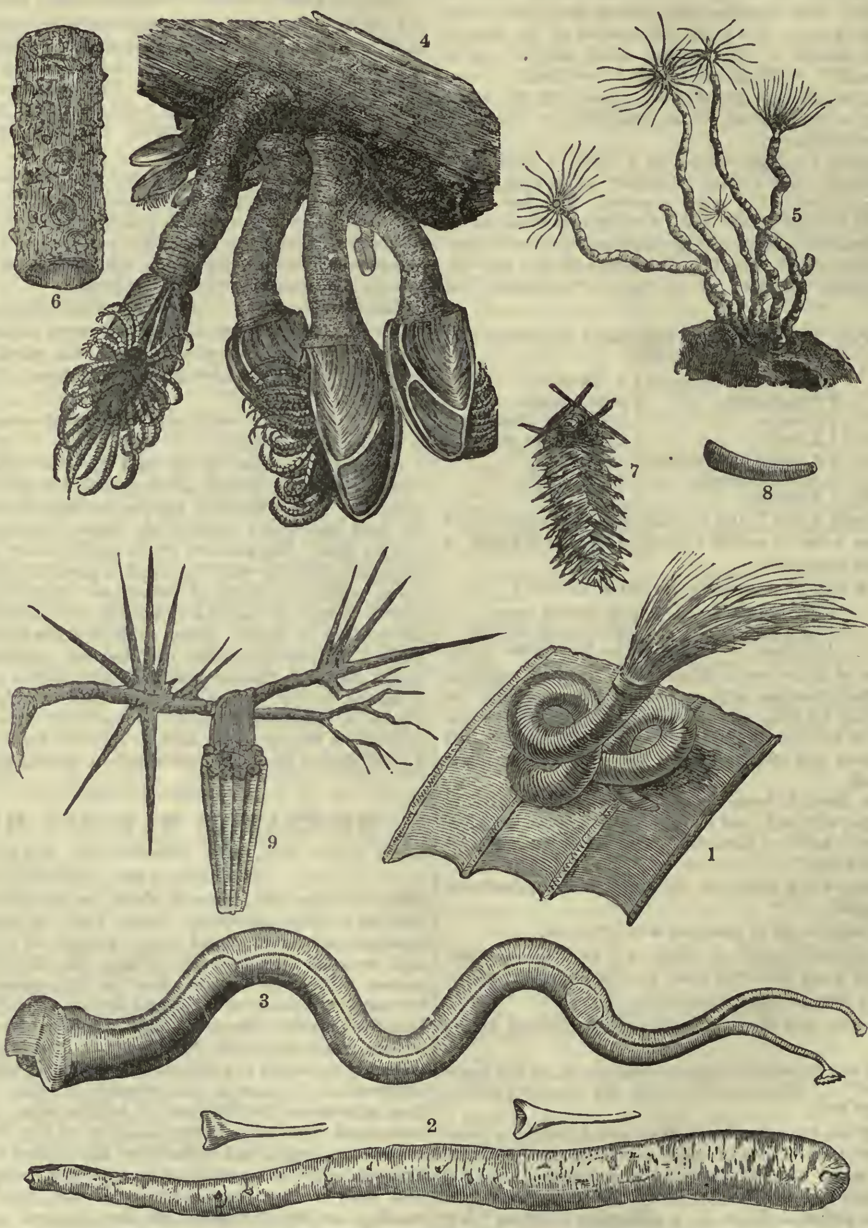
is customary and good.

Some have denied to *an* and *the* the honour of being a separate part of speech, alleging that the article is merely an adjective. Thus they say that in *the chair* and *mahogany chair*, *the* and *mahogany* perform the same functions, namely, they qualify *chair*. But the two words qualify *chair* with a difference, the one indicating what the chair is made of, the other denoting some particular chair of whatever material it may consist. Surely there is a material difference of meaning between these three forms of words: green chair, *a* green chair, and *the* green chair. At least the article qualifies the qualifier as well as the object qualified, inasmuch as it tells us that *a single* green chair is meant, or *the particular* green chair in which some one sat. There is consequently solid grounds for studying the article apart from the adjective, and, if only for that purpose, there is a good reason for giving the article a specific name.

RECREATIVE NATURAL HISTORY.

SOME LAND, SEA, AND FRESHWATER SHELLS, WORMS, AND TUBE-DWELLERS (*continued*).

NOT far from the homes of these sea rock-borers we shall, by dint of a little searching about, find, on some fragment of broken shell or detached stone, a mass of coiled up, twisted, and irregular-looking white tubing, like liliputian tobacco-pipe stems, or tiny ram's horns. Each of these minute dwellings will be found to hold an inhabitant (*Serpula contortuplicata*), whose beautiful scarlet fringe-like gills, or cilia, wave and undulate as the fresh sea-water flows over it, bearing the microscopic elements on which it subsists. It is deeply interesting to trace the gradual increase in the capacity of these tubes from their first appearance in the form of hollow pipes, no larger than a hair, until, by the untiring industry of the little tube-dweller within, the length and capacity of his twisted mansion increases until at length it becomes as we see it represented in Fig. 1; and here we have an example of the fixed form of tube, needing no shield beyond its own natural calcareous walls. Should fortune favour our search among the rocks and rock-pools, we shall probably find some fragment of broken spar or piece of wood which, sea-borne, has voyaged from afar to be cast up by the tide at last. On examining this we shall find it perforated in every direction by tubular orifices, the dwelling-places of the *Teredo navalis*. On looking closely we shall perceive that each tube has a lining to it, but that the lining differs in character according to the position it occupies in the interior of the tube. Within an inch of the mouth of the canal or orifice, it will be found to consist of a viscid paint-like mucus. Beyond this distance, and extending inwards, the tube will be found smoothly and beautifully lined with a white hard china-like material, which chemical analysis has shown to consist of ninety-seven parts of carbonate of lime and three parts of animal matter. The thickness of this hard crust or shell has been computed at $\frac{1}{24}$th of an inch. The external orifice might, without careful search, escape observation, as it is generally hidden by marine growths which usually flourish in situations favourable to the well-being of the teredo, and is much smaller than the interior of the tube. In fact, the outer portion of the pipe is but barely large enough to give passage to the two small tubular processes in which the creature may be said to be equally divided. Figs. 2 and 3 show the teredo both in its shell and out of it. Many of these worms measure as much as eight inches in length, and when in their tubes appear to completely fill them. They, however diminish considerably in size when removed from the timber, from their throwing out a considerable quantity of sea-water from their internal organs. When exposed to light and air, at the head of the worm are found two concave shell-like substances, united by a strong ligament, and to these shells the boring powers of the worm have been attributed. Sir Everard Home, in speaking of the proboscis of the teredo, says, that as this proboscis has no orifice there is reason to believe that it adheres to the wood, acting as a centre-bit, while the animal is at work with the shell, and thus the canal in the wood is perfectly cylindrical. It has not unfrequently been asked whether the teredo bored into wood in order to feed on it. Our observations have led us to the conclusion that it derives no nourishment whatever from the timber it is engaged in penetrating, but rather that, like the pholas and serpula before described, it needs a protecting and sheltering tube in which to dwell, whilst its support is drawn from amongst the countless myriads of organisms which fill the sea surrounding its abiding-place. That this is the case will appear probable when we take into consideration that the body of the living animal and the shell covering it will be found of equal bulk and greater specific gravity than the woody substance which is removed in making the tube. Here again we are of opinion that it is not alone the boring shell which cuts away and removes the solid timber. The *Teredo gigantea*, a species found in the Eastern seas, although living in a shell constituted exactly like that of the *Teredo navalis* of our own coasts, bores his tube in soft mud, where the so-called boring or centre-bit mode of operation is perfectly needless. Although it is difficult to ascertain precisely by what train of laws the shell-bearing borers effect their marvellously curious excavations, it is easy enough to convince oneself of the alarming extent to which the ravages of these never-wearying, indefatigable, yet destructive creatures extend. There appears little doubt that the *Teredo navalis* has been introduced from warmer climates into our seas. However that may be, his acclimatisation has been fully achieved, and he now abounds. Although insignificant in dimensions, it would be difficult to find any creature amongst created things which causes the same amount of destruction to valuable property as the much-dreaded "ship-worm" (*Teredo navalis*). Ships, boats, piles, dock-gates, and submarine wood-work of all kinds are hopelessly ruined by it; and although fabulous sums of money are from time to time expended in order to check his ravages, little can be done to control them.



The magnificent floating dock at Sebastopol, destroyed by the allies at the conclusion of the Crimean war, was constructed at a vast cost by the Russian Government, in order that such ships as were required to undergo repair, etc., might, by being caused to float in fresh water, escape the destruction caused by the worm. The river Tchernaya was therefore brought for a number of miles over costly aqueducts to supply the dock, but, to the consternation of the naval authorities, it was found that instead of the river water proving destructive to the teredo, it only acted as a stimulant to its growth and a help to its increase. In short, the floating dock became a perfect nursery for the ship-worm. Thus the intention with which it was constructed was at length abandoned, and salt water from the harbour was allowed to flow freely in and out. Timbers of the largest size, placed to season in the waters of the Black Sea, soon became so perforated as to become next to useless. The piles driven about our own dockyards show a fate but little better. A heavy piece of American pine timber has been ruined in the course of forty days' immersion among the ship-worms. The safety of Holland has ere this been menaced by them through the dykes being rendered insecure and riddled with worm-tubes. A great number of expedients have been had recourse to in order to guard against the surface of the wood being perforated, and it has been found that a great number of wide-headed but short-shanked nails driven into the timber to some extent answer the desired end. The sea-water rapidly oxidises the iron, causing it to throw out a large quantity of rust; this forming with the surrounding substances a dense rough crust remains unacted on, and so long as no breach is made the *Teredo navalis* remains excluded.

Whilst hunting for fragments of bored rock we shall have a fair chance of lighting on some ocean waif, bearing with it from some genial seas a cluster of necked barnacles (*Lepas anatifera*), the subjects of our illustration (Fig. 4). These are the marine animals which by some of the older naturalists were believed to be immature geese, and there are works in the British Museum in which representations of the metamorphosis can be found. It is strange and appears almost incredible that a notion so wild and baseless as this could have prevailed, and it only shows us how requisite it is that due attention should be paid to the natural orders of living things and the axiom that "like begets like." These long-necked, shell-tipped creatures are constantly found congregated on the bottoms of sea-going ships in such countless thousands as to seriously interfere with the prosecution of ocean travel, from the resistance they offer to the passing water. We have seen them chopped off with adzes literally by the cart-load. It is with a view to preventing these pests, together with sea weeds, from attaching themselves to ships' bottoms that the almost endless number of anti-fouling compositions, as they are called, have been invented. Iron ships, as well as those built of wood, are liable to become encumbered in this manner. Copper sheathing appears so far to be the most valuable protection, but up to this time serious difficulties have stood in the way of its being attached to submerged iron surfaces, on account of the decomposition of the latter metal by voltaic electricity. Science may, however, solve this difficulty. The valves of barnacles are extremely beautiful objects. Shell-like in structure, they are delicately pencilled and shaded with bands of a pale blue, varied with markings of white, whilst the valve borders are not unfrequently of scarlet, fading away into rich orange

A search along the sand flats left by the receding tides on many of our beaches will bring to light a family of tube-constructing annelids, the *Sabellæ*, represented at Fig. 5. Instead of, like the teredo, forming their tubes from calcareous matter, they build them up from minute particles of solid substance gleaned from the sedimentary deposits at the bottom of the sea. A set of organs, marvellous and admirable in their conformation, grasp the particles of matter, and by the aid of viscid and glutinous secretions thrown out by the animal the whole mass is carefully united, lined, and converted into a sand tube of exceeding grace and beauty. A fine reed can be easily passed into a newly-vacated sabella tube, and when the lining membrane is dry it retains its form and becomes a charming object for the cabinet of the collector of natural history specimens. In the formation of the sabella's tube we see another instance of what may be called special secretion. The most accomplished chemist would find it a difficult task to compound a cement which shall possess the power of firmly uniting and binding together minute particles of shell and stone gathered wet from the sands of the sea and saturated with saline elements. To him the task would be well nigh as difficult as that which tradition has assigned to the wandering phantoms of Dosmerry Pool, in Cornwall. No rest, it is said, can they enjoy until they succeed in making fagots of sand, and binding them with bands of the same material. The sabella performs a more difficult task than even this, for he constructs for himself a comfortable marine residence, with sand for his only building material.

This power of tube-building by the aid of adhesive secretion is not confined to creatures inhabiting the sea. We shall find, as in the case of land, sea, and fresh-water shells, that a striking resemblance exists between the results of the labours of aquatic and terrestrial tube-dwellers. Quitting the sea-shore, let us turn our attention to the still pools of some clear brook where the water weeds and rushes grow. Let us search amongst the lily roots and between the stones at the bottom, and we shall find case or caddis worms, the larvæ of a family of neuropterous insects, the short-lived ephemeral flies, of which the March brown and May-fly of the anglers are examples. There are, however, a great number of lesser members of this family remarkable for constructing their tubes from selected and special materials; whilst other kinds appear to glean hap-hazard from amongst the small substances at the bottom of the stream, and cement together tenantless fresh-water shells, bits of broken unio, particles of gravel, sand, etc. Fig. 6 represents one of them. We find another kind making use of short lengths of hard sharp grass stem, so arranged that all the ends point outwards like the quills of a diminutive hedgehog, as shown in Fig. 7; and a third, forming a case tusk-like in shape, and entirely of very fine grains of sand, represented at Fig. 8. We find yet other kinds building up sticks and bits of bark by a system of longitudinal arrangement, and one whose tube is formed by uniting lengths cut from blades of grass. Some of these larvæ remain more than one year in the cased stage before becoming perfect insects. In order to obtain a view of the true land case-worm or *oiketicus*, we must visit the jungles of India, or the forests of Australia, Brazil, or the Philippine Islands. Like the caddis-worm of the brook, the oiketicus makes use of a variety of materials for the construction of its castle. The first we ever discovered was suspended, as represented at Fig. 9, from a Baubul thorn-tree (*mimossa*), under which we chanced to seek shade in Bengal. The thorns of this description of tree are remarkable for their great length, toughness, and penetrating power. Taking advantage of these qualities, the oiketicus cuts them off at suitable lengths, arranges them side by side, with the points all one way, like a tapering bundle of bayonets. In the centre of this formidable array of spikes the retreat of the worm is formed. By a stout band of tough silk it swings itself from the thorn-guarded branch, and bids defiance to furred or feathered marauders. There is a most curious and interesting point in the history of the oiketicus in which it differs from most other insects. Male moths only pass through the process of transformation. The female remains during her life a tube-dweller, receiving the visits of the male in her bayonet house. After the deposition of a number of fertile eggs on the bottom of the castle of strength, the grub gradually wastes away, and at length shrivels completely up, leaving merely a ball of dry skin as a protection to the eggs below. The question as to what becomes of the young brood on arriving at an age to shift for themselves we must solve in our next paper.

CIVIL SERVICE PAPERS.—V.

GROUP V.

1.—THE SEAMEN'S REGISTER AND RECORD OF SEAMEN.

(Open Competition.)

THIS is a subordinate department of the Board of Trade, and the educational qualifications are the same as for that department. The office is at London Bridge, and the duties of it, called into existence by the Merchant Shipping Act, consist in recording the services and characters of merchant seamen, and watching over the interests of the seaman as against his employers and the officers of ships. Complaints on either side are investigated and recorded by the registrar, and in the office are compiled many valuable statistics, which serve from time to time as the basis of new regulations on the subject of the treatment of seamen. The muster roll of the naval reserve and all the detail connected therewith is kept in the office.

Salaries:—Third-class clerks, £85 to £300; second-class clerks, £250 to £400; first-class clerks, £420 to £600.

2.—STATIONERY OFFICE. (*Open Competition.*)

Office and stores at Storey's Gate, Westminster. Function —to supply all the public departments with every kind of stationery and office small stores; to print, bind, repair, and to do all that an ordinary stationer would do.

Establishment as follows:—Controller, £1,000 to £1,200, and £100 in lieu of residence; one assistant controller, £800; 1 clerk in charge of accounts, £450 to £550; 1 registrar and clerk of demands, £450 to £550; 1 storekeeper, £450 to £550; 1 clerk, of old first-class, £375 to £500; 12 clerks, £420; 2 examiners of printers' accounts, £260 to £400; 11 clerks, lower division, £80 to £200.

Professional staff:—1 superintendent of printing, £450 to £550; 1 assistant and deputy-superintendent ditto, £500; 1 assistant examiner of printing and binding in Dublin, £100 to £300; 1 receiver and examiner of job-work printing, £100 to £250; 1 examiner of paper, £400 to £500; 1 assistant examiner ditto, £200 to £300; 1 examiner of binding, £350 to £450; 1 assistant examiner ditto, £200 to £300; 1 extra examiner ditto, £100 to £150.

THE COMPETITIVE EXAMINATIONS.

We have given in a preceding paper full particulars of the subjects in which candidates are examined. It now remains that we should give a list of the departments in which, up to the present time, situations have been assigned to candidates who have succeeded in passing first-class and lower division examinations.

Admiralty.
British Museum.
Chancery (Scotland).
Charitable Donations and Bequests Commission (Ireland).
Charity Commission.
Chelsea Hospital.
Chief Secretary's Office (Ireland).
Civil Service Commission.
Colonial Office.
Constabulary (Ireland).
Criminal Law Accounts (Office of Examiner).
Customs.
Deeds, Registry of (Ireland).
Dublin Metropolitan Police.
Ecclesiastical Commission.
Education Department.
Exchequer and Audit Office.
Fisheries Office (Ireland).
Foreign Office.
Friendly Societies' Registry.
High Court of Justice (England) Pay Office.
High Court of Justice (Ireland) Accountant's Office.
Home Office.
India Office.
Inland Revenue.
Irish Land Commission.
Land Office (England).
Local Government Board (England).
Local Government Board (Ireland).
Lunacy Commission.
Mint.
National Debt Office.
National Education Office (Ireland).
Patent Office.
Paymaster-General's Department.
Post-Office.
Prisons Service (Ireland).
Prisons Department (Scotland).
Privy Council Office.
Public Works Loan Office.
Public Works Office (Ireland).
Queen's and Lord Treasurer's Remembrancer's Office (Scotland).
Record Office (England).
Record Office (Ireland).
Reformatories Office.
Registrar-General's Office (England).
Registrar-General's Office (Ireland).
Registrar-General's Office (Scotland).
Science and Art Department.
Scotch Education Department.
Seamen's Registry Office.
Stationery Office.
Temporary Commissions.
Trade, Board of.
Treasury.
Valuation Office (Ireland).
War Office.
Woods, Office of.
Works, Office of.

Specimens of Examination Papers.

The rather formidable list of subjects in which the candidates will be examined, especially under Scheme I., will probably create some little curiosity, not unmingled with apprehensions as to the value of the questions he will be required to answer. It will be impossible to anticipate the exact questions; and the candidate must trust to his general acquaintance with the subjects, when he finds himself in the room with the paper of questions before him, and no means of reference at hand. But the papers used at previous examinations have been published, and afford a tolerably safe guide as to the scope of the future examinations. The Reports of the Civil Service Commissioners, published yearly, and to be obtained at the office for the sale of parliamentary papers in Great Queen Street, contain abundant specimens of these examination papers; and we append some samples of questions which have been already put, and which may be taken as samples of those which the candidates will be expected to answer.

SPECIMENS OF QUESTIONS IN ENGLISH LITERATURE AND LANGUAGE.

Classify the letters, diphthongs, and consonants in the English alphabet.

What parts of speech admit of inflection in the English language? To what kind of inflection are they subject respectively?

Illustrate, by a few decisive examples, the manner in which the English language adopts words from the French, from the Latin, and from the Greek languages respectively, and the nature of the changes, whether in spelling, in the pronunciation, or in both, by which it assimilates them, and makes them its own.

Give instances of words ending in *head, ship, let, rie, ling, dom, most*, and explain the force of these terminations.

Explain fully the difficulty about the use of *shall* or *will*; and explain the rule by which such use ought to be regulated.

Correct the following phrases, and give in every case your reason:—

(*a*) Do not be too harsh neither.
(*b*) Either the king or his advisers has acted unwisely.
(*c*) We are now arrived at the conclusion of the three first chapters.
(*d*) By the sending to them this message he greatly comforted them.
(*e*) All that is true is not proper to be uttered.
(*f*) Whom do men say that I am?

Define a substantive. Of what equivalents for substantives does the English language admit?

How are plurals formed in English? Give examples of plurals which do *not* involve the idea of more than one of the things designated.

What do you consider to be the chief literary merits of Chaucer?

Give an analysis of the story of some one of the "Canterbury Tales."

To what causes do you ascribe the extreme meagreness of English literature in the fifteenth century?

Quote any passages, containing allusions to religious doctrines or practices, which you may recollect as occurring in Shakespeare.

SPECIMEN HISTORY PAPER.

Enumerate the principal measures of the Long Parliament, pointing out which of them were unconstitutional or unfavourable to liberty.

Give a short description of the following battles:—Verneuil, Pharsalia, Cheronæa, Morat, Chalons.

Sketch the characters, *not the lives*, of Socrates, Pausanias, Caius Gracchus, Vespasian, Cardinal Ximenes, Oxenstiern.

Give some account of the sieges of Gibraltar, Rochelle, Ciudad Rodrigo, Silistria.

Describe the policy of Henry VIII. in his relations to Charles V. and Francis I.

Mention any of the most important harbours of ancient Greece, and describe their historical incidents.

Point out some of the general results of the reign of Louis XIV. on France and on the world.

LESSONS IN ITALIAN.—XVII.

Vocabulary.

Altro, other.
Andrò, I shall go.
Bosco, forest, wood.
Cade, he falls.
Canto, lato, side.
Carta, f., paper.
Chi, who.
Dipendete voi, do you depend.
Discende, he is descended.
Dopo, after.
E' gia partito, he has already departed.
Egli abita, alloggia, sta, he lives or resides.
E'gli è ritornato, he has returned.
E' ritornata, she has returned.
E' venuto, he came.

Genitore, father, *i genitori*, pl., parents.
Glascovia, Glasgow
Io sono tradito, I am betrayed.
Lontano, distant, far.
Lui, him.
Lungi, distant, far.
Me, me.
Mercante, merchant.
Miei, my (pl. m.).
Monte, mountain.
Napoli, Naples.
Nobile, noble.
Non è ancora uscito, he has not yet gone out.
Non si distingue, one does not distinguish.
Non volevano uscire, they did not want to go out.
Oggi, to-day.
Per tutto, da per tutto, everywhere, in all places, all over.
Poc' anzi (for *pó-co án-zi*), a little while or time before; lately, the other day.
Pranzerò, I shall dine.
Pranzo, dinner (*dopo pranzo*, after dinner; in the afternoon).
Presso, near, close to, with, about.
Quà, here; *di quà*, from here (also, on this side; through this place, through here; in this world or life).
Scende, he descends.
Schiatta, race, family.
Scorre giù, flows down.
Sono stato, I have been.
Stamattina (for *qué-sta mat-ti-na*, this morning).
Tetto, roof.
Uno, one.

EXERCISE 15.

1. E'-gli è ri-tor-ná-to dal bô-sco. 2. E' gia par-tí-to da Ná-po-li. 3. I'-o só-no tra-dí-to da voi, da tút-ti. 4. Di-scên-de da ú-na schiát-ta nô-bi-le. 5. Lon-tá-no dai mié-i ge-ni-tó-ri. 6. Da chi di-pen-dé-te voi? 7. Non si di-stin-gue l' ú-no dall' ál-tro. 8. Non è an-có-ra u-scí-to dál-la cit-tà. 9. Scén-de, cá-de dal tét-to. 10. L' á-cqua scór-re giù món-te. 11. Da per tút-to. 12. Da un cán-to, da un lá-to. 13. Non vo-lé-va-no u-scí-re di quà. 14. E' ri-tor-ná-ta pôc' án-zi di Prús-sia. 15. E'-gli è di Gla-scô-via. 16. Só-no stá-to da mí-a so-rêl-la. 17. Og-gi pran-ze-rò dal mer-cán-te. 18. Dó-po prán-zo an-drò da lui. 19. E' ve-nú-to sta-mat-tí-na da me. 20. E'-gli á-bi-ta, al-lôg-gia, sta da sú-o pá-dre (*or* in cá-sa di sú-o pá-dre; *or* prês-so sú-o pá-dre).*

VOCABULARY.

A, to.
A mio pá-dre, to my father.
A qué-sto giar-dí-no, to this garden.
Da, from, by.
Da mí-o pá-dre, from my father.
Dá-to, given.
Di mí-o pá-dre, of my father.
Di qué-sto giar-dí-no, of this garden.
E'-gli á-ma, he loves.
E'-gli pén-sa, he thinks, directs his thoughts to.
Il lét-to, the bed.
Il cor-tí-le, yard, court-yard.
I'-o á-mo, I love.
I'-o pén-so, I think, direct my thoughts to.
La stán-za, room, chamber, apartment.
La tá-vo-la, the table.
Pre-stá-to, lent.

EXERCISE 16.—COLLOQUIAL.

1. Dó-ve a-vé-te voi per-dú-to il vô-stro lí-bro? 2. In qué-sto giar-dí-no. 3. Mí-o pá-dre ha ri-ce-vú-to ú-na lêt-te-ra da nô-stra zí-a. 4. Hai tu ri-ce-vú-to qué-sto re-gá-lo da tú-a so-rêl-la? 5. Mí-a má-dre ha com-prá-to qué-sta cúf-fia da vô-stra so-rêl-la. 6. Il tem-pe-rí-no che ab-biá-mo ri-ce-vú-to da nô-stro zí-o è buô-no e bêl-lo. 7. A'-mo mí-a so-rêl-la. 8. Qué-sta má-dre á-ma sú-o fí-glio. 9. Pên-so a mí-o fra-têl-lo. 10. Mí-a zí-a pên-sa a sú-o fí-glio ed a sú-a fí-glia. 11. Qué-sto fan-ciúl-lo ha scrít-to ú-na lêt-te-ra a sú-a má-dre. 12. Mí-o zí-o ha ven-dú-to il sú-o bêl ca-vál-lo a mí-o pá-dre. 13. Hô dá-to il mí-o tem-pe-rí-no a mí-a so-rêl-la. 14. A-vé-te voi pre-stá-to la vô-stra om-brêl-la a mí-o fra-têl-lo? 15. Il fí-glio di nô-stra zí-a è gran-dís-si-mo. 16. Ab-biá-mo scrít-to ú-na grán-de lêt-te-ra a nô-stro pá-dre. 17. Mí-a zí-a ha ri-ce-vú-to qué-sta cúf-fia de sú-a fí-glia. 18. A-vé-te voi ven-dú-to la vô-stra ta-bac-chiê-ra a mí-o pá-dre? 19. Hô pre-stá-to a tú-o fra-têl-lo il tem-pe-rí-no che í-o hô ri-ce-vú-to da mí-o zí-o. 20. Ab-biá-mo dá-to un man-têl-lo a qué-sto fan-ciúl-lo. 21. Hai tu pre-stá-to il tú-o lí-bro a qué-sto buôn fan-ciúl-lo? 22. A-vé-te voi tro-vá-to qué-sta pén-na nél-la scuô-la? 23. Pên-so a qué-sto fí-glio ed a qué-sta fí-glia.

VOCABULARY.

And not, *e non.*
Answer, *ri-spó-sta*, f.
Ball, *bál-lo*, m.
Cambridge, *Cam-brig-ge*
Chase, *các-cia*, f.
Coffee-house, *caf-fè*, m.
Counting-house, *scrit-tó-jo*, m.
Does he come, *vién' é-gli.*
Do you come, *ve-ní-te voi.*
Fishing, *pé-sca*,† f.
French, *fran-cé-se.*
Furniture, *i mó-bi-li*, pl. m.
Gentlemen, *Si-gnó-re*, m.
Has been already, *è gia stá-to.*
Has been sold, *só-no stá-ti ven-dú-ti.*
Has returned, *è ri-tor-ná-to.*
He comes, *é-gli vié-ne.*
Here is, *éc-co.*
His heir, *il sú-o* (pl. *suó-i*) *e-ré-de*, m.
His, *sú-o.*
I come, *í-o vén-go.*
I expect, *í-o a-spét-to.*
Is a hundred and ninety miles, *ci só-no cén-to no-ván-ta mí-glia*, pl.
Is expected, *vié-ne a-spet-tá-to.*
Is far shorter than (the transition), *è as-sá-i più cór-to che non è il pas-ság-gio.*
Is not far, *non è lon-tá-no.*
John, *Gio-ván-ni.*
Latter, *úl-ti-mo*, m.
Money, *da-ná-ro*, m.
Month, *mé-se*, m.
No, Sir, *non, Si-gnó-re.*
No, we come, *nò* (pron. *nó*), *ve-niá-mo.*
Other, *ál-tro.*
Oxford, *Os-fór-dia.*
Paris, *Pa-rí-gi.*
Play (comedy), *com-mé-dia*, f.
Return, *ri-tór-na-no.*
Riding-school, *ca-val-le-ríz-za* (*ts*), f.
Shop, *bot-té-ga*, f.
This depends, *qué-sto di-pén-de.*
Three, *tre.*
To-day, *óg-gi.*
Transition, *pas-ság-gio*, m.
Vice, *ví-zio*, m.
Virtue, *vir-tù*, f.
Walking, *pas-ság-gio*, m.
Where do . . . come from, *dón-de vén-go-no.*
Which has been sent to me, *che mi è stá-to spe-dí-to*
William, *Gu-gli-él-mo.*

* To live or reside with one may also be translated by *a-bi-tá-re* (*al-log-giá-re, stá-re*), *in cá-sa di qual-cú-no*, to live or reside in the house of some one, or *prês-so qual-cú-no*, near some one.

† Mind this important difference: *pé-sca*, fishing, fishing-place, fishery; and *pê-sca*, peach; lividity, black and blue spot (from a blow); blow, thump, cuff.

EXERCISE 17.—COLLOQUIAL.

1. He comes from the riding-school, and not from the garden. 2. From Hamburg to Paris is a hundred and ninety French miles. 3. Oxford is not far from London. 4. Does he come from the shop? 5. No, Sir, he comes from the counting-house. 6. Do you come from the play? 7. No, we come from the ball. 8. The furniture of Mr. Hall has been sold by his heirs. 9. Do you come from the garden? 10. No, I come from the coffee-house. 11. Where do these gentlemen come from? 12. Some return from the chase, others from walking, and these latter from fishing. 13. Here is the money which has been sent to me by the father. 14. This depends on the mother, and not on the brother. 15. The transition from virtue to vice is far shorter than from vice to virtue. 16. I expect an answer from John; he has been already for three months in London. 17. William has returned to-day from Paris, and his brother is expected from Cambridge.

KEY TO EXERCISES IN LESSONS IN ITALIAN.—XVI.

EXERCISE 13.

1. I have sent the letter to John. 2. To shoot at a bird. 3. The merchant thinks of profit. 4. A florin falls to the share of one. 5. Every one draws the water to his mill (looks to number one). 6. From words they came to blows. 7. To whom have you shown it? to Peter or to the cousin? 8. What are you thinking of? 9. I am thinking of the future. 10. Shall we soon arrive at the next post? 11. He ran immediately to the door. 12. He spoke to a stranger. 13. He provoked him to anger. 14. He prefers good to evil. 15. His conversation becomes tedious to me. 16. He reckons it a dishonour. 17. Liberality is imputed to him as a fault. 18. They were at the chase, the wedding, the dinner, the supper, the ball. 19. Will you go to-morrow to the public masquerade? to the concert? 20. I shall go to a ball to-morrow. 21. Go to learn, to write, to sleep, to eat. 22. They go for amusement; to take a walk. 23. Let us go to the coffee-house. 24. Which is the way to the post? to the Custom-house? 25. He is at Berlin. 26. He lives at Florence. 27. He died at Nottingham. 28. He will conduct him to Chester. 29. She arrived at Lyons. 30. He has arrived in Bristol. 31. He was born in Plymouth.

EXERCISE 14.

1. Tua madre ha perduto la sua ombrella. 2. Mia sorella ha trovato una penna. 3. Dove avete voi comprato questo temperino? 4. Hai tu veduto il nostro cavallo? 5. Abbiamo veduto un grand' osteria. 6. Vostro piccolo fratello ha un buon orologio. 7. Nostro fratello è grande ma nostra sorella è piccola. 8. Ho un cappello che è molto bello. 9. L' orologio che avete comprato è buono. 10. Nostro zio ha ricevuto una lettera. 11. Questo figlio ha perduto sua madre. 12. Questa figlia ha perduto suo padre. 13. Questo regalo è per questo fanciullo.

LESSONS IN ENGLISH LITERATURE.—VI.

FROM THE DEATH OF CHAUCER TO THE ELIZABETHAN PERIOD.

WITH the death of Chaucer and his few eminent contemporaries the first period of English literature closes, and it is succeeded by a period of literary dearth. The last half of the fourteenth century was, as we have seen, in England, an age of national unity and national glory, of religious and intellectual energy. But, for the century which followed, England was torn by the civil conflicts arising out of the claims of the rival houses of York and Lancaster. The flower of her nobles fell in the field or on the scaffold; but the distresses of the nobles can have been but small in comparison with those of other classes. In respect of foreign policy, except during the short though brilliant interlude of Henry V.'s French wars, the power and influence of England sank very low. The religious movement, which seemed nnder Wickliffe's leading to promise so mnch, appeared to have shared the fate of all premature efforts. The severe persecution of the Lollards under the Lancastrian kings, the errors and excesses of their own leaders, and the pre-occupation of men's minds with the stern realities of civil war, seemed between them to have been wholly fatal to the reforming spirit which Wickliffe had kindled; though subseqnent events showed that there was more of his spirit left among the masses in England than might have been thought. And the slaughter and ruin of so many of the cultivated classes during the civil conflicts of course reduced the number of those for whom books would be written far below what it had once been. From all these causes, the century between the death of Chaucer and the re-settlement of the English crown upon the family of Tudor, which we have taken as the second period of English literary history, was one extremely unfavourable to literature, and singularly barren of any valuable literary fruit. Indeed, though England produced many writers during this century, there is not one of them who, in almost any other age, would be thought worthy of mention. The best known among them are two poets, Occleve and Lydgate, the former a lawyer, and apparently a contemporary of, thongh very much younger than, Chancer; the latter, a monk, who flourished a few years later, and who was a skilful versifier, though no poet.

Yet, with all its barrenness, one event makes the later years of the fifteenth century a great epoch in the history of our literature, and that is the introduction into England of the art of printing, which took place probably between 1470 and 1480. This art had been used in Germany, its birthplace, for twenty or thirty years previously; but the honour of its introduction into England is due to William Caxton, himself a learned and laborious scholar and author, who, during a residence abroad, acquired the art which he imparted to his countrymen. Before the close of the century, Caxton found many imitators, and printing-presses became nnmerous, not only in London, but in Oxford and other cities.

In Scotland, during the same period, the literary spirit was far more active than in England. A national literature in Scotland had begun with Barbour, Archdeacon of Aberdeen, who flourished during the latter half of the fourteenth century, and was thus a contemporary of Chaucer. His principal work is a long poem in which he relates the adventures of Robert Bruce. The literature, of which he may be said to have been the founder, was as thoroughly national as that of England; and the language in which it was composed, though not identical with the literary language of England at the same period, was not less highly cultivated. It was the language of the Scottish Court, and of the educated classes in Scotland; and it bears much the same relation to the present Lowland Scotch dialect that the literary English of the same date does to the ordinary spoken language of to-day in England. The early Scotch writers themselves were careful to assert that they wrote Scotch, not English. Among the successors of Barbour, during the fifteenth century, the most celebrated are Wyntoun, the author of a metrical chronicle, principally of the history of Scotland; King James I. of Scotland, the romantic story of whose capture and captivity in England is so well known, and who wrote the "King's Quhair" (or book), in honour of the lady of whom he was enamoured; William Dunbar, a poet of considerable power; Gawain Douglas, Bishop of Dunkeld, the first translator of Virgil's "Æneid" into any English dialect, for we may now venture to call his language English, though he would have been but little pleased to hear it so called; Robert Henryson, or Henderson; a poet known among his contemporaries as Blind Harry, or Harry the Minstrel, author of a narrative poem in honour of William Wallace; and the accomplished knight, Sir David Lyndsay. It would be inconsistent with the plan of these elementary lessons to go into any elaborate examination of this early Scottish literature; but it must by no means be overlooked by the student of English literature, and we have said enough to intimate its importance.

With the accession of Henry VII. to the throne of England, the second period into which we have divided the history of English literature ends. Not that any great revival of literary energy, or any great change in the condition of our literature, is to be seen upon this event; but England was at this time brought under new influences which in the end produced great results. So long as the country was wasted with civil war, or paralysed by universal distrust, any real progress in literature or learning was impossible. But with the close of the dynastic struggle the danger of civil war was at an end. Domestic peace and the influence of a strong government brought with them increasing wealth and prosperity. Men were at leisure for the pursuits of peace, and England was in a condition to take her place in the race of learning. In the fifteenth century the decisive test by which advancement in learning was to be measured was knowledge of the Greek language. Among many Continental nations, and especially in Italy, the Greek language and literature had been studied for the greater part of the century. But now for the first time we find Greek regularly taught, and a high degree of Greek scholarship attained in England. And this in its turn, while it was partly caused by, largely increased that close communication between English and foreign scholars which was necessary in order to give to England the full benefit of what had been achieved in other countries. All these causes contribnted to prepare the national mind in England to receive its share of that great wave of intellectual energy which was beginning to sweep over Europe, and to render possible the literary glories of the sixteenth century.

The reign of Henry VII. itself has little literary fruit to show. Stephen Hawes was a poet once famous; but his many poems, of which the chief is an allegorical work, "The Pastime of Pleasure," are now almost forgotten. A little later in date than Hawes was another poet, Alexander Barclay, whose chief work is a translation from the German of Sebastian Brandt's satire, "The Ship of Fools."

John Skelton belongs to the reign of Henry VII. and the early part of the next. He was a Churchman by profession, and his scholarship is spoken of by no less a scholar than Erasmus in terms of the highest admiration. He was a voluminous writer, both in Latin and English. But what he best deserves to be remembered for are his hnmorous and satiric poems in English. The great butt of his satire was Cardinal Wolsey. And no doubt the great popularity of these poems, and probably, too, the impunity of their anthor, were due to the universal unpopularity of the cardinal. To a modern taste, these satires are wholly destitute of poetical power; bnt they are not without hnmour, though their chief characteristic, and no doubt at the time their chief merit, was their exhaustless fertility of abuse. The jingling metre in which Skelton wrote, and the plainness of his abuse, may be well understood from a single specimen of a very few lines. The contrast between Wolsey's pride and his low birth are delicately alluded to as follows:—

> But this mad Amalek,
> Like to a Mameluke,
> He regardeth lords
> No more the potshords;
> He is in such elation
> Of his exaltation,
> And the supportation
> Of our sovereign lord,
> That, God to record,
> He ruleth all at will
> Without reason or skill;
> Howbeit the primordial
> Of his wretched original,
> And his base progeny,
> And his greasy genealogy,
> He came of the sang royal
> That was cast out of a butcher's stall.

In the reign of Henry VIII., we need hardly remind our readers, the Reformation was in progress. The great religious struggle was convulsing Europe, and England not less than other countries. The intellectual atmosphere was essentially religious and controversial, and the literature of the day is in the main of a corresponding character. Theological treatises, sermons, serious, didactic, and philosophic writing, form its staple.

One consequence of this character in the literatnre of the period deserves the careful attention of every student. It is an invariable law in the history of literature that the weapon is not forged till it is needed. No form of literary composition comes into existence till the time has come when men's thoughts require that form for their due expression. Up to the time at which we are speaking, any literature in English having anything artistic about it had been the literature of pleasure, and its form, therefore, was naturally almost exclusively poetical. There had, no doubt, been controversies enongh carried on in England, as that between nominalists and realists, and others npon like qnestions of philosophy. But, except for a short time in the days of Wickliffe, controversy and speculation had till now been amongst philosophers, and on subjects which concerned them alone. They had, therefore, naturally been carried on in Latin, the language of the learned. But the questions now at issue were questions which concerned every man. The theologians and philosophers of the Reformation period had to address themselves not to the learned class, but to the nation; and they aimed not merely at compelling the assent of men's judgments, but at engaging their sympathies and rousing them to action. For this purpose they needed an instrument of a compass and variety unknown before. The formation of English prose style therefore dates from this period.

A very judicious critic, Hallam, pronounces Sir Thomas More to have been the first who wrote good English prose. More was unquestionably the first in learning, in genius, and in integrity among Englishmen of his day. He was known and respected among scholars throughout all Europe; filled the highest offices in the state with equal uprightness and ability; and at last died on the scaffold for his fidelity to the Roman Catholic faith. Among his works, the one which is best known in the present day is his "Utopia," in which he develops his views of government and political systems by depicting an ideal republic. The "Utopia" was written in Latin, but More's English writings are numerous, most of them being tracts bearing upon various phases of the great controversies of the day. His English work of most permanent interest is "The Life and Reign of King Richard III."

Among the leaders of the English Reformation were many copious and fluent writers, Cranmer and Latimer perhaps standing first among them. Less serious in purpose, but of not less interest in the present day, are the translation by Lord Berners of the great chronicle of Froissart, and the works of Roger Ascham. The learned Ascham was tutor to both Queen Elizabeth and Lady Jane Grey. He left behind him two works, "The Schoolmaster," a treatise on education, and "Toxophilus," the object of which is to explain and encourage the use of the bow.

But there can be no doubt that by far the most important prose works of the reigns of Henry VIII. and his successor—most important in the history of literature, no less than from other and higher points of view—were the several translations of the Bible into the English tongue, and the compilation of the Book of Common Prayer. It must be remembered that each of the long series of versions, beginning with that of Tyndale and Coverdale in Henry VIII.'s reign and ending with our present authorised version in James I.'s, was not a separate, independent translation, but, speaking generally, each was founded upon and largely influenced by its predecessor. And each of the various forms in which the Book of Common Prayer was from time to time issued was only a comparatively slight modification of the book previously in use. And if this be borne in mind, and it be further remembered how many thousands of men and women must in successive generations have derived all their literary enjoyment and formed their literary taste from little else than the English Bible and Prayer-Book, it will not be difficult to realise how great and lasting the influence even of the earliest translators and compilers must have been in developing the faculty of literary enjoyment, cultivating the national taste, and establishing and maintaining a high standard of tone and style in English prose-writing.

We have reserved to the close of this lesson the works of the two poets who adorned the latter portion of the reign of Henry VIII. The Earl of Surrey and Sir Thomas Wyatt were little removed in actual date from Barclay, Skelton, and others whom we have already mentioned, but in the style and character of their poetry there is the widest gulf between them. The one batch of poets connect the age of Henry VIII. with the darker period that preceded; the other are the harbingers of the Elizabethan day.

Sir Thomas Wyatt was the elder by some years of these illustrious friends, having been born in 1503, and having died in 1542. From his wit and accomplishments, he was one of the most brilliant ornaments of the court of Henry VIII., and his public career was distinguished, but he died in the very prime of life. His character, as painted by Lord Surrey—and Lord Surrey's sketch is in harmony with all we learn of Wyatt from other sources—is singularly attractive.

Lord Surrey was born in 1517. He was heir-apparent to the dukedom of Norfolk, and the leading representative of the ancient and noble house of Howard. His rare mental gifts and noble and generous character made him, during his short career, the very ideal of the chivalrous noble. At the very close of Henry VIII.'s reign, Surrey, together with his father, the Duke of Norfolk, was thrown into prison on a charge of treason. There does not seem to have been the slightest pretext for any such charge, and probably it is to be ascribed to the jealousy and ill-will of the reigning favourite, Hertford. Surrey was, however, found guilty after the mockery of a trial; and one of the last acts of the king's life—the last of his long series of crimes—was to order his execution.

The poetry of Wyatt and Surrey is very similar in its general character, though Surrey was decidedly the greater poet of the two. The poems of both are generally short, and for the most part on amatory subjects. They are clearly formed upon Italian models; and they show a smoothness and ease of versification, and a delicacy and refinement both of thought and expression, quite unknown to any poet since Chaucer. Surrey deserves to be remembered, also, as the first to introduce blank verse into England. This metre he derived, no doubt, from the Italian, and he used it in his translation of two books of the "Æneid" of Virgil.

A single specimen of one short poem of Surrey is all that our space allows us to give. It is a fair specimen of his style:—

Give place, ye lovers, here before
  That spent your boasts and brags in vain;
My lady's beauty passeth more
  The best of yours, I dare well sayen,
Than doth the sun the candle light,
Or brightest day the darkest night.

And thereto hath a troth as just
  As had Penelope the fair;
For what she saith ye may it trust,
  As it by writing sealed were;
And virtues hath she many mo'
Than I with pen have skill to show.

I could rehearse, if that I would,
  The whole effect of Nature's plaint,
When she had lost the perfect mould,
  The like to whom she could not paint;
With wringing hands, how she did cry,
And what she said, I know it, aye.

I know she swore, with raging mind,
  Her kingdom only set apart,
There was no loss by law of kind
  That could have gone so near her heart;
And this was chiefly all her pain,
"She could not make the like again."

Sith Nature thus gave her the praise,
  To be the chiefest work she wrought,
In faith, methink, some better ways
  On your behalf might well be sought,
Than to compare, as ye have done,
To match the candle with the sun.

READINGS IN LATIN.—VI.

CICERO.

The perfection of the literature of Rome culminates in Marcus Tullius Cicero, who lived from B.C. 106 to B.C. 43. Both as an orator and a philosopher Cicero attained to the highest point of excellence, and as a writer of letters he is without a rival. With his achievements as a statesman we have little to do in this place, but it may be at least noticed that he took an active part in political affairs, and at least on one occasion—the conspiracy of Catiline, the merit of the discovery and suppression of which fairly rests with him alone—was in a literal sense the "saviour of his country." The part which he subsequently played in the civil wars between Pompey and Cæsar does not greatly redound to his credit, and he showed himself weak and vacillating. Probably he was too much of a philosopher to be a man of energetic action when the right path was difficult to discover, and in each of the great political parties Cicero must have seen much that was revolting. Still, one forgets much of his weakness in his tragical end, and his murder, which was an act of stupid, unreasoning cruelty, must remain for ever as a dark blot on the policy of those who dictated it. But it is by his writings that Cicero will best be remembered. Treatises on philosophy, speeches forensic and judicial, and letters innumerable flowed from his pen, and happily the greater part of them have been preserved to our own times. He left to others the writing of history, but his short essay, "De Republicâ," shows that he had an intimate and critical acquaintance with the history of his country, and a sound knowledge of the political principles on which the Roman constitution had been built up. His style has always been allowed to be perfect, "Ciceronian" Latin having passed into a proverb, and it is the ideal to which all the writers of Latin prose in the Middle Ages and subsequently have endeavoured to attain. It is distinguished by its simple elegance and singular absence of mannerism; the words are selected and the sentences constructed and balanced with a careful attention to the laws of rhythm and harmonious propriety, which, in a writer so voluminous, may well excite our astonishment and challenge our imitation. In the extracts given below we have endeavoured to give the reader a specimen of Cicero's powers in each of the branches of literature in which he chiefly distinguished himself—philosophy, oratory, and letter-writing—though our space is far too limited to allow us to do anything like justice either to the quantity or the quality of his writings. Cicero's philosophical works, always faultlessly written, contain, every now and then, passages of singular beauty. The following eloquent apostrophe to philosophy, taken from the "Tusculan Disputations," a series of imaginary discourses and conversations held at his villa at Tusculum, has always been greatly admired:—

CICERO.—"TUSC. DISP.," V. 2.

Sed et hujus culpæ,[1] et ceterorum vitiorum peccatorumqne nostrorum omnis a philosophia petenda correctio est: cujus in sinum cum a primis temporibus ætatis nostræ voluntas studiumque nos contulisset, his gravissimis casibus[2] in eundem portum,[3] ex quo eramus egressi, magna jactati tempestate confugimus. O vitæ Philosophia dux! O virtutis indagatrix, expultrixque vitiorum! quid non modo nos, sed omnino vita hominum sine te esse potuisset? tu urbes peperisti; tu dissipatos homines in societatem vitæ convocasti; tu eos inter se primo domiciliis, deinde conjugiis, tum literarum et vocum communione junxisti; tu inventrix legum, tu magistra morum et disciplinæ fuisti: ad te confugimus, a te opem petimns: tibi nos, ut antea magna ex parte, sic nunc penitus totosque tradimus. Est autem unus dies bene et ex præceptis tuis actus, peccanti immortalitati[4] anteponendns. Cujus igitur potius opibus utamur quam tuis? quæ et vitæ tranquillitatem largita nobis es, et terrorem mortis sustnlisti? Ac Philosophia quidem, tantum abest, ut[5] proinde ac de hominum vita est merita, laudetur; ut, a plerisque neglecta, a multis etiam vituperetur. Vituperare quisquam vitæ parentem, et hoc parricidio[6] se inquinare andet? Et tam impie ingratus esse, ut eam accuset, quam vereri deberet, etiam si minus percipere potuisset?

NOTES.

1. Hujus culpæ. The error to which Cicero had just before alluded of magnifying and exaggerating our misfortunes.
2. His—casibus. He probably alludes to Cæsar's death, or perhaps more generally to the civil wars of the period.
3. Eundem portum, etc., philosophical retirement and contemplation.
4. Peccanti immortalitati, *an eternity of sin.* The reader will perforce be reminded of the more pious ejaculation of the Psalmist, "One day in thy courts is better than a thousand."
5. Tantum abest, ut, etc., *is so far from being praised as it deserves, that it is even railed at.*
6. Hoc parricidio, *by the guilt of such a parricidal act.*

The following extract is the vigorous commencement of the first of Cicero's speeches against Catiline, the story of whose conspiracy, and its detection by Cicero, we have already given in our extracts from Sallust's account of the transaction. In spite of the fact that his treason was well known, Catiline still had the audacity to appear in the Senate; and it was while he was sitting there that Cicero attacked him in the following indignant words:—

CICERO.—"IN CATILINAM," I. 1.

Quousqne tandem,[1] Catilina, abutere patientia nostra? Quamdiu etiam[2] furor iste tuus nos eludet? Quem ad finem sese effrenata jactabit audacia? Nihilne te nocturnum præsidium Palatii,[3] nihil urbis vigiliæ, nihil timor populi, nihil concursus bonorum omnium, nihil hic munitissimus[4] habendi senatus[5] locus, nihil horum ora vultusque moverunt? Patere tua consilia non sentis? Constrictam[6] jam horum omnium scientia teneri conjurationem tuam non vides? Quid proxima,[7] quid superiore nocte egeris, ubi fueris, quos convocaveris, quid consilii cœperis, quem nostrum ignorare arbitraris? O tempora![8] O mores! senatus hæc intelligit: consul videt: hic tamen vivit. Vivit? immovero in senatum venit, fit publici consilii particeps: notat et designat oculis ad cædem unumquemque nostrum. Nos autem, fortes viri, satisfacere rei publicæ videmur, si istius furorem ac tela vitemus. Ad mortem te Catilina, duci jussu consulii jam pridem oportebat; in te conferri pestem quam tu in nos omnes jamdiu machinaris. An vero vir amplissimus P. Scipio,[9] pontifex maximus, Ti. Gracchum mediocriter[10] labefactantem statum rei publicæ privatus interfecit. Catilinam orbem terræ cæde atque incendiis vastare cupientem, nos consules[11] perferemus. Nam illa nimis antiqua prætereo, quod C. Servilius Ahala,[12] Sp. Mælium novis rebus studentem[13] manu sna occidit. Fuit, fuit ista quondam in hac re publica virtus, ut viri fortes acrioribus suppliciis civem perniciosum quam acerbissimum hostem coercerent. Habemns senatus consultum[14] in te, Catilina, vehemens et grave, non deest rei publicæ consilium atque auctoritas hujus[15] ordinis: nos, nos, dico aperte, consules desumus.

NOTES.

1. Tandem, *to what length will it go, when will it cease?*
2. Quamdiu etiam, *how long still?*
3. Palatii, the ascent to the Palatine Hill from the Via Sacra had been occupied by an armed force.
4. Munitissimus, *most strongly defended.*
5. Habendi senatus. The participle in dus agreeing with the noun, in preference to the gerund governing the noun—habendi senatum.
6. Constrictam, *stifled, restrained.*
7. Proxima. The speech was delivered on the 8th of November; on the 6th superiore (= priore) a meeting of the conspirators had been held at the house of M. Læca.
8. O tempora, etc. The degeneracy of the age consisted in the fact that Catiline could still show his face, without danger of being put to death.
9. P. Scipio. This was P. Scipio Nasica Serapio, Pontifex Maximus, who led the rout that attacked Ti. Gracchus and killed him, B.C. 133.—*Long.*
10. Mediocriter, etc., *who was only sapping the foundations of the state, to a moderate extent.*
11. Privatus—consules. If he did this as a private man, how much more should we, who are the constituted authorities, act in a similar way in this case?
12. C. Servilius Ahala. Ahala killed Mælius because he refused to obey the orders of the dictator, Cincinnatus.—*Long.*
13. Studentem. Studeo, with acc., means *to study*; with dat., *to be bent upon, to aim at*; novis rebus, *a revolution.*
14. Senatus consultum. This was a decree passed on the 21st of October previous, by which the consuls received authority to employ force of arms.—*Long.*
15. Hujus, the senatorial order.

The following is one of Cicero's letters to his friend Atticus, which will serve as a specimen of his style in this branch of literature:—

CICERO.—"EPISTOLÆ AD ATTICUM," I. 15.

Asiam Quinto, suavissimo fratri, obtigisse audisti: non enim dubito, quin celerius tibi hoc rumor, quam ullius nostrum litteræ nuntiarint. Nunc quoniam et laudis avidissimi semper fuimus,[1] et præter ceteros φιλέλληνες[2] et sumus et habemur, et multorum odia atqne inimicitias reipublicæ cansa suscepimus, παντοίης ἀρετῆς μιμνήσκεο, curaque et effice, ut ab omnibus et landemur et amemur. His de rebus plura ad te in ea epistola[3] scribam, quam ipsi Quinto dabo. Tu me, velim,[4] certiorem facias, quid de meis mandatis egeris, atque etiam, quid de tuo negotio. Nam ut Brundisio[5] profectus es, nulla mihi abs te redditæ litteræ. Valde aveo scire, qnid agas. Idib. Mart.[6]

Cicero's brother Quintus has just obtained the government of the province of Asia (Asia Minor), and Cicero writes to Atticus to ask him to endeavour to strengthen his hands.

NOTES.

1. Fuimus. Cicero by this expression completely identifies himself with the welfare of his brother.
2. Φιλέλληνες. Cicero very frequently makes use of Greek words and phrases in his familiar letters, just as we often use French; a knowledge of Greek being considered in a Roman a mark of a polite education, as French with us.
3. Ea epistola. There are extant some letters of Cicero to his brother, on the occasion of his appointment, full of excellent advice on these points.
4. Tu me, velim, etc., *please let me know.*
5. Brundisio. A town on the south-west coast of Italy, the usual starting-point for Greece.

6. Idib. Mart. Sc. Idibus Martiis dato; posted on the 15th of March.

TRANSLATION OF LIVY, I. 13, IN READINGS IN LATIN.—V.

At this juncture the Sabine women, from the outrage on whom the war originated, with hair dishevelled and garments rent, the timidity of their sex being overcome by such dreadful scenes, had the courage to throw themselves amid the flying weapons, and making a rush across, to part the incensed armies, and assuage their fury; imploring their fathers on the one side, their husbands on the other, "that as fathers-in-law and sons-in-law they would not contaminate each other with impious blood, nor stain their offspring with parricide, the one their grandchildren, the other their children. If you are dissatisfied with the affinity between you, if with our marriages, turn your resentment against us; we are the cause of war, we of wounds and of bloodshed to our husbands and parents. It were better that we perish than live widowed or fatherless without one or other of you." The circumstance affects both the multitude and the leaders. Silence and a sudden suspension ensue. Upon this the leaders come forward in order to concert a treaty, and they not only conclude a peace, but form one state out of two. They associate the regal power, and transfer the entire sovereignty to Rome. The city being thus doubled, that some compliment might be paid to the Sabines, they were called Quirites, from Cures.

LESSONS IN BOTANY.—XL.

SECTION CXXI.—MOSSES (*continued*).

Mrs. Somerville, in her "Physical Geography," has given some curious facts regarding mosses and lichens on those Antarctic lands which are scattered, according to some, at immense distances from each other round the South Pole, while others suppose that they are connected at points beyond the parallel of latitude to which man has hitherto been able to penetrate, and thus form a great southern continent. She says:—"As the latitude increases, the vegetation decreases, till at last utter destitution prevails, not a lichen clothes the rocks, nor a seaweed lives beneath the gelid waves. In the Arctic regions, on the contrary, no land has yet been discovered wholly destitute of vegetable life. The difference seems to arise more from the want of warmth in summer, than from the greater degree of cold in winter." She also states that "in Tierra del Fuego there is a greater number of plants identical with those of Great Britain, or representatives of them, than is to be found in any other land in the southern hemisphere, and among them, forty-eight of the same mosses."

Lovely as is this tribe of plants, we cannot give a good report of them as ministering directly to the life of any part of the animal creation. They do not furnish nectar for the moth or butterfly, nor honey for the bee; nor does any grub or worm find its sustenance from them; and if they are eaten by cattle, or by hares, and other small animals, it is rather by accident than choice. They, however, tend much to the extension and preservation of vegetable life, both by the soil which their decay supplies, and by their power of absorbing moisture and retaining it, which makes them a valuable shelter to the roots of trees and plants. The power which they possess of imbibing, as it were, new life from water after they have long been dry and apparently dead, renders mosses very useful in the greenhouse. Very beautiful baskets for holding flowers may be made of the longer and more feathery kinds. We have made them often; and never do flowers, whether wild or garden, look more lovely than when clustered within a verdant border of that most delicate and beautiful material, which by proper management may be made to preserve its freshness and brilliancy for many months. We will here give a receipt for their manufacture.

A light frame of any shape you like should be made with wire and covered with common pasteboard or calico, and the moss, which should first be well picked over and cleansed from any bits of dirt or dead leaves which may be hanging about it, gathered into little tufts, and sewed with a coarse needle and thread to the covering, so as to clothe it thickly with a close and compact coating, taking care that the points of the moss are all outwards. A long handle made in the same manner should be attached to the basket, and a tin or other vessel, filled with either wet sand or water, placed within to hold the flowers. By dipping the whole fabric into water once in three or four days, its verdure and elasticity will be fully preserved, and a block of wood about an inch thick, and stained black or green, if placed under the basket, will prevent all risk of damage to the table from the moisture. To make such baskets affords much pleasant social amusement for children, who will find a constantly renewing pleasure in varying their appearance. One week, snowdrops and crocuses will cluster among the mossy edges; then will come groups of "dancing daffodils" and hazel catkins, which, mixed with ivy leaves, make almost the prettiest dressing that can be found for it. In another week or two, anemones, hyacinths, and jonquils will crave admittance into the place of honour; and long before the basket is decayed, roses, lilies, jasmine, and even carnations, will have sprung into beauty, and had their day in the favourite moss basket.

CLUB-MOSSES.

The organisation of the *Lycopodiaceæ*, or club-mosses, will be found well worthy the attention of those who delight to find subjects for praise and adoration of the great Creator in the works which he has made. The order contains but two families, the true club-mosses and the *Isoeteæ*, or quill-worts.

The club-mosses have a tough, persistent stem, beset with hard short leaves. There are no veins in their leaves, which are, however, furnished with large stomata, or apertures in the cuticle for the admission of air to the cellular tissue of the plant, and are for the most part narrow and taper-pointed. The stems are frequently twelve or thirteen feet in length, and in some species raise themselves into an erect position and become woody; thus approximating to the character of some *Coniferæ*. In the coal strata are found some curious fossilised remains of gigantic *Lycopodiaceæ*, which are called *Lepidodendra*, or scaly trees, from the mode of the arrangement of their leaves. These in outward appearance form a connection between the two groups—the club-mosses and the *Coniferæ*. The fructification of this group consists of a short spike, formed by a prolongation of the branch, round which are clustered a number of two-valved capsules. These are sometimes of two kinds; one containing a mass of fine powdery granules; the other, including only three or four roundish fleshy bodies, are very much larger in size than the granules. Both these kinds of capsule lie among the hair-pointed leaves of the head, one in the bosom of each leaf, and enclosed in pale yellow cases. Whether both these kinds, the powder and the spores, have alike the power of reproducing their species, seems as yet not to be determined, and botanists differ as to which of them is to be considered as the seed. Lindley tells us the larger bodies are the reproducing organs; Decandolle thinks the one fertilises the other. It is certain that the powder is endued with a curious inflammable property, and is used in making the Chaldee fire, and has also been employed in making artificial lightning at the theatres.

Lycopodium clavatum (Fig. 286), the wolf's-claw or stag's-horn moss, is the only species that can be said to be common in England, but that may be found on most elevated moors and heaths. It was formerly found on Hampstead and Hounslow Heaths, and in other London localities. In Wales, Scotland, and the lake countries, and in other mountainous districts, it is abundant, but in Ireland less frequent. The roots of this species are not deeply fixed into the earth, but they run matting themselves together just under the surface, serving thus to bind the soil, and prevent it from crumbling away. The stem is prostrate, frequently branched; the branches slightly raised at first, and then becoming procumbent; these branches thus run sometimes for ten or twelve yards from a centre. The branches are covered with narrow, flat, smooth leaves, the edges of which are slightly toothed and hair-tipped. These leaves do not fall off, but are evergreen and persistent. When about to form fruit there are thrown out from various parts of the branches spikes clothed with leaves, longer, narrower, and of a paler green than those which beset the original stem; these branches are crowned with pale sulphur-coloured heads, something like catkins, usually two on each stem in pairs, but in some cases three will start from the same point. In these spikes are the smaller kind of fruit which we have described. The capsules which contain them are in this species kidney-shaped, perfectly sessile, and situated at the base of the bracts. Each is two-valved, and full of the small spores or powder.

Lycopodium annotinum, the interrupted club-moss (Fig 287), is another very interesting species of this genus, of rare occurrence in the British Isles, but common in Norway, Sweden, and in North America. The roots of this species are tough, wiry, and tortuous, the stem creeping, very strong, and with a deeply indented and striped surface. It sends out at intervals branches from one to three or four inches apart, in an erect position; these increase annually, the growth of each year being marked by the altered length and direction of the leaves. These upright branches sometimes divide again, and when fertile, which is not always the case, the spike is usually on the sixth or seventh joint of the branch. When mature, the branches become prone, throw out roots, and send up erect branches as before. The branches are clothed throughout with linear leaves very acutely pointed, and with minute serratures at the edges. The fruit spike is oblong, and seated on the point of the branch in this species, being entirely devoid of the peduncle or foot-stalk on which the spike of *Lycopodium clavatum* is elevated. The leaves, or bracts, in the spikes are nearly round, yet pointed at the apex, and in the axil of each is placed a large conspicuous veniform capsule, which, when ripe, opens transversely, and sheds numerous minute sulphur-coloured spores.

Lycopodium alpinum, the savin-leaved club-moss, is more common than the last-named species; it is a pretty plant, its foliage of a brighter green than any other of its congeners, and in the summer its young shoots have a blue tint. After the escape of the seeds, the spikes bend into a semi-circular shape, and the bracts become reflexed. Sir W. Hooker tells us that it is much used in Iceland as a dye for woollen cloths. He says, "A vast heap of *Lycopodium alpinum*, lying before the priest's house, drew my attention, and on inquiring, I found that it was used for the purpose of giving their wadmal a yellow dye, which is done by merely boiling the cloth in water with a quantity of the *Lycopodium*, and some leaves of *Vaccinium uliginosum* (the bog-whortleberry). The colour imparted by this process, to judge from some cloth shown me, was a pale and pleasant, though not a brilliant, yellow." Wadmal is the woollen cloth usually worn by the Icelanders. Sir W. Hooker tells us that this species of club-moss is the badge of the Clan Macrae.

The marsh club-moss (*Lycopodium inundatum*) is a rather insignificant species which springs up on heaths and commons, especially where the turf has been pared; and neither that nor the prickly club-moss (*Lycopodium selaginoides*) must receive much of our attention, though of the latter we must just notice that it alone produces the double sort of fructification which we have named in our account of the genus *Lycopodium*. The upper capsules contain the minute pollen-like granules, the lower larger grains almost equal in size to the seeds of some flowering plants.

286. WOLF'S-CLAW OR STAG-HORN MOSS (LYCOPODIUM CLAVATUM). 287. INTERRUPTED CLUB-MOSS (LYCOPODIUM ANNOTINUM).

The fir club-moss (*Lycopodium Selago*) is the last species on our list. This ascends the summits of our highest mountains, and is also found on the level of the sea. It has been considered as possessing many extraordinary medical properties, but seems an unsafe remedy to meddle with, as, if too much is used, it induces convulsions. There is a curious species of lycopodium mentioned by Dr. Carpenter as inhabiting Peru, which he says is liable to be entirely dried up when deprived of water for a time. "It then folds in its leaves and contracts its roots, so as to form a ball, which, apparently quite devoid of animation, is driven about hither and thither by the wind. As soon as it reaches a moist situation, it sends down its roots into the soil, and unfolds to the atmosphere its leaves, which, from a dingy brown, speedily change to the bright green of active vegetation."

The quill-wort (*Isoetes lacustris*) is the only other genus comprised under the order *Lycopodiaceæ*. This is a little plant confined to mountain lakes, and there are but few other species in the genus. It has a tuberous root about the size of a hazel-nut, from which hang tubular white fibres; the leaves are also tubular, and rise from the point of the root without any foot-stalk. They are of a bright green, and very brittle. The fruit is very curious, consisting of capsules about the size of swan-shot, embedded in the very substance of the base of each leaf. Newman says the quill-wort "clothes the bottom of deep and still waters with a perennial verdure." It is found in the little lakes which abound among the Snowdon range and other mountainous districts.

The *Lycopodiaceæ* are considered to be, on the whole, the most highly organised of the cryptogamous or flowerless plants.

RECREATIVE SCIENCE.—VI.

REFRACTION, LENSES, AND MAGNIFYING POWER.

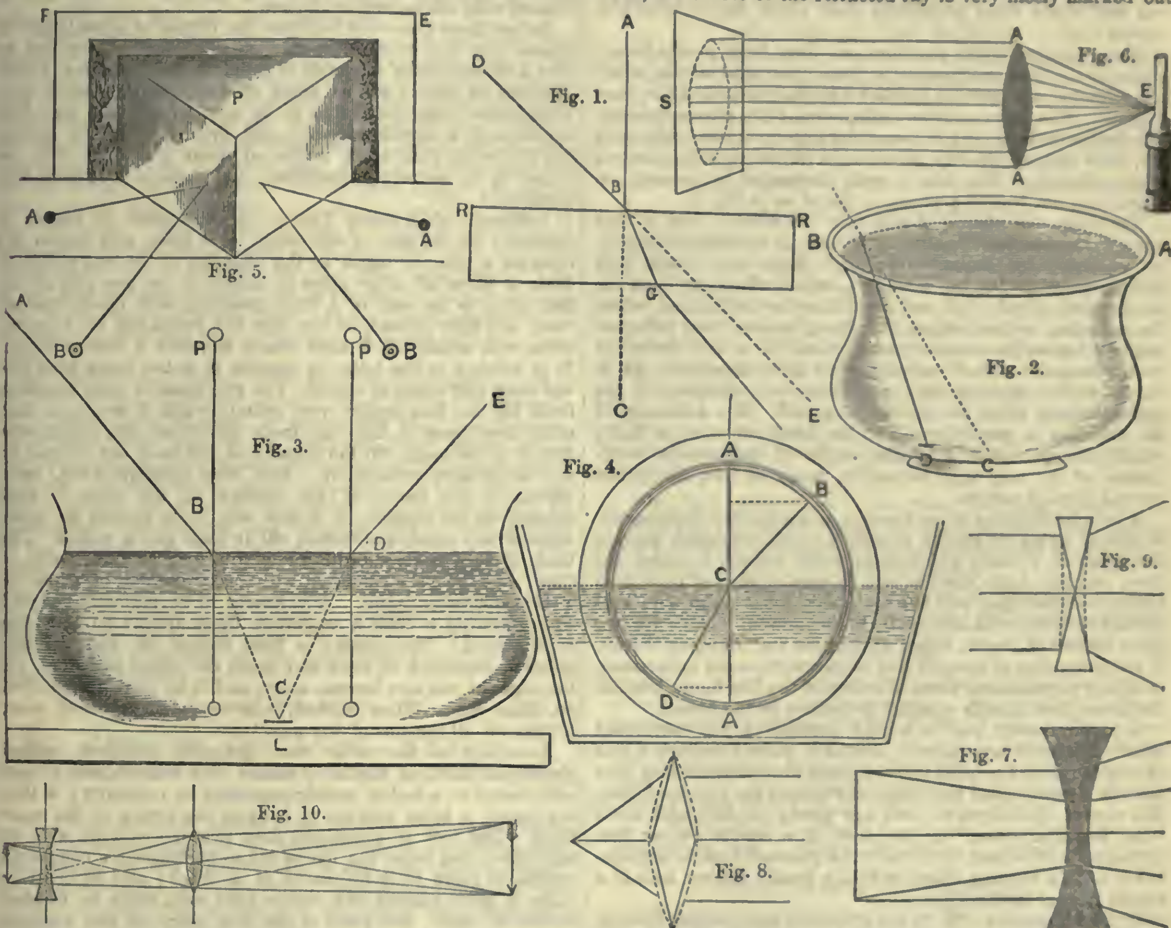
Refraction—from *re* (back) and *frango* (to bend), the bending back of the ray of light—is a property of light which has tempted many a youth to plunge into water that appeared shallower than it really was, because a place six feet deep would seem to be only a depth of four feet and a half; and upon this fact may be founded the question, Why does the water appear to be shallower than it really is? The answer is best given experimentally.

When a pencil of light falls upon the surface of water in a perpendicular direction, nearly every portion passes into, and is transmitted by the latter. If the rays fall obliquely upon the water some of them are reflected, whilst that portion which enters the water does not pursue a straight line, but is bent in a direction towards or nearer to the perpendicular; and it is this bending of the ray which is called refraction.

Thus the ray A B (Fig. 1) enters the refracting surface R R, and proceeds to C in the same direction, whilst D B, entering the water obliquely, instead of proceeding in the same direction B E, is bent in the direction B G, which makes a less angle with the perpendicular, B C, than if it had proceeded to E.

It is therefore asserted, with certain exceptions, that a ray of light in passing from a rare into a denser medium is bent towards the perpendicular, and the contrary when the pencil of light emerges from a dense into a rarer medium. It must be understood that the density or rarity of the body referred to is not that of specific gravity. Optically considered, one body may be denser than another, whilst, physically, it is really lighter; thus, oil of turpentine is lighter than water, but has a higher refracting power than the latter, so that a ray of light passing from turpentine into water is refracted *from* the perpendicular, and in passing from water into turpentine it is bent *towards* the perpendicular. In optical language the densest body is that which has the highest refracting power; and this being understood, the above general assertion is easily proved by allowing a sunbeam to pass through a hole in a shutter, so that it may fall upon the bottom, C, of an empty glass fish-globe, A B, or other convenient basin. (Fig. 2.)

The place, C, where the ray of light strikes the glass, should now be marked by laying a piece of bright silver there, and when the globe is filled with water, without moving it from its position, the ray no longer falls upon the spot where the silver was placed, but at D; hence "the angles of incidence and refraction are in the same plane perpendicular to the refracting surface," corresponding in this experiment with the shutter-line through which the beam of light passes. If the water in the globe is made slightly opalescent by the addition of a few drops of milk, the course of the refracted ray is very nicely marked out,



and when allowed to fall upon a piece of looking-glass it is seen to be reflected through the water, according to the laws of reflection, and emerging from the denser medium, water, into the rarer one, air, the bending of the ray from the perpendicular is seen: thus both refraction and reflection are illustrated in these experiments.

The sunbeam, A B (Fig. 3), falling on the surface of the water, where a plummet line, P, is suspended, is bent or refracted in the direction B C, or towards the perpendicular; the ray, B C, falling on the looking-glass, L, is reflected at an equal angle through the water to D; here, on emerging into the air, it is refracted from the perpendicular or plummet line, L, in the direction D E; hence "the sine of the angle of incidence, divided by the sine of the angle of refraction, is a constant quantity," and is called the *index of refraction*. The *sine* is a perpendicular line drawn from the extremity of an arc to the diameter of a circle. The law of sines published by Descartes, and known as Descartes' law, was discovered by Willebrord Snell, a Dutch mathematician, about 1612.

At the back of a white plate, A (Fig. 4) describe a circle in black paint, and after drawing a perpendicular line, A A, and a horizontal one, which will be the diameter of the circle, imagine the horizontal line to represent the surface of the water, and the other will of course be perpendicular to it. Let B C be the incident ray, and C D the refracted ray; if a dotted line is drawn from the extremity of the arc at B to the diameter A, that will be the sine of the angle of incidence, and the other dotted line, drawn from the extremity of the arc at D to the diameter A, will be the sine of the angle of refraction; then if the sine of the angle of incidence, which may be supposed to be four inches, is divided by the sine of the angle of refraction, ascertained by direct experiment to be three inches, the quotient will be 1·333, which is called the index of refraction for water. If the lines are drawn upon the plate with black varnish, the plate can be held upright in water, and the young student may trace out and study more practically that which might otherwise puzzle him.

There are particular positions, as when light passes from a dense into a rare medium—viz., from glass into air—in which the refracted ray becomes parallel with the surfaces of the glass and air. At a more oblique angle, when light passes through the denser medium, and becomes incident upon the surfaces of the glass and air, the ray is no longer refracted, but undergoes *total reflection.* This fact is well illustrated by placing an engraving, E E, behind a prism, P, placed as in Fig. 5.

The prism and picture should face the window, and if they are placed on a stand level with the eyes, it is curious to notice, as the spectator walks round, that there are certain very oblique positions at the sides, A A, where the light from the window only is reflected and no picture is visible, and where the reflecting surface shines like silver, because total reflection occurs; but as the observer moves round in a half circle, say from B to B, the picture reappears, and again disappears as he passes to the opposite side, and looks very obliquely at the surface behind which the picture is placed. The brilliancy of the diamond is greatly owing to the total reflection of light, which becomes visible at smaller angles of incidence in consequence of the very high refractive power of this, the purest natural form of carbon.

A lens, in dioptrics (from διοπτρον, a perspective instrument), is defined by an old author to signify a small roundish glass of the figure of a *lentil*, which, in scientific botany, is called the lens; and this Latin word is said to have originated from *lenis* (mild), because those who fed upon this sort of pulse were supposed to become mild and gentle in disposition. There are two great classes of lenses, called convergent and divergent lenses. If the properties of concave and convex mirrors are understood, it is easy to remember those of lenses of the like figure, because the latter have exactly opposite properties to the former.

A double convex lens is a good example of the convergent class: divergent rays become parallel if passed through a lens of this shape, and parallel rays are made so convergent that they meet at a point called the *focus*, and termed the *principal focus.* The rays of light from the sun are nearly parallel, and hence "the principal focus," or *fire-place*, of a double convex lens corresponds with that spot where the greatest heat is accumulated, as in a burning glass, so that a double convex lens is a simple form of burning glass.

In the illustration (Fig. 6) the divergent rays passing from an aperture, E, in the copper chimney of an argand oil or gas light, fall upon a double convex lens, A A, and by refraction become parallel, and fall upon the screen of paper, S; by reversing the description, and starting from S, as the source of parallel rays, they are collected by A A, and meet at the focus, or fire-place, E.

A double concave lens (Fig. 7) is a good example of the divergent class. Rays of light already divergent become still more so if allowed to fall upon a lens of this form. Parallel rays are made divergent, and even convergent rays are turned in the opposite direction, and made less so by a double concave lens.

With two prisms the principle of the double convex or concave lens is demonstrated in the most instructive manner. By placing the prisms base to base, and passing a pencil of sunlight from a hole in a shutter through them, the rays are bent inwards, and converge to a point, as they would do with a convex lens, and this is easily seen by referring to Fig. 8.

When the position is reversed, as in Fig. 9, and the prisms are held edge to edge, they virtually form a double concave lens, and the same rays are now scattered outward, and become divergent.

Lenses have various figures, and the lines that bound them may be portions of circles or ellipses, or they may be right lines. Generally speaking, one or both sides are portions of a spherical surface, or one side may be a portion of a sphere, and the other a plane surface. Thus there are plano-convex or plano-concave lenses, one side of which would be flat, and the other curved; or concavo-convex lenses, concave on one side and convex on the other, and if the concavity exceeds the convexity, it would be regarded as a concave lens belonging to the divergent class. A most useful lens is the meniscus, meaning a *little moon* or *crescent*, one of whose surfaces is convex and the other concave; but as the convexity exceeds the concavity, this would be considered to be a convex lens, and must be classed with the convergent lenses.

Before there were such facilities for obtaining glass lenses of almost any size or shape, it was always thought necessary to give a description of the mode of grinding and polishing lenses in works on optics; and as many of our younger readers may have lathes, and would like to be able to say that they had constructed a simple telescope, and ground their own lenses, the following particulars, published many years ago, will be found to be eminently practical, and capable of giving fair results:—

"*Manner of Grinding Lenses.*—A little piece of copper is cemented to the end of the arbor of a lathe, and turned till it forms a dish or bason of the diameter of the lens required. Then a piece of clear glass is cemented, on one side of its flat sides, to the end of a little mandrel, with black Spanish wax; and thus ground, on the side not cemented, on a grindstone with water, till it hath nearly acquired a convex figure. It is finished in the lathe by turning it in the basin with fine wet sand, grit stone, or emery. The grit must be often repeated fresh till the lens appear very round; when it comes to that point they cease to take any fresh grit stone, but continue to turn it in the basin, till the remains of the sand are become so fine as to have polished it. This they perceive when, upon wiping it, the image of the window of the place is seen painted on its surface; if it does not, it is rubbed in water without any sand, and turned till it hath got a polish. The basin is then covered, withinside, with two or three folds of linen, and the polish finished with putty powder, or tripoli of Venice steeped in water. It is known to be perfectly polished when, viewing it with a magnifier, there appear no scratches of the sand. The cement is then broken off, and the side polished cemented, to work and grind the other, as before, till the edges of the lens become sharp, and it be perfectly polished on either side. When finished, it is washed in spirits of wine, to take off all remains of the wax."

According to the mode now generally practised, optical glasses are fixed on blocks by means of a cement, and ground with emery on a tool of proper convexity or concavity; if they are small, a large number is fixed on the blocks at the same time. The tool is sometimes first turned round its axis by machinery, and when the lenses are to be finished, a compound motion is given to it by means of a crank; and in order to make it work smooth, the wheels turn each other by brushes instead of cogs. The point of the lens where its two surfaces are parallel is determined by looking through it at a minute object while it is fixed in a wheel with a tubular axis, and shifting it until the object appears no longer to move; a circle is then described as it revolves, in order to mark its outline.

The dishes in which lenses are ground are of bell metal, and the emery is prepared by elutriation. The writer has seen five hundred spectacle-glasses ground and polished at the same time by machinery at Sheffield, the operation being principally conducted by women, who exhibited the greatest dexterity in all the manipulations, such as cementing the glasses on to the tool, and adjusting the basins and emery-powder to the work required to be done.

The focal length of any convex lens is easily found, by holding its axis in a line with the sun; the burning-point, or the place where the rays are concentrated to the smallest speck, is its focus; the distance of that focus from the lens is its *focal length.*

The nearer an object is brought to the focus of a convex lens the larger will be the image. The brightness of an image increases with the size of a convex lens, but decreases in sharpness; for only the rays that fall in the central part of the lens converge to a point; those towards the edge disperse as in a prism, and make the image of the object confused. Hence the lens of the eye is covered with the iris, except at its centre; and reading glasses have their edges ground off or covered with black horn. This defect is called the "aberration of sphericity."

It is, perhaps, difficult to say who made the first telescope. The conception of such an optical instrument appears to belong to Friar Bacon, as it is asserted by Dr. Jebb, who edited the famous work of Roger Bacon entitled "Opus Majus," that in one of the passages of this work the friar states he actually applied telescopes to astronomical purposes, and therefore so long ago as the thirteenth century. Afterwards the names of Baptista Porta, Digges, and then Jansen and Galileo, were connected with this important instrument.

A very simple astronomical telescope can be made with two paper, wooden, or brass tubes, sliding one within the other. At one end of the widest tube is fixed the *object-glass*, a double convex lens with a long focal distance, and called the object-glass because it is nearest the object; while the lens placed at the other end of the smaller tube, through which the observer looks, is called the *eye-glass*, also a double convex lens, but having a short focal distance. An inverted image is formed in the focus of the object-glass, and this is magnified again by the eye-glass. With this telescope all objects are inverted, and therefore the one invented by Galileo (Fig. 10) is the more convenient. It is constructed like the astronomical telescope, only a double concave lens is substituted for the donble convex one used as the eye-glass. It is, in fact, similar to an opera-glass, and has this advantage, that the object is seen erect.

Mr. Richard A. Proctor, in his excellent work entitled "Half Hours with the Telescope," says: "There are few instruments which yield more pleasure or instruction than the telescope. Even a small telescope—only an inch and a half or two inches perhaps in aperture—will seem to supply profitable amusement to those who know how to apply its powers. I have often seen with pleasnre the surprise with which the performance of an opera-glass, well steadied, and directed towards certain parts of the heavens, has been witnessed by those who have supposed that nothing but an expensive and colossal telescope could afford any views of interest. But a well-constructed achromatic of two or three inches in aperture will not merely supply amusement or instruction—it may be made to do useful work." The principles of the achromatic telescope will be considered hereafter.

LESSONS IN GREEK.—XXXI.

THE FUTURE AND FIRST AORIST MIDDLE AND THE PERFECT FUTURE.

The future middle is formed from the fntnre active by changing the personal ending of the active—that is, ω—into the personal ending of the middle—that is, ομαι: as λυσ-ω, λυσ-ομαι. The ο here may be considered as a connecting vowel, and the mood be divided thus—λυ-σ-ο-μαι. Of each of these four parts the student should give an account.

The first aorist middle is formed from the future middle by prefixing the augment and changing ομαι into αμην—thus, λυσ-ομαι, ε-λυσ-αμην; or it may be formed from the first aorist active by simply adding μην—thus, ελυσα, ελυσα-μην

The perfect future, or, as it is sometimes called, the third fnture (also the paulo-post-futurum), is formed from the second person singular of the perfect passive by changing αι into ομαι, as λελυσαι, λελυσ-ομαι—where, again, ο may be acconnted a connecting vowel as well as the model vowel, or vowel marking the indicative mood. For the optative, ο becomes οι, as λελυσοιμην—that is, ι is added to ο.

The principal parts of παυω are, παυω, παυσω, πεπαυκα, πεπαυσμαι; the future middle, παυσομαι; first aorist middle, επαυσαμην; perfect future, πεπαυσομαι.

VOCABULARY.

Αναπαυω, I cause to rest; in the middle, I rest.

Γευω, I let taste; in the middle, I taste (with genitive).

Επιτηδευω, I attend to, I prosecnte, practise.

Παυω, I make to cease; in the middle, I cease or stop.

Πολιτεια, -ας, ἡ (from πολις: hence our *police, policy, politic, political, polity*), a state, constitution, government.

Πορευω, I bring, bring forward; in the middle, I go, proceed, travel.

Πυλη, -ης, ἡ, a door, gate.

EXERCISE 90.—GREEK-ENGLISH.

1. Οἱ πολεμιοι επι την ἡμετεραν πολιν στρατευονται. 2. Περι της των πολιτων σωτηριας βουλευσομεθα. 3. Ὁ πατηρ μοι ελεγεν ὁτι πορευσοιτο. 4. Οἱ Ἑλληνες επι τους Περσας εστρατευσαντο. 5. Αναπαυσωμεθα, ω φιλοι. 6. Προ του εργου ευ βουλευσαι. 7. Παντες τιμης γευσασθαι βουλονται. 8. Ὁ πατηρ αναπαυσαμενος πορευσεται. 9. Αἱ πυλαι της νυκτος κεκλεισονται. 10. Εαν τοιουτος ανηρ την πολιτειαν επιτηδευῃ, αυτη ευ βεβουλευσεται.

REMARKS ON THIS EXERCISE.

Πορευσοιτο, the optative, because it is preceded by an historical tense, and because the action depends on the words or declaration of the subject πατηρ (*obliqua oratio*).

Αναπαυσαμενος, *having rested*; that is, *when he has rested*. The force of the participle in Greek can often be given in English only with the aid of a conjunction or an adverb.

Της νυκτος, *by night*, the genitive of time. (See the Syntax.)

EXERCISE 91.—ENGLISH-GREEK.

1. I shall have been educated. 2. He will have been educated. 3. We shall have been educated. 4. They will have been planted. 5. He will have been slain. 6. The general will march to the city. 7. The general marched to the city. 8. The general may have marched to the city. 9. The general might have marched to the city. 10. We shall have consulted respecting the safety of our native land. 11. He will consult respecting thy safety. 12. He consulted respecting the safety of the citizens. 13. They ceased. 14. They will have ceased. 15. He will cease. 16. The two men ceased. 17. We will cease, O friends. 18. The friends travel. 19. The friends will travel. 20. The friends travelled.

THE FIRST AORIST AND THE FIRST FUTURE PASSIVE.

The first aorist passive is formed from the stem of the perfect active by changing κ into θην, and by changing the reduplication into the syllabic augment, as λελυκ, ελυθην.

The first future passive is formed from the first aorist passive by dropping the augment and changing ν into σομαι, as ελυθην, λυθησομαι.

VOCABULARY.

Δημοκρατια, -ας, ἡ, democracy, the government of the δημος or people (that is, the popnlace).

Επιφερω, I bring upon, I introduce; πολεμον τινι (Lat. *bellum infero*), to make war on.

Μη, not, lest (Latin, *ne*).

Πολεμιος, -α, -ον, hostile, the enemy's.

Συνθηκη (συν and τιθημι), a convention, agreement, treaty; in the text, used in the plural, the agreements—that is, the treaty considered as containing many heads.

Τυραννος, -ου, ὁ, a tyrant.

EXERCISE 92.—GREEK-ENGLISH.

1. Ἑκτωρ ὑπο Αχιλλεως εφονευθη. 2. Τω αδελφω ὑπο του αυτου διδασκαλου επαιδευθητην. 3. Πολλαι δημοκρατιαι ὑπο των τυραννων κατελυθησαν. 4. Μεγας φοβος τους πολιτας εχει, μη αἱ συνθηκαι ὑπο των πολεμιων λυθωσιν. 5. Ειθε παντες νεανιαι καλως παιδευθειεν. 6. Φονευθητι, ω κακουργε. 7. Οἱ στρατιωται εις την πολεμιαν γην πορευθηναι λεγονται. 8. Οἱ πολεμιοι, των συνθηκων λυθεισων, ἡμιν πολεμον επιφερουσιν. 9. Ὁ λῃστης φονευθησεται.

REMARKS ON THIS EXERCISE.

Τυραννος does not exactly correspond with our word *tyrant*, though the latter comes from the former, but denotes one who has seized the helm of government in a free state. A tyrant, therefore, in the Greek sense of the term, is not necessarily a despot, and the Greek may often be rendered by our *usurper*.

Μη after verbs expressive of fear may be rendered by *lest*, and requires the subjunctive with a present, a perfect, or a future tense; and is followed by the optative when the verb in the principal sentence is in an historic tense.

Συνθηκων λυθεισων. This is what is called "the genitive absolute," and corresponds with "the ablative absolute" in Latin—*the treaty being broken*.

Exercise 93.—English-Greek.

1. They will be slain. 2. They were slain. 3. He was slain. 4. Two soldiers were slain. 5. Many men will be slain. 6. I shall be educated. 7. He will be educated. 8. We shall be educated. 9. Ye two will be educated. 10. I was well educated. 11. The constitution was destroyed. 12. The constitution will be destroyed. 13. The treaty was broken. 14. The treaty will be broken. 15. The treaty being broken, the citizens were slain. 16. The robbers were slain. 17. The robbers are said to have been slain. 18. The democracy will be destroyed.

KEY TO EXERCISES IN LESSONS IN GREEK.—XXX.

Exercise 84.—Greek-English.

1. The soldiers have slain two thousand two hundred and sixty-five of the enemy. 2. Pherecydes used to say that he had sacrificed to no god. 3. As you are (*having been produced*) young, learn many good things. 4. The soothsayer has foretold the future well. 5. You have instructed your children well. 6. Medea, having slain her children, rejoiced. 7. The Lacedæmonians had destroyed Platæa. 8. Sardanapalus had put on a woman's garment. 9. When the sun had set, the enemy approached. 10. Alexander, in his pursuit of (*pursuing*) Darius, the king of the Persians, had made himself master of great wealth.

Exercise 85.—English-Greek.

1. Πεφονευκα. 2. Πεφονευκασιν. 3. Επεφονευκει. 4 Φονευσουσιν. 5. Εφονευσεν. 6. Φονευσομεν. 7. Πεφονευκαμεν. 8. Επεφονευκειμεν. 9. Θυσουσιν. 10. Τεθυκασιν. 11. Ετεθυκεσαν. 12. Εθυσαν. 13. 'Ο μαντις τῳ θεῳ εθυσεν. 14. 'Ο μαντις τῳ θεῳ βους ἑκατον τεθυκεν. 15. Παιδευω τα τεκνα. 16. Επαιδευον τα τεκνα. 17. Παιδευσω τα τεκνα. 18. Εποιδευσα τα τεκνα. 19. Πεπαιδευκα τα τεκνα. 20. Επεπαιδευκειν τα τεκνα. 21. Αλεξανδρος Βαβυλωνα κατελυσεν. 22. Αλεξανδρος Βαβυλωνα κατελελυκει. 23. 'Ο παις στολην γυναικειαν ενδυει. 24. 'Ο παις στολην γυναικειαν ενδεδυκεν. 25. 'Ο παις στυλην γυναικειαν ενεδεδυκει. 26. 'Ο παις στολην γυναικειαν ενδυσει.

Exercise 86.—Greek-English.

1. Two men are fighting. 2. Let us fight bravely for our country. 3. It is necessary that a son should obey his father. 4. Many good men are poor. 5. It is honourable to obey the laws of the country. 6. Do not welcome those of your friends who gratify you in bad things. 7. Let each go quietly along the middle of the road. 8. Let the citizens obey the laws. 9. My two brothers follow me. 10. If you are willing* to do well, work. 11. If you wish* (*should you wish*) to do well, work. 12. No one who lies is concealed for a long time (i.e., *no one lies for a long time without being found out*). 13. The Lacedæmonians used to go on their expeditions to the sound of flutes. 14. Would that all would consult without anger. 15. Two beautiful horses were driven into the city. 16. If you are poor you have few friends.

Exercise 87.—English-Greek.

1. Εκεινος πενεται και ολιγους φιλους εχει. 2. Πενομαι. 3. Εβουλευετο. 4. Εβουλευεσθην. 5. Βουλευομαι. 6. Βουλευεται. 7. Βουλει καλως πραττειν, εργαζου. 8. Εαν βουλῃ καλως πραττειν εργαζου. 9. Εργαζονται. 10. Καλως εργαζεται. 11. Ειργαζετο. 12. Ειργαζεσθε. 13. Ειργαζεσθον. 14. Εργαζομεθα. 15. Μαχομαι. 16. Εμαχομην. 17. Εμαχοντο. 18. Μαχονται γενναιως. 19. Μοχεσθε. 20. Εμαχεσθε. 21. Ω στρατιωται γενναιως μαχεσθε περι της πατριδος. 22. Καλον εστι περι της πατριδος μαχεσθαι. 23. Σοι ἑπομαι. 24. Εμοι ἑπεται. 25. Εμοι ἑπονται. 26. Τῳ στρατηγῳ ἑπομεθα. 27. Τῳ στρατευματι εἱπομεθα. 28. Τοις νομοις, ω παιδες, ἑπεσθε.

Exercise 88.—Greek-English.

1. The robbers have been slain. 2. Two brothers have been educated by the same master. 3. The monarchy has been destroyed by the people. 4. Many temples to the gods have been built by the Athenians. 5. Let the door be shut at once. 6. Take care to have consulted well before acting (lit., *before the deed*). 7. The desire of self-government is implanted in all men. 8. Let the robbers be slain at once. 9. The enemy are said to have been shut up in the citadel. 10. Xenophon's two sons, Gryllus and Diodōrus, had been educated in Sparta.

Exercise 89.—English-Greek

1. Πεφονευται. 2. Οἱ παιδες πεφονευνται. 3. Οἱ στρατιωται επεφονευντο. 4. Κατακεκλεισται. 5. Κατακεκλεισθε. 6. Κατεκεκλεισθε. 7. Κατακεκλεισμενοι εισιν. 8. 'Ω δυο ανθρωπω κατεκεκλεισθην. 9. Οἱ βους κατακεκλεισθαι λεγυνται. 10. Ευ πεπαιδευμαι. 11. Ευ επεπαιδευσο. 12. Ευ πεπαιδευνται. 13. Κακως επεπαιδευμην. 14. Κακως επεπαιδευσο. 15. Τα δενδρα ευ πεφυτευται. 16. Τα δενδρα κακως επεφυτευτο.

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* The difference between ει βουλει and εαν βουλῃ may be thus explained: ει βουλει assumes that you are willing—*if you are willing, which I believe you to be*—and so may be translated *since*; εαν βουλῃ makes no such assumption—*should you be willing, about which I express no opinion either way.*

EXERCISES IN EUCLID.—V.

Proposition XXIX.—To trisect a given right angle; that is, to divide it into three equal parts.

Let B A C (Fig. 28) be the given right angle; in A C take any point D, and on A D describe an equilateral triangle A D E; bisect the angle E A D by the line A F, meeting E D in F; then the lines A E, A F will trisect the given right angle. For since the three angles of a triangle are together equal to two right angles, and the angles of an equilateral triangle are equal, the angle E A D is equal to one-third of two right angles, *i.e.*, to two-thirds of one right angle. But the whole B A C is a right angle; therefore the remainder B A E is equal to one-third of a right angle. And the angles E A F, F A D are each half the angle E A D; therefore each of them is one-third of a right angle; hence A E, A F trisect the right angle. Q. E. F.

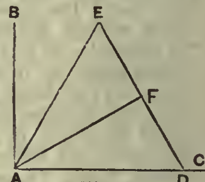

Fig. 28.

Proposition XXX.—If two right-angled triangles have one side and the base in the one equal to one side and the base in the other, each to each, they shall be equal in every respect.

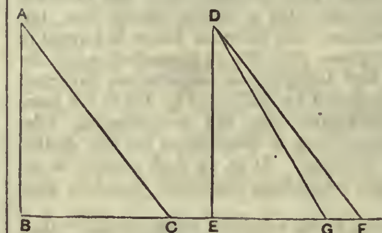

Fig. 29.

Let A B C, D E F (Fig. 29) be two triangles, having A B C, D E F right angles, and let A B, A C in the one be equal to D E, D F in the other; then shall B C be equal to E F, and the triangles equal in every respect. For if B C be not equal to E F, one of them must be greater. Let E F be the greater, and from E F cut off E G = B C; join D G; then since A B, B C are equal to D E, E G, each to each, and the included right angles are equal, therefore base A C is equal to base D G (Euc. I. 4). But A C = D F by construction; therefore D G = D F, and angle D G F = angle D F G (Euc. I. 5). But since D E G is a right angle, D G E is less than a right angle (Euc. I. 17); therefore D G F, which with D G E is equal to two right angles (Euc. I. 13), is greater than a right angle. Hence D G F and D F G together are greater than two right angles, which is impossible by Euc. I. 17: hence E G is not equal to B C. And similarly it may be proved that no line but E F is equal to B C; hence E F is equal to B C, and the triangles equal in every respect. Q. E. D.

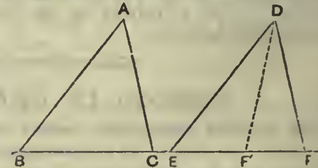

Fig. 30.

Corollary.—This proposition is not necessarily true, as might be supposed, if the equal angle in the two triangles be not a right angle; for in this case it is not necessarily untrue that D G is equal to D F. If the equal angle be not a right angle, there will be two positions possible for the third side, as in Fig. 30, D F and D F′ both satisfying the conditions of the proposition. This is, of course, the "ambiguous case" of trigonometry.

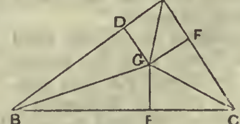

Fig. 31.

Proposition XXXI.—The straight lines which bisect the angles of a triangle meet in a point.

Bisect the angles A B C, B C A (Fig. 31) of the triangle A B C by the lines B G, C G meeting in G; join A G; then shall A G bisect the angle B A C. Draw G D, G E, G F perpendicular to A B, B C, C A; then in the two triangles G D B, G E B, since the right angle G D B is equal to the right angle G E B, and by construction the angle G B E is equal to the angle G B D, and the side G B is common; therefore by Euc. I. 26 the triangles are equal, and therefore G D = G E. By an exactly similar course of reasoning G E = G F, therefore G D = G F; and because G D = G F, and G A is common, also right angle G D A = right angle G F A. therefore, by the last proposition, the triangles are equal; therefore angle G A D = angle G A F, or G A bisects the angle at B A C. Q. E. D.

PROPOSITION XXXII.—The straight lines drawn perpendicular to the sides of a triangle through their middle points meet in a point.

Bisect the sides A B, B C (Fig. 32) of the triangle A B C in D, E, and let D G, E G perpendicular to A B, B C meet in G; draw G F perpendicular to A C; then shall F be the middle point of A C. Join A G, B G, C G; then since A D = D B, and D G is common and at right angles, base A G = base G B. Similarly, because B E = E C, and E G is common and at right angles, therefore B G = G C, therefore A G = G C; and because A G = G C, and G F is common, also right angle G F A = right angle G F C, therefore the triangles G F A, G F C are equal by Proposition XXX., and A F = F C. Q. E. D.

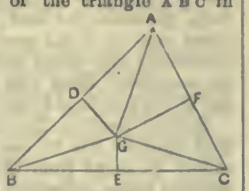

Fig. 32.

PROPOSITION XXXIII.—The straight lines which bisect one interior and two exterior angles of a triangle meet in a point.

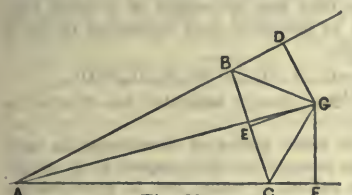

Fig. 33.

Produce A B, A C (Fig. 33), sides of the triangle A B C, to D and F, and bisect the exterior angles D B C, B C F by the lines B G, C G meeting in G; join G A; then G A shall bisect the angle B A C. Draw G D, G E, G F perpendicular to A B, B C, C A; then in the triangles G B D, G B E, because angle G B D = angle G B E by construction, and the right angle G D B = right angle G E B, also side G B is common, therefore the triangles are equal; therefore G D = G E (Euc. I. 26). Similarly G E = G F, therefore G D = G F; and because G D = G F, and G A is common, also right angle G D A = right angle G F A, therefore, by Proposition XXX., the triangles G D A, G F A are equal, and the angle G A D equals the angle G A F—that is, G A bisects the angle B A C. Q. E. D.

PROPOSITION XXXIV.—If two triangles have one side, and one angle in the one equal to one side and one angle in the other, and likewise their areas equal, then shall also their other sides and angles be equal to each.

Let A B C, D C F (Fig. 34) be the two triangles of equal area, and let them be placed so that B C, C F, their equal sides, are in the same straight line, and B C A, C F D their equal angles; then because angles B C A, C F D are equal, A C is parallel to D F. Join A D; then because A B C, D C F are equal triangles upon equal bases in the same straight line, A D is parallel to B F (Euc. I. 40); therefore A D F C is a parallelogram. Therefore, by Euclid I. 34, A C is equal to D F; and therefore, by Euc. I. 4, the triangles are equal in every respect. Q. E. D.

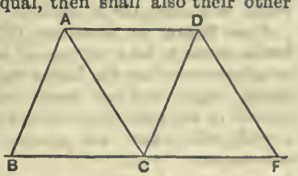

Fig. 34.

PROPOSITION XXXV.—If the bases of two equal triangles be in the same straight line, and the line joining their vertices be parallel to this line, their bases will be equal.

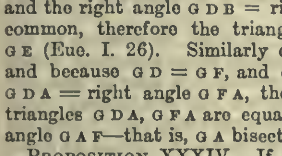

Fig. 35.

This is evidently the converse of Euclid I. 40. Let A B C, D E F (Fig. 35) be two equal triangles having their bases B C, E F in the same straight line, and let A D, the line joining their vertices, be parallel to B F; then shall B C be equal to E F. For if B C be not equal to E F, one of them must be the greater. Let E F be greater, and from E F cut off E G, equal to B C, and join D G; then because A B C, D E G are two triangles upon equal bases, B C, E G, in the same straight line, and between the same parallels B G, A D, they are equal (Euc. I. 38). But by the proposition the triangle A B C is equal to the triangle D E F; therefore the triangle D E F is equal to the triangle D E G, the greater equal to the less which is absurd. Hence E G is not equal to B C. And similarly it may be proved that no line but E F is equal to B C; hence E F = B C. Q. E. D.

PROPOSITION XXXVI.—In the figure of Euclid I. 5, if A C (Fig. 36) be bisected in H, and C G be equal to C A, then B G shall be equal to twice B H.

From C draw C K parallel to A B, meeting B G in K (Euc. I. 31), and join A K; then the triangles A K C, B K C are upon the same base K C, and between the same parallels K C, A B; hence they are equal (Euc. I. 37). Again, the triangles A K C, G K C are upon equal bases A C, C G, and have the same vertex K; hence they are equal (Euc. I. 38); but A K C = B K C; therefore triangle B K C = triangle G K C. Hence, by the last proposition, B K = K G; therefore B G is double B K. Again, because B K = K G, triangle B K C = half-triangle B G C; and because A H = H C, triangle B H C = half-triangle B A C; but because A C = C G, triangle B A C = triangle B G C, and the halves of equal triangles are equal; therefore triangle B H C = triangle B K C, and the angle B C K is equal to the alternate angle A B C (Euc. I. 29), and A B C is equal to A C B (Euc. I. 5). Hence the angle B C K is equal to the angle B C H. Hence the two triangles B H C, B K C have one side B C and one angle B C H in the one equal to one side B C and one angle B C K in the other; and their areas are equal, because, by Proposition XXXV., they are equal in every respect; therefore, B H = B K = half B G. Q. E. D.

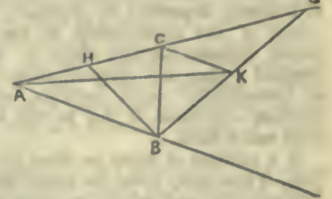

Fig. 36.

Our next article will embrace the whole of Book I., and will contain proofs of the following propositions:—

PROPOSITION XXXVII.—If the diagonals of a four-sided figure bisect each other, it is a parallelogram.

Corollary 1.—If the diagonals be equal as well as bisecting each other, the figure is rectangular.

Corollary 2.—Hence the angle in a semicircle is a right angle.

PROPOSITION XXXVIII.—If the diagonals of a four-sided figure bisect each other at right angles, the figure is a rhombus.

Corollary.—If the diagonals be also equal, it is a square.

PROPOSITION XXXIX.—If a four-sided figure have its opposite sides equal, it is a parallelogram.

PROPOSITION XL.—If A B, B C, C D, D A be the sides of a parallelogram taken in order, and points E, F, G, H be taken in them such that A E = C G, and B F = D H, the figure E F G H shall be a parallelogram.

PROPOSITION XLI.—If A B C be any triangle, and D E the line joining the middle points of the sides A B, A C, then shall D E be parallel to B C, and B C shall be double D E.

Corollary 1.—The angles of the triangle D F E are equal to the angles of the triangle B A C, where F is the middle point of B C.

Corollary 2.—The sides of the triangle D F E are each equal to one-half the corresponding sides of the triangle B A C, and the area equal to one-fourth of the whole triangle B A C.

PROPOSITION XLII.—If O be any point within a triangle A B C, and D, E, the middle points of A B, A C, be joined with F G, the middle points of O B, O C, the figure D E G F will be a parallelogram.

PROPOSITION XLIII.—If in the last proposition H K be the middle points of O A, B C respectively, the six-sided figure D K G E H shall be equal to one-half the triangle A B C.

PROPOSITION XLIV.—If D be the middle point of B C, the side of a triangle A B C, and if A D be joined, then if D A be equal to D B or D C, the angle at A is a right angle.

LESSONS IN CHEMISTRY.—XXXI.

FERMENTATION.

The Sugars.—The saccharine group occupies a prominent place in Organic Chemistry. It is closely allied to the amylaceous group, for, as we have already seen, starch can be converted into sugar; moreover, the alcohols and their allies owe their existence to the decomposition of the members of this group. The sugars all possess a characteristic sweet taste

They are composed of carbon, hydrogen, and oxygen; the carbon always is present in the proportion of six atoms, whilst the oxygen and hydrogen appear in the exact proportion to form a whole number of molecules of water. Hence the sugars have been called *hydrates of carbon*. Their various decompositions are effected by the removal or addition of the elements of water; when oxidised, they generally yield oxalic acid.

The chief sugars are—cane sugar, or *sucrose* ($C_{12}H_{22}O_{11}$); grape or starch sugar, or *glucose*, $2(C_6H_{12}O_6,H_2O)$; and milk sugar, or *lactose* ($C_{12}H_{22}O_{11},H_2O$). Besides these there are some less prominent members of the group.

Cane Sugar, or *Sucrose* ($C_{12}H_{22}O_{11}$), is the sweetening principle in a great number of tropical fruits; it is chiefly procured for the market from the sugar-cane, the maple tree, and beetroot. It is also found in small quantities in carrots and turnips, and in the chestnut and pumpkin.

It is soluble in water and alcohol, but ether is unable to effect its solution. When its water solution is evaporated, it becomes deposited in crystals—oblique rhomboidal prisms —this is the sugar-candy of the confectioner. Its brown colour depends on the state to which the syrup has been clarified before the crystallisation. Loaf sugar is composed of innumerable small crystals, which are transparent; its dazzling whiteness is due to the reflection of the light from their many faces.

If a solution of sugar be kept at the boiling point for some time, it gradually loses the viscid nature of a syrup, exhibits an acid reaction, and refuses to crystallise.

It is now called *inverted* sugar, and its peculiar properties seem to be due to the fact that another molecule of water has been assimilated, its formula being $C_{12}H_{24}O_{12}$. If the boiling still be continued for some hours more, water is taken up, and *grape sugar* is the result, $2(C_6H_{12}O_6,H_2O)$. These effects are produced with greater rapidity if any of the strong acids be present in a small proportion; and hence, to prevent this change, lime is mixed with the juice of the sugar-cane as soon as it is expressed.

Sugar possesses eminent antiseptic powers, and therefore it is much used in "preserving." If spread over any fermentable or decaying matter, it will arrest the action.

Manufacture of Sugar.—The canes are cut close to the soil before they flower. In the *rolling* mill they are crushed between grooved steel rollers. The juice thus expressed is so readily fermentable that it may not be left for half an hour, but is immediately mixed with about $\frac{1}{1000}$ its weight of lime, and heated to 60° Cent. in copper vessels. Here the albuminous constituents of the juice coagulate, and are skimmed off. This necessary heating has the effect of inverting some of the sugar, and rendering it of the uncrystallising quality; and much more would be so treated were it not for the lime, which neutralises the free acid. It is transferred from the clarifiers to shallow wooden coolers, and finally to the *potting-casks*, which have perforated bottoms; and in the course of four or five weeks all the molasses—the inverted sugar—drains off, leaving "raw sugar." A gallon of juice generally yields a pound of sugar.

Refining.—If loaf-sugar be required, this raw sugar is mixed with one-third of its weight of lime-water, which contains three or four per cent. of "bone-black." After being heated by injections of steam, it is filtered through pipes made of cotton twill. Sometimes the serum of bullock's blood is added to this syrup, which, as it coagulates, gathers in its meshes the mechanical impurities.

The brown syrup is now bleached by allowing it to filter through some twelve feet of animal charcoal, which is made by calcining bones in closed vessels.

This clear liquid must be evaporated down to a thicker consistency ere it will crystallise; but owing to its viscidity a temperature of 110° Cent. is required for its ebullition. Were the syrup raised to this heat, much of it would become inverted, and much would be burnt, and so colour the sugar. The difficulty is removed by conducting the evaporation in a spherical closed vessel—the lower half of which is double—by means of a powerful air-pump; a partial vacuum is produced, and when steam is injected into the cavity at the bottom of the pan, the syrup boils at about 70° Cent. When it has reached a certain consistency it is placed in a vessel heated by steam to 170°; here it is beaten about by wooden oars until it appears granular, when it is placed in conical vessels of earthenware, which have a hole at their apex. This hole is stopped by a plug for a few hours, and when it is removed the uncrystallisable syrup drains out; the loaf is finally dried, and finished in a lathe for the market.

Maple Sugar is a product of the American forests. The tree is tapped on its sunny side; two holes, about half an inch deep, penetrate the bark; reeds are fitted into these, and the rising sap—or, if the operation be conducted in the autumn, the descending sap—flows through the reeds into vessels placed for its reception. Each hole exudes as much as six gallons a day, and if the tree be old this quantity yields a pound of sugar.

Beetroot Sugar.—The manufacture of sugar from the white beet owes its rise to the wars of Napoleon. When the French supply of sugar from the West Indies was cut off, they had recourse to its extraction from beetroot. The expressed juice contains about ten per cent. of saccharine matter. The clarification, etc., is conducted upon the same principles as those given above.

Grape or Starch Sugar—Glucose ($C_6H_{12}O_6,H_2O$).—This sugar may be prepared by boiling starch in twice its weight of water, acidulated with one per cent. of sulphuric acid.

Starch is $C_{12}H_{20}O_{10}$, so that two molecules of glucose may be supposed to be formed by inserting four molecules of water into one molecule of starch.

$$C_{12}H_{20}O_{10} + 4H_2O = C_{12}H_{28}O_{14}, \text{ or } 2(C_6H_{12}O_6,H_2O).$$

It has been shown that this change can also be effected by diastase.

This sugar has not the same power of sweetening as cane sugar; 1 part of the latter is equal in this respect to $2\frac{1}{2}$ of the former. Neither is it so soluble in water, but is more readily taken up by alcohol. The action of sulphuric acid readily distinguishes these two varieties of sugar. Cane sugar is decomposed by the acid, but with grape sugar a compound is formed —sulpho-saccharic acid.

Sugar of Milk, or *Lactose* ($C_{12}H_{22}O_{11},H_2O$), is peculiar to the milk of the mammalia. It is fitted to be an ingredient of this secretion by its non-fermenting quality. It may be procured by evaporating *whey* until it reaches the crystallising point. Then the lactose appears as semi-transparent, right, four-sided prisms, terminated by pyramids, on pieces of thread or wood, which are placed in the liquid to form nuclei. It has even less sweetening power than glucose, it is more difficult of solution in water, and insoluble in alcohol.

Fruit Sugar, or *Lævulose* ($C_6H_{12}O_6$), which is found in ripe fruits, seems to be a mixture of cane and inverted sugars. By a spontaneous action the latter variety separates into crystallised starch sugar and an uncrystallisable syrup. This may be noticed in the case of preserved fruits. They are covered with a candy which does not possess a sweetness equal to that of cane sugar.

FERMENTATION.

A ferment is an active principle of organicised matter, which is capable of setting up decomposition in organic matter. It is now generally admitted that ferments are vital organisms— fungi, infusoriæ, etc., the very lowest forms of vegetable and animal life. These seedlings of life are everywhere. The very dust which a sunbeam reveals floating in the air contains them. If their vitality be destroyed in any body, that body will not ferment: for instance, if milk be made to boil under a pressure of $1\frac{1}{2}$ atmosphere, the high temperature kills these organisms; and if the liquid be now kept from the air, or such air only be allowed to come into contact with it as has been strained by passing through a plug of cotton wool, it may be kept for any length of time without undergoing any decomposition.

Fermentation has been classed by Miller in three divisions— 1. Where the body is simply broken up into compounds of less complicated structure, thus:—

$$C_6H_{12}O_7 \text{ (fruit sugar) gives } 2CO_2 \text{ (carbonic acid)} + 2C_2H_6O \text{ (alcohol).}$$

2. Where beyond this decomposition the elements of water are separated, thus:—

$$C_6H_{14}O_7 \text{ (grape sugar)} = 2CO_2 + 2C_2H_6O + H_2O.$$

3. Where the elements of water are assimilated, and the new body thus formed split up into simpler compounds. Thus:—

$$\begin{array}{lllll} & \text{Cane Sugar.} & & & \text{Fruit Sugar.} \\ (1) & C_{12}H_{22}O_{11} & + H_2O & = & 2C_6H_{12}O_6. \\ (2) & C_6H_{12}O_6 & & = & 2CO_2 + 2C_2H_6O. \end{array}$$

There are various kinds of fermentation, which are named after their products, as *alcoholic*, *acetic*, *butyric* fermentations.

It seems that the substance of the ferment does not mingle with the products; but the plant or animal is propagated at the expense of the albumen, or other nitrogenous matter, which may be present; and, as might be anticipated, the substance of the ferment is nitrogenous matter.

In what way the ferment determines the decomposition of the compounds in its neighbourhood is at present a mystery.

Alcoholic Fermentation.—When the juices of fruits, etc., which contain sugar are kept at a temperature of about 20° Cent. for some hours, they become turbid and begin to *work*, or ferment. Bubbles of gas escape, which is carbonic acid. When once this change has fairly set in, the presence of air is no longer necessary. When the gas has ceased to come off, upon distilling the liquor, *alcohol* is found to come over at the commencement of the operation. If the liquid be examined after the fermentation is complete, it is found to contain *yeast*, which, under the microscope, appears to be oval organised bodies, about $\frac{1}{310}$ of an inch in diameter. These bodies cluster together, and propagate by budding—after the manner of certain cacti. The growth of this fungus is prohibited if any of the mineral acids be present, if the solution contain more than a quarter of its weight of sugar, or twenty per cent. of alcohol. The presence of many of the metallic salts also arrests fermentation. There seem to be two varieties of yeast—*oberhefe* (surface yeast) and *unterhefe* (sediment yeast). The latter is the less active of the two. It appears in detached cells, which do not propagate by buds, as the oberhefe, but by spores which the larger cells throw off.

The Rising of Bread.—In the making of bread, the flour dough is mixed with yeast—either fresh brewer's yeast, or German yeast, which is yeast dried by pressure—a process which does not injure the vitality of the plant. Some of the starch of the flour acted upon by the yeast is converted into sugar. This undergoes fermentation. The alcohol escapes into the oven, and the carbonic acid being liberated from all points in the dough, blows up the bread by filling it with bubbles of the gas, the walls of the hole being rendered tenacious by the gluten. Bread may also be "raised" by "baking-powder," or by a mixture of sodic carbonate and hydrochloric acid, the result being common salt, a necessary ingredient of good bread, and carbonic acid, which makes the bread spongy.

Dr. Dauglish introduced a third method, which is used to make "aërated bread." The flour is mixed in a closed iron vessel with water, which is impregnated with carbonic acid gas at a pressure of 100 pounds on the square inch. The dough is drawn off into tins, and is baked in the usual way.

New and Stale Bread.—It is a popular fallacy that bread becomes stale because it *dries*. This, however, is not true, for in both cases a loaf contains as much as forty-five per cent. of water. The soft texture of new bread seems to depend on a certain molecular arrangement, which may be restored to stale bread by re-heating it in the oven. To prevent too great hardening of the crust, the loaf should be steeped for a few minutes in milk and water before being introduced into the oven a second time.

ELECTRICITY.—V.

SPOTTED JAR—JAR WITH MOVABLE COATINGS—LEYDEN PANE—ELECTRIC PENDULUM—BATTERY—ELECTROMETERS—HARRIS'S UNIT JAR—EFFECTS OF SHOCK.

INSTEAD of coating the outside of the Leyden jar with tinfoil, it may be varnished, and some metallic powder—as, for instance, fine brass filings—sprinkled on while it is wet, a narrow band of tinfoil being placed round the top. The exterior will then be illuminated as the jar is charged and discharged. To show this to the greatest advantage, the knob should be bent over so as to come within striking distance of the exterior coating, and the jar suspended by the loop thus formed from the conductor, a connection being made from the exterior to the ground, as shown in Fig. 13.

The piece of apparatus known as the diamond, or spotted jar, likewise affords a very interesting experiment.

In this the glass jar, instead of being covered with a continuous surface of tinfoil, has a number of diamond-shaped pieces carefully fastened to it in such a way that their points nearly touch one another. These spangles are usually cut with sides about three-fourths of an inch long, and a hole is punched out of the centre of each, so that the sparks between the points of those on the interior are seen through the apertures in those outside. The annexed sketch will render this more clear; the shaded parts in it represent the clear glass (Fig. 14). As will be seen shortly, a plane sheet of glass may be used for this instead of a jar, and it is much easier to fasten the spangles evenly to it. Considerable care is required in placing them, but the beauty of the experiment will repay the trouble.

As we saw in the last lesson, the opposite coatings of the jar act upon each other by induction; the charge, however, is lodged on the surfaces of the glass, and not in the tinfoil, as might at first be supposed. The foil merely serves to convey the electricity, and distribute it over the surface of the glass. An experimental proof of this can easily be furnished. Procure a jar of a somewhat conical form, as shown at B (Fig. 15), and let C be a tin or zinc covering made just to fit it. Procure also a cylinder of metal, D, just fitting the inside of B, and having a knob by which it may be charged fixed to it. Now put the whole together, as at A, and we shall have a complete Leyden jar; the only difference between it and those we have been considering being that the coatings are movable, instead of being fixed to the glass.

This jar may now be charged in the usual way, and then placed upon some insulating material, such as a sheet of glass or gutta-percha. The object of this is to prevent the shock being received when the knob is touched, for if the jar be placed on a table as usual, the wood, etc., will complete the circuit through the person and the floor, and a violent shock will be felt; the non-conductor, however, entirely prevents this. Having thus insulated the jar, we may remove the interior cylinder by means of the rod, and, on testing it, we shall detect very little free electricity in it. Now carefully lift the glass by its edges out of the outer coating; this too, like the inner one, will be found to be neutral. The proof plane, however, if applied to the inner or outer side of the glass, will at once show the presence of electricity, and on restoring the coatings the jar may be discharged as at first. If a second set of coatings be made, the jar may be placed in them, and will be found to have lost but little of its charge.

If the glass be thick, the electricity does not all remain upon the surface, but penetrates a slight distance into its substance. This is seen by what is called the *residuary charge*. After a Leyden jar has been discharged, and allowed to stand a little while, a second charge much weaker than the first may be taken from it, and sometimes even a third and fourth have been felt. If the jar has been highly charged, and kept so for a short time, these residuary charges are stronger. The electricity appears to have penetrated a little way into the glass, and therefore the equilibrium is not completely restored at the first discharge. As soon, however, as this discharge is effected, the electricity gradually finds its way to the coating, thereby causing the second shock.

It is, however, only with a thick jar that this is much noticed, and such a jar does not take a very high charge; a good jar should therefore be thin, and this effect should not be seen to any great degree.

When filings are used instead of tinfoil for lining the inside of a jar, these secondary shocks are much stronger; the cause, however, in this case is the want of absolute contact between the particles, which prevents the electricity from passing as rapidly as it otherwise would.

Now the effect of induction is not affected by the shape of the interposed di-electric, and hence we may obtain similar effects if we employ a sheet of glass instead of a jar. This is easily seen by taking a pane of glass, and coating both sides of it evenly, leaving a clear margin of two or three inches all the way round. From this we shall be able to obtain a shock similar to that obtained from the Leyden jar. One side must be held to the conductor of the machine, and the finger placed against the other, or some other plan arranged to connect it with the earth, and thus allow of the escape of its electricity. Usually, a strip of the foil is brought from the under surface to the edge, so as to render it more convenient to use; then the pane may be laid down, and a wire or chain from the conductor laid upon its upper coating. If we examine the state of the two coatings of a charged pane, we shall find that there is a small amount of positive electricity on one side un-neutralised by induction, and therefore free. The amount of this depends on the thickness of the glass.

If then we hold the finger to this side, taking care that the other coating is insulated, we shall obtain a small spark from it. As soon as this has passed, a similar amount of negative electricity will be set free at the other side, and we can then draw a spark from that; in this way, we may continue drawing off the charge, drop by drop, as it were, till it is all gone. If a Leyden jar be placed on an insulating stand, we may discharge it in a similar way.

Two interesting experiments may be tried as illustrations of this—one with the pane, the other with the jar. Make two feet of gutta-percha, or some insulating material, so that the pane may stand vertically. Having charged it, take a piece of wire and place a pith-ball on each end; then bend it almost round, so that when it rests on the upper edge of the pane the balls may each be about an inch from the coating. The side on which the excess exists will first attract the ball nearest to it, and thus part with its excess of electricity; the other ball will then be attracted by the other side, and in this way the wire will rock backwards and forwards till the charge is dissipated. This is called the electric pendulum.

To show the same thing with a Leyden jar, we must fix a bell on the wire just below the ball. A metal support, A (Fig. 16), carrying a similar bell at the same height, must be fixed on a stand, and connected with the outer coating of the jar by a piece of wire or tinfoil, B. The upper part of this support has a bent wire fixed to it, from which a small ball is suspended by a thread of silk. If now the jar be charged, this ball will be alternately attracted and repelled by the bells, and thus will continue to ring them till the jar is discharged.

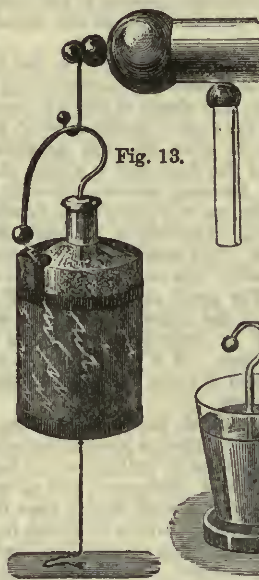

Fig. 13.

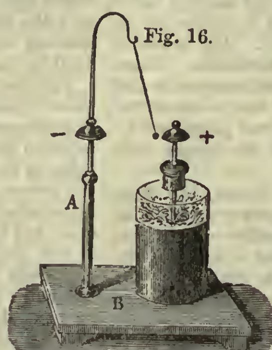

Fig. 16.

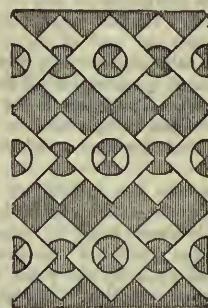

Fig. 14.

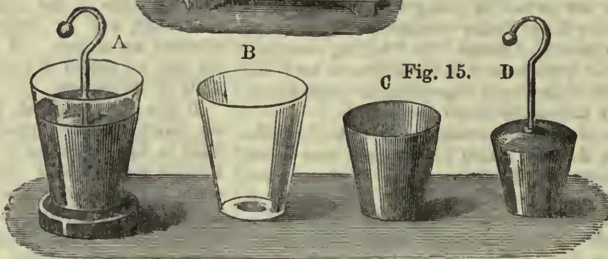

Fig. 15.

If a jar be charged, and allowed to stand, the electricity in it will be slowly dissipated, chiefly owing to the moisture in the air, which acts as an imperfect conductor. This may be partly obviated by coating the surface of the glass with shellac varnish, and thus hindering the deposit of damp which usually forms on it. When, however, it is desired to preserve a charge for any length of time, the construction of the jar is slightly altered. The rod is not fixed to the cap, but passes through a glass tube fixed in it to the bottom; and when the jar is charged, it may be inverted, and the rod allowed to fall out. When the charge is required, the rod must be carefully dropped in again. In doing this, however, it is advisable to take the precaution of placing it first upon some non-conducting substance.

Theoretically, there is no limit to the size of the jar that may be employed. In practice, however, many inconveniences attach to the use of those which are very large. The tension of the electricity frequently becomes so great in them, that if there be a flaw or thin place in the glass it will pierce it; and if it be made thick, to guard against this danger, the induction is considerably weakened. The plan therefore adopted is to employ a number of small jars, and connect them together so as to form a battery. They are usually placed in a tray lined with metal, so as to connect their exterior coatings, and a wire is brought from this to one of the handles; the knobs are also connected together by wires passing through them. (Fig. 17.)

Various batteries of great size and power have thus been made at different times: for all ordinary purposes, however, from four to nine jars, holding about five or six pints each, will be amply sufficient.

It is important to be able to estimate with some degree of accuracy the intensity of the charge in a jar, and different means of attaining this end have been devised. The simplest is by means of the quadrant electrometer A (Fig. 17), which is shown on one of the knobs of the battery. It consists of a thick brass rod, surmounted by a knob, and bearing on one side a semi-circular graduated scale, usually made of bone or ivory. At the centre of this is suspended a thin wood rod, carrying a pith-ball on its further end. As the charge increases, this ball becomes more and more repelled, and the angle shown on the graduated arc increases, thereby giving a rough indication of the intensity of the charge. It must be remembered, however, that it is the intensity, and not the quantity, of the electricity that is indicated. If the same amount of electricity be distributed over jars or batteries having double the amount of coated surface, the electrometer will only show one-half the intensity. Still, the instrument is very useful, especially if it is made with the rod somewhat smaller at the lower end, so that it will fit into the prime conductor or any other piece of apparatus.

A better way of regulating the intensity of a shock is by means of Lane's discharging electrometer, which is represented in Fig. 18. It depends for its action on the fact that the distance through which a charge will dart between the balls, or, as it is called, the striking distance, is, for small charges, directly proportional to the intensity of the charge; that is, if double the amount of electricity be present on the same surface the striking distance will be twice as great. This distance varies, too, inversely as the amount of surface over which the charge is distributed. Thus, if one jar has twice the surface of another, and the same amount of electricity be passed into each, the striking distance of the first will be only one-half that of the second. These results will easily be understood if we recollect that it is always intensity, and not quantity, that is shown; just as a thermometer shows the intensity and not the quantity of heat, for there clearly is a larger quantity in a gallon of water at the temperature of the body than in a cupful at the boiling-point, and yet the thermometer shows a much higher temperature if immersed in the latter.

The electrometer consists of a metal tube, A, which fits on to the rod of a jar or battery, and carries at one side a curved rod of glass, B. At the end of this is fixed a second tube, C, with a brass wire, terminated at one end in a ball, D, and at the other in a ring, passing through it. When this is attached to a jar, the ball D may be brought within any desired distance of the knob, and a chain is then attached to the ring and connected with the outside. When the jar is sufficiently charged, the electricity darts between the balls and discharges it. If it be desired to pass this shock through the body, or through any substance, the two sides of it are connected by brass chain or wire with the ring and outer coating respectively, and the shock passes as before.

There are one or two other forms of discharging electrometer which are sometimes used, and which depend on the attraction of the knob of the jar for a balanced metal rod. We need not, however, stop to explain them here.

In all these the shock is given as soon as the necessary charge is communicated; this is sometimes rather a disadvantage, and may be obviated by the use of a unit jar, which consists of a small Leyden jar exposing about six inches of coated surface on each side. This is supported on an insulating stand, so that its exterior is in contact with the knob of the jar to be charged. A rod and ball are also connected with its outside coating, and brought within striking distance of its inner rod. The jar is now brought to the conductor of the machine, and as it becomes filled a corresponding amount of electricity passes from its exterior into the large jar. This continues till the unit jar is fully charged, when it discharges itself, and the same process is repeated. In this way, by counting the number of discharges of the small jar, we ascertain the number of units of electricity contained in the large one.

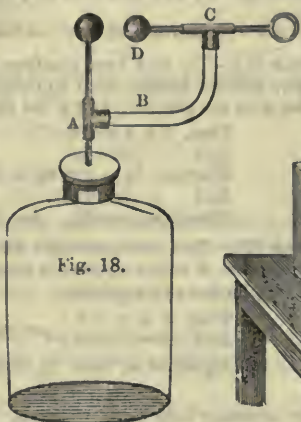

Fig. 18.

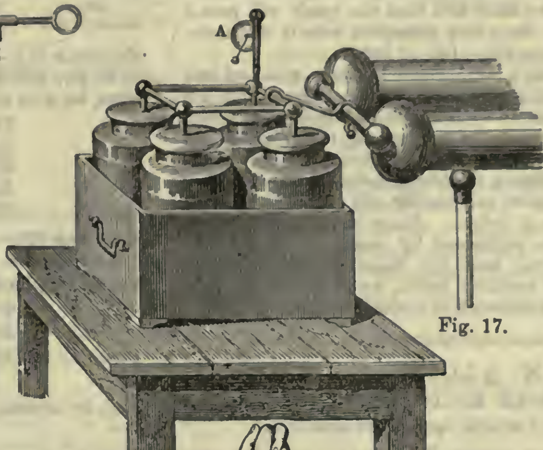

Fig. 17.

As we now clearly understand the construction and action of the Leyden jar and battery, we may notice some of the effects produced by the electric shock. We will look at the physiological effects; and the first which we observe is the peculiar sensation experienced when the charge is allowed to pass through the body. The sensation varies, of course, with the intensity of the shock, and is most strongly felt at the elbows and across the breast. If the shock of a large battery be taken dangerous results may ensue, especially if the electric fluid pass through any vital portion; but with ordinary charges no ill effects whatever seem to be produced; in some cases it even appears to be beneficial. The effect of a very strong charge is seen when a person is struck by lightning, death being frequently caused by it. The action appears to be mainly on the nervous system. If we pass the shock through small animals, such as birds or mice, they will be killed instantaneously, and larger animals have been killed by shocks from powerful batteries. There is, however, nothing further to be learnt by these experiments, and it is therefore cruel and needless to repeat them.

Fig. 20.

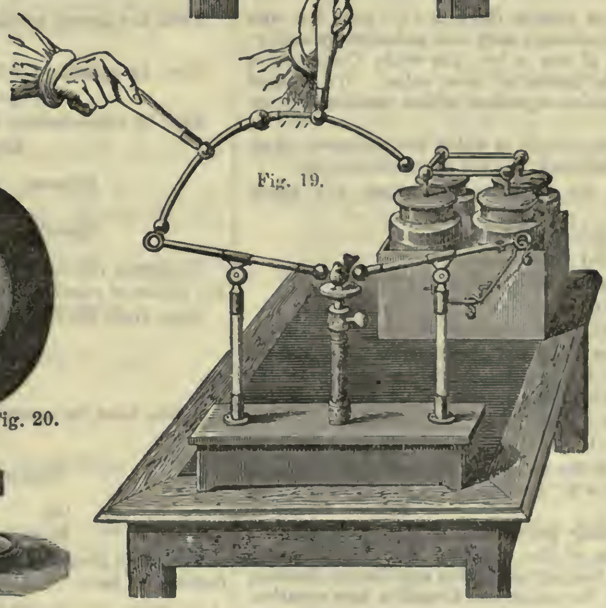
Fig. 19.

The electric fluid, in its passage through living or dead bodies, also causes convulsive contractions of the muscles. Its physiological effects will, however, be seen much more clearly when we come to treat of Voltaic Electricity, and we may therefore leave further notice of the matter till then

In studying the effects produced by electricity, we need some method of conveniently holding an object while the shock is passed through it, and this is afforded us by a very useful piece of apparatus, known as Henley's Universal Discharger. The construction and mode of using this will be understood by reference to Fig. 19, which represents the charge from a battery being passed through a bird by means of this discharger.

A piece of hard wood is taken, about twenty inches long and six inches wide, and in the middle of it there is fixed a small table, which can be adjusted at a convenient height by means of a thumb-screw. The top of this table is usually made of a disc of glass fixed on by shellac, or else it has a strip of ivory inlaid across it. At each end of the board is fixed a glass rod, carrying at the top a revolving cap fitted with a compass joint, so that the wire passing through it may be inclined at any angle. The wires can also be slipped backwards or forwards, so that they may easily be brought into contact with any part of the substance to be operated upon. These wires are pointed at the ends, and brass balls are fitted so as to screw on over the points when required; but as brass balls are rather expensive, lead bullets may, in most cases, be substituted for them, the main difference being in the appearance. One of these instruments will be found to be of great use to the student, and he should therefore endeavour to procure, or, better still, to make one; for a better knowledge of the principles of a science may usually be obtained by making apparatus than by merely experimenting with that already made. As shown in the figure, the object through which the charge is to be passed is placed on the table, and the knobs or points of the wires brought into contact with opposite sides of it. One wire is then connected with the outside of the jar or battery, and the other connected with the knob by means of the jointed discharging rod, contact being made with the wire of the discharger first. For this purpose, however, it is necessary that it should have an insulating handle, as the electricity always chooses the best conductors, and if there be any distance between the knobs, or if a badly conducting substance be interposed, the electricity may travel through the body of the operator to the ground instead of passing through the discharger

The next class of effects we notice are the luminous. As already seen, whenever the spark traverses air a line of light is seen; when the two electricities from the opposite sides of a jar unite, the spark is much more luminous, being thicker and denser, because of the passage of a much greater amount of the fluid. This spark is almost instantaneous, so that if a dark room be suddenly illuminated by it, a rapidly revolving wheel in it will appear to be at rest. So instantaneous is it, that a printed bill has been fixed on to a wheel, and made to revolve several hundred times per minute, and yet a distinct photograph of it has been taken by means of the light from the spark, the time required for its passage being so short that the light has faded before the wheel has moved through an appreciable space.

If the points be made nearly to touch, and the thumb pressed down upon them, it will appear to be rendered semi-transparent, and the shock will not be felt. In a similar way the shock may be passed through eggs, oranges, etc., illuminating them. Some substances, too, remain luminous for some time after the charge has passed through them.

If we fix a ball to the plate of an air-pump, and connect it with the exterior of a jar, and then place over it an open receiver with a similar ball and rod passing air-tight through a plate at its upper end, we shall find that the spark will pass a much greater distance. In a long exhausted tube it will sometimes appear to dart along like a ball of light.

Similarly, if we exhaust a large globe having a wire and ball fixed tightly in each end, and connect the upper one B (Fig. 20) with the prime conductor, we shall find that, instead of the electricity passing along in a series of thin sparks, it will spread out and form a large faintly luminous space, having a violet tinge. On again gradually admitting the air by means of the stopcock, this space will grow smaller and smaller, till at last the narrow but bright sparks pass as before. Many similar experiments of great beauty may be performed by means of voltaic electricity, and it is believed that the beautiful phenomena of the aurora borealis, or northern lights, so frequently seen in high latitudes, may be attributed to a similar cause.

LESSONS IN ALGEBRA.—XXII.

SIMPLE EQUATIONS.

TWO UNKNOWN QUANTITIES.

IN our former Lessons on Simple Equations we gave the rules for solving those which contain only *one* unknown quantity; and, with the exception of one or two, the whole Centenary of Problems were solved by means of these rules. We proceed now to show how to resolve equations which contain *two* unknown quantities.

Cases indeed frequently occur in which *two* unknown quantities are necessarily introduced into the same calculation.

EXAMPLE.—Suppose the following equations are given, viz. :—

$$(1.)\ x + y = 14,$$
$$(2.)\ x - y = 2.$$

Here, if y be transposed in each, they will become

$$(1.)\ x = 14 - y,$$
$$(2.)\ x = 2 + y.$$

Now, the first member of each of the equations is x, and the second member of each is *equal* to x. But according to the axiom that quantities which are respectively equal to another quantity, are equal to each other; therefore we have

$$2 + y = 14 - y;\ \text{whence } y = 6.$$

Lastly, by substituting the value of y in the 1st equation, we have $x + 6 = 14$; and $x = 8$. Therefore, 8 and 6 are the values of x and y.

In solving the preceding problem, it will be observed that we first found the value of the unknown quantity x in each equation; and then, by making one of the expressions denoting the value of x equal to the other, we formed a new equation, which contained only the other unknown quantity y. This process is called *extermination* or *elimination*.

In the resolution of equations there are three methods of extermination, viz., by comparison, by substitution, and by addition and subtraction.

CASE I.—To exterminate one of the two unknown quantities by comparison.

RULE.—*Find the value of one of the unknown quantities in each of the equations, and form a new equation by making one of these values equal to the other. Find the value of the unknown quantity in this equation, by the rules formerly given. Then substitute this value of the one unknown quantity in either of the other equations, and resolving it by the same rules, the other unknown quantity will be found.*

EXAMPLE.—Given $x + y = 36$, and $x - y = 12$; to find the values of x and y.

Transposing y in the 1st equation, gives		$x = 36 - y$.
Transposing y in the 2nd equation,	,,	$x = 12 + y$.
Making these values of x equal,	,,	$12 + y = 36 - y$.
Transposing, etc.,	,,	$y = 12$.
Substituting the value of y,	,,	$x = 12 + 12 = 24$.

Hence, 24 and 12 are the values required.

EXERCISE 36.

1. Given $2x + 3y = 28$, and $3x + 2y = 27$; to find the values of x and y.
2. Given $4x + y = 43$, and $5x + 2y = 56$; to find the values of x and y.
3. Given $4x - 2y = 16$, and $6x = 9y$; to find the values of x and y.
4. Given $4x - 2y = 20$, and $4x + 2y = 100$; to find the values of x and y.
5. Given $5x + 8 = 7y$, and $5y + 32 = 7x$; to find the values of x and y.

EXAMPLE (1).—To find two numbers such that their sum shall be 24; and the greater shall be equal to five times the less.

Here, let x be the greater; and y the less.

Then, $x + y = 24$,
And $x = 5y$.
Whence, $5y + y = 6y = 24$,
And $y = 4$;
Therefore, $x = 20$. *Ans.* 20 and 4.

EXAMPLE (2).—Find two quantities whose sum is equal to h; and the difference of whose squares is equal to d.

Let x and y be the two quantities.

$$\left.\begin{array}{l}\text{Then } x + y = h \\ \text{And } x^2 - y^2 = d\end{array}\right\}\text{ per question.}$$

From the first equation we have, by transposition,

$$x = h - y,$$

And, by squaring both sides, we have,

$$x^2 = h^2 - 2hy + y^2.$$

From the second equation, we have, by transposition,

$$x^2 = y^2 + d.$$

Now, by equating the two values of x^2, we have,

$$y^2 + d = h^2 - 2hy + y^2;$$

And, by transposition and cancelling, we have,

$$2hy = h^2 - d;$$

$$\text{Whence, } y = \frac{h^2 - d}{2h}.$$

$$\text{Therefore, } x = h - \frac{h^2 - d}{2h} = \frac{h^2 + d}{2h}.$$

EXAMPLE (3).—Given $ax + by = h$, and $x + y = d$; to find the values of x and y.

Here, from the first equation, we have, by transposition,

$$ax = h - by,$$

$$\text{And } x = \frac{h - by}{a}.$$

Again, from the second equation, we have, by transposition,

$$x = d - y,$$

$$\text{Whence, } \frac{h - by}{a} = d - y;$$

$$\text{Or, } h - by = ad - ay,$$

$$\text{And } ay - by = ad - h.$$

From this equation, by separating the left-hand member into factors, we have

$$(a - b)\,y = ad - h;$$

$$\text{Whence, } y = \frac{ad - h}{a - b};$$

$$\text{Consequently, } x = d - \frac{ad - h}{a - b} = \frac{h - bd}{a - b}.$$

The rule given above may be generally applied for the extermination of unknown quantities. But there are cases in which other methods will be found more expeditious.

EXAMPLE (4).—Given $x = hy$, and $ax + bx = y^2$; to find the values of x and y.

As in the first of these equations x is equal to hy, we may in the second equation *substitute* this value of x for x itself. The second equation will then become, $ahy + bhy = y^2$.

The equality of the two sides is not affected by this alteration, because we only change one quantity x for another which is equal to it. By this means we obtain an equation which contains only one unknown quantity. Whence, $y = ah + bh$, and $x = ah^2 + bh^2$.

This process is called *extermination by substitution.*

CASE II.—To exterminate an unknown quantity by substitution.

RULE.—*Find the value of one of the unknown quantities, in one of the equations, in terms of the other unknown; and then in the other equation* SUBSTITUTE *this value for the former unknown quantity. From this equation, find the value of this unknown quantity, as before.*

EXAMPLE (5).—Given $x + 3y = 15$, and $4x + 5y = 32$; to find the values of x and y.

Here, transposing $3y$ in the first equation, we have,

$$x = 15 - 3y.$$

Substituting the value of x in the second equation, we have,

$$60 - 12y + 5y = 32;$$

Whence, by transposition, etc.,

$$y = 4.$$

And, from the first equation,

$$x = 15 - 12 = 3.$$

There is a *third* method of exterminating an unknown quantity from an equation, which, in many cases, is preferable to either of the preceding.

EXAMPLE (6).—Given $x + 3y = a$, and $x - 3y = b$; to find the values of x and y.

Here, if we *add together* the first members of these two equations, and also the second members, we shall have,

$$2x = a + b,$$

an equation which contains only the unknown quantity x. The other, having equal co-efficients with contrary signs, has disappeared. Still the equality of the sides is preserved, because we have only added equal quantities to equal quantities.

$$\text{Whence, } x = \frac{a+b}{2},$$

$$\text{And} \quad y = \frac{a-x}{3} = \frac{a-b}{6}.$$

EXAMPLE (7).—Given $3x + y = h$, and $2x + y = d$; to find the values of x and y.

Here, if we *subtract* the second equation from the first, we shall have $x = h - d$, where y is exterminated, without affecting the equality of the sides. Whence, $y = 3d - 2h$.

EXAMPLE (8).—Given $x - 2y = a$, and $x + 4y = b$; to find the values of x and y.

Here, multiplying the first equation by 2, we have,

$$2x - 4y = 2a;$$

Then, adding the second and third equations, we have,

$$3x = b + 2a;$$

$$\text{Whence, } x = \tfrac{1}{3}(b + 2a),$$

$$\text{And} \quad y = \tfrac{1}{6}(b - a).$$

This process is called *extermination by addition and subtraction.*

EXERCISE 37.

1. Given $8x + y = 42$, and $2x + 4y = 18$; to find the values of x and y.
2. Given $2x + 8y = 84$, and $4x + 6y = 68$; to find the values of x and y.
3. Given $3x + 3y = 72$, and $4x + 5y = 116$; to find the values of x and y.
4. Given $\frac{1}{2}x + 10y = 124$, and $2x + 9y = 124$; to find the values of x and y.
5. A privateer in chase of a ship 20 miles distant, sails 8 miles, while the ship sails 7. How far will each sail before the privateer will overtake the ship?
6. The ages of two persons, A and B, are such that seven years ago A was three times as old as B; and seven years hence, A will be twice as old as B. What is the age of each?
7. There are two numbers, of which the greater is to the less as 3 to 2; and their sum is the sixth part of their product. What are the numbers?

CASE III.—To exterminate an unknown quantity by addition and subtraction.

RULE.—*Multiply or divide the equations, if necessary, by such factors that the term which contains one of the unknown quantities shall be the same in both equations. Then subtract one equation from the other, if the signs of this unknown quantity are alike, or add them together if the signs are unlike; the result will be an equation containing only one unknown quantity, which is to be resolved as before.*

It must be kept in mind that both members of an equation are always to be increased or diminished alike, in order to preserve their equality.

EXAMPLE (9).—Given $2x + 4y = 20$, and $4x + 5y = 28$; to find the values of x and y.

Here, multiplying the first equation by 2, we have,

$$4x + 8y = 40.$$

Subtracting the second equation from this, we have,

$$3y = 12;$$

$$\text{Whence, } y = 4, \text{ and } x = 2.$$

In the solution of the succeeding problems, either of the three rules for exterminating unknown quantities may be used at pleasure. *That quantity which is the least involved should be the one chosen to be first exterminated.*

The student will find it a useful exercise to solve every example by *each* of the several methods, and carefully to observe which is the most comprehensive, and the best adapted to different classes of problems.

EXAMPLE (10).—To find a fraction such that, if a unit be added to the numerator, the fraction will be equal to $\frac{1}{3}$; but if a unit be added to the denominator, the fraction will be equal to $\frac{1}{4}$.

Let $x =$ the numerator, and $y =$ the denominator.

Here, by the first condition, we have $\frac{x+1}{y} = \frac{1}{3}$;

And by the second, we have $\frac{x}{y+1} = \frac{1}{4}$.

Whence, $x = 4$, the numerator;

And $y = 15$, the denominator.

Therefore, $\frac{4}{15}$ is the required fraction.

EXERCISE 38.

1. Given $2x + y = 16$, and $3x - 3y = 6$; to find the values of x and y.
2. Given $4x + 3y = 50$, and $3x - 3y = 6$; to find the values of x and y.
3. Given $3x + y = 38$, and $5x + 4y = 68$; to find the values of x and y.
4. Given $4x - 40 = -4y$, and $6x - 63 = -7y$; to find the values of x and y.
5. The numbers of two opposing armies are such, that the sum of both is 21,110; and twice the number in the greater army, added to three times the number in the less, is 52,219. What is the number in each army?
6. The sum of two numbers is 220, and if three times the less be taken from four times the greater, the remainder will be 180. What are the numbers?
7. The mast of a ship consists of two parts; one-third of the lower part added to one-sixth of the upper part, is equal to 28 feet; and five times the lower part, diminished by six times the upper part, is equal to 12 feet. What is the height of the mast?
8. What two numbers are those, whose *difference* is to their sum as 2 to 3; and whose sum is to their product as 3 to 5?
9. To find two numbers such that the product of their sum and difference shall be 5, and the product of the sum of their squares and the difference of their squares shall be 65.
10. To find two numbers whose sum is 32, and whose product is 240.
11. To find two numbers whose sum is 52, and the sum of their squares 1,424.
12. A certain number consists of two digits or figures, the sum of which is 8. If 36 be added to the number, the digits will be inverted. What is the number?
13. The united ages of A and B amount to a certain number of years, consisting of two digits, the sum of which is 9. If 27 years be subtracted from the amount of their ages, the digits will be inverted. What is the sum of their ages?
14. A merchant having mixed a quantity of brandy and gin, found if he had put in 6 gallons more of each, the compound would have contained 7 gallons of brandy for every 6 of gin; but if he had put in 6 gallons less of each, the proportions would have been as 6 to 5. How many gallons did he mix of each?

KEY TO EXERCISES IN LESSONS IN ALGEBRA.

EXERCISE 34.

1. $d^5 + 5d^4h + 10d^3h^2 + 10d^2h^3 + 5dh^4 + h^5$.
2. $b^n + Ab^{n-1}y + Bb^{n-2}y^2 + Cb^{n-3}y^3 + Db^{n-4}y^4 +$ etc., in which the co-efficients which are here represented by A, B, C, etc., are respectively $n, n.\frac{n-1}{2}, n.\frac{n-1}{2}.\frac{n-2}{3}$, etc.

3. $729x^6 + 2916x^5y + 4860x^4y^2 + 4320x^3y^3 + 2160x^2y^4 + 576xy^5 + 64y^6$.
4. $a^2 - 2ab + b^2$.
5. $a^3 - 3a^2b + 3ab^2 - b^3$.
6. $a^4 - 4a^3b + 6a^2b^2 - 4ab^3 + b^4$.
7. $x^6 - 6x^5y + 15x^4y^2 - 20x^3y^3 + 15x^2y^4 - 6xy^5 + y^6$.
8. $a^n - na^{n-1}b + n\frac{n-1}{2}a^{n-2}b^2 - n\frac{n-1}{2}\frac{n-2}{3}a^{n-3}b^3 +$, etc.
9. $a^4 - 4a^3 + 6a^2 + 6a + 1$.
10. $1 - 6y + 15y^2 - 20y^3 + 15y^4 - 6y^5 + y^6$.
11. $1 + nx + n.\frac{n-1}{2}x^2 +$, etc.
12. $a^2 + \frac{4}{3}a + \frac{4}{9}$.
13. $x^2 - bx + \frac{b^2}{4}$.
14. $\frac{b^2}{m^2} - \frac{6bxy}{m} + 9x^2y^2$.
15. $\frac{36}{49} - \frac{24}{7}abc + 4a^2b^2c^2$.

LESSONS IN GEOGRAPHY.—XXXIX.

SOUTH AMERICA.

SOUTH America has on the map the appearance of the vertical section of an irregularly shaped pear. The stalk end is broken off at the island of Tierra del Fuego, where it meets the junction of the Atlantic and Pacific Oceans, on the south. The projection of a map of this continent is to be made in the same manner as a projection for a map of Africa, namely, by drawing the parallels of latitude as horizontal *straight* lines, parallel to each other, and equidistant by a space assumed to represent 5° or 10°, and the meridians as *curved* lines on either side of a perpendicular, representing the meridian of 55° or 60° W. longitude, the curves being regulated by the comparative length of the degree under each parallel of latitude laid down, as shown by a diagonal scale made for the purpose. The latitudes and longitudes of places may be obtained from the index to any good atlas.

Boundaries.—It is bounded by the Caribbean Sea on the north; by the Strait of Magellan on the south; by the Pacific Ocean on the west; and by the Atlantic Ocean on the east. It is connected with the North American continent at the north-west point by the Isthmus of Panama, and includes the narrowest portion of that isthmus, which forms the State of Panama, in the Granadian Confederation. The most northerly point of this continent is Point Gallinas, in New Granada, very nearly in lat. 12° 30′ N., and long. 71° 53′ W.; the most southerly point, including Tierra del Fuego, or the "land of fire," and the adjacent islands, is Cape Horn, in lat. 55° 59′ S. and long. 67° 12′ W.; the most westerly point is Parina Point, near the Lobos Islands, in lat. 4° 43′ S. and long. 81° 11′ W.; and the most easterly point is the entrance to the River Goyana, near Olinda, in lat. 7° 31′ S. and long. 34° 47′ W.

Length, Breadth, and Superficial Area.—The length of this continent from north to south is about 4,800 miles; and its greatest breadth about 3,300 miles. The surface of South America, including its adjacent islands south of the equator, is about 6,700,000 square miles; and the population is about 23,000,000; hence this continent contains, on an average, about 3½ inhabitants to every square mile.

Islands.—The islands considered as belonging to South America are few and unimportant. The largest, namely, Tierra del Fuego, is considered sterile, and scarcely habitable. Between the continent and this island, and Clarence and Desolation Islands to the west of it, lies the long, narrow, and winding *strait*, called by the name of Magellan, or Magalhaens, the navigator who first sailed through it and discovered the passage to the Pacific Ocean. Off the southern coast of Tierra del Fuego lie Londonderry, Hoste, and Wollaston Islands, with the small islets, on the south of which is the famous headland called Cape Horn, or Hoorn, after its discoverer. The islet, it should be said, bears the same name. Staten Land is an island of small size, lying off its eastern coast, and separated from it by the Strait of Le Maire. About 350 miles east of the entrance to this strait lie the Falkland Islands, one of which is called the East Falkland, and the other the West, between which runs the Falkland Sound; besides these, this group consists of 200 smaller islands, the area of the whole being about 13,000 square miles. About 800 miles south-east of these islands lies the South Georgian group, the largest of which, South Georgia, from which the group takes its name, is 90 miles long by 10 miles broad, and forms a useful depôt for the seal and whale fishery. The Galapagos Islands are situated on the equator, about 750 miles west of the state called Ecuador, to which they belong. The Lobos Islands and the Chinca Islands, celebrated for their guano, lie off the west coast of the state of Peru, to which they belong. The island of Jnan Fernandez lies nearly 400 miles off the west coast of the State of Chili. The Patagonian Archipelago, including the islands of Chiloe, Chonos, Wellington, Madre de Dios Archipelago, Hanover, Adelaide, etc., lies west of the country or region from which it receives its name. North-east of Cape St. Roque, the easternmost point of Brazil, lie the islands of Fernando Noronha and Rocas; and near the twentieth parallel of S. latitude, about 700 miles from the coast, lie the islands of Trinidad and Martin Vaz. North of the entire continent lie the West Indies, in the Caribbean Sea, as described in a former lesson.

Seas, Gulfs, Bays.—Of inland seas in this continent there are none; and the gulfs and bays are small and unimportant. At the north-west corner, where it joins North America, are found, on the Pacific side, the Bay of Panama and the Gulf of St. Miguel; on the Atlantic side, and to the north of it, are the Gulf of Darien, the Gulf of Maracaybo, the Gulf of Triste, the Gulf of Paria, the estuary of the Orinoco, the estuary of the Amazon, and the estuary of the Maranham. On the east of the continent are the bays of Todos Santos (or All Saints Bay), Espirito Santo, the estuary of the Rio de la Plata, the Gulf of San Antonio, and the Bay of St. George. On the west, the Gulf of Penas, the Bay of Morena, the Bay of Pisco, the Gulf of Guyaquil, and the Bay of Choco.

Mountains.—The most remarkable natural feature in the continent of South America is, with one exception, the grand range of mountains called the Cordillera de los Andes, or Chain of the Andes, which run nearly parallel and comparatively close to its western shores. The commencement of this range is south of the Isthmus of Darien, and its termination is at the Strait of Magellan, its whole extent being about 4,500 miles, but varying considerably in altitude as well as in name. The mountains of this range, indeed, take their names according to the countries through which they pass; hence we have the Columbian, the Peruvian, the Bolivian, the Chilian, and the Patagonian Andes. The average height of the Columbian Andes is about 12,000 feet above the level of the sea, and the highest peak is Chimborazo, which is 21,425 feet above the same level. Antisana, Pichincha, Tolima, Cotopaxi, and others, are little inferior in altitude to the "giant of the western world," and the last is reckoned the most tremendous volcano on the face of the globe. The average height of the Peruvian and Bolivian Andes is greater than that of the Columbian chain, being about 14,000 feet; their highest peaks, Sorata and Illimani, reach the respective elevations of 21,190 feet and 21,150 feet above the level of the sea; and many of the passes across the chain of Upper Peru are about 16,000 feet above the same level. The Chilian Andes have a less average elevation than any of the former; but the peak of Aconcagua, which is 23,910 feet above the level of the sea; overtops all the high peaks already mentioned, and forms the culminating point of South America. The Patagonian chain is very considerably lower than any of the preceding, its average height being only 3,000 feet, and its highest peaks only 9,000 feet above the level of the sea. In Venezuela are the mountains of Parimé, the culminating peak of which is Maravaca, about 10,500 feet above the level of the sea. Along the southern frontier of Guiana runs a mountain range called the Sierra Acary, while Brazil is traversed from north to south by several ranges parallel to each other, and of no great altitude when compared to the Andes, the principal of these being the Sierra del Espinhaço and the Cordillera Grande.

Table-lands.—The plateaus or table-lands of South America are formed of the elevated intervening grounds between the chains or ridges of its mountains just described, and they rival in elevation those of the continent of Asia. The principal of these plateaus are those of Quito, Pasco, and Titicaca. The elevation of the plateau of Quito, above the sea-level, is about 9,600 feet; of Pasco, 13,700 feet; and of Titicaca, 12,850 feet.

Rivers.—The vast plains of South America give rise to a system of rivers unparalleled in the rest of the world for magnitude and extent. The great central plain of this continent is divided into three large portions, which receive their names from the immense rivers which run through them respectively,


SOUTH AMERICA
Scale of Miles
200 400 600 800
50 Lon. West from Greenwich
Lon 23 W. from Washington
27 Lon East
Latitude of Sierra Leone
Latitude of the Cape of Good Hope
Lat. of Van Diemens Land
Tropic of Capricorn
Equator
CARIBBEAN SEA
PACIFIC OCEAN
ATLANTIC OCEAN
NEW GRANADA
VENEZUELA
GUIANA
ECUADOR
PERU
BRAZIL
BOLIVIA
PARAGUAY
URUGUAY
LA PLATA
CHILI
PATAGONIA
Isthmus of Darien
Bay of Panama
Bay of Choco
Panama
Chagres
Carthagena
Maracaybo
L. Maracaybo
Coro
La Guayra
CARACAS
Valencia
Cumana
Grenada
Margarita
Tobago
Trinidad
Orinoco R.
Truxillo
Merida
BOGOTA
Magdalena R.
Meta R.
Cataracts
Ipaya L.
Esmeraldas
Parima Mt.
Acaray Mt.
Georgetown
New Amsterdam
Paramaribo
Cayenne
Popayan
Llanos or Plains
R. Vaupes
San Gabriele
Carmo
Macapa
Mazagao
Para R.
Cotopaxi Mt.
QUITO
Mt. Chimborazo
Riobamba
Guayaquil
Gulf of Guayaquil
Caqueta R.
Putumayo
Barcellos
Moura
Obidos
Barra
Santarem
Para
Bayao
Funil
Itapicura
Maranham
Seara
Princeza
Valencia
Natal
Parahyba
Cuenca
Omaguas
Teffe
Olivenca
Tabatinga
Coary
Borba
C. Blanco
Jaen
Tunguragua R.
Caxamarca
Region but little known
Purus R.
Crato
Madeira R.
Tapajos R.
R. Xingu
Jurumenha
Oeiras
Govanna
Pernambuco
Maceyo
Truxillo
Yungay
Balsamao
Ferrol
Huaura
Guarmey
Cataracts
Elevated Plains
Geral Mts.
Pontal
Pambo
Sergipe del Rey
Bahia or St. Salvador
Bay of All Saints
Cerro Pasco
Source of the Amazon
Callao
Lima
Guancavelica
Guamanga
Cuzco
Pisco
Ica
Guapore R.
Villa Bela
St. Felix
Diamond District
Porto Seguro
Abrolhos I.
Mt. Sorata
L. Titicaca
Mt. Illimani
Cochabamba
Xarayes L.
Cuyaba
Tacoary R.
Villa Boa
Principe
Tejuco
Portalegre
Espiritu Santo
Arequipa
Arica
Oruro
CHUQUISACA
New Coimbra
Conception
Iquique
Desert of Atacama
Potosi
Pilcomayo R.
Tarija
Parana R.
Gold Mines
Brazilian Mts.
Villa Rica
Cape Frio
St. Felix I.
St. Ambroso
Jujuy
Vermejo R.
Salta
Salado R.
San Paulo
Curuguaty
Santos
St. Sebastian
ASSUMPTION
Villa Rica
Itapua
Dulce R.
Tucuman
St. Catharine
Desterro
Copiapo
Rioja
Catamarca
Corrientes
Huasco
Santiago
Portalegre
Coquimbo
St. Juan
Santa Fe
L. de los Patos
Cordova
Rio Grande
Is. of Juan Fernandez
Mas a Fuero
Mas a Tierra
Valparaiso
SANTIAGO
Mendoza
BUENOS AYRES
Salladillo R.
Maldonado
MONTEVIDEO
RIO DE LA PLATA
Conception
Andes
Araucania
Colorado R.
Vulcan Mt.
Valdivia
Negro R.
G. of San Antonio
St. Carlos
CHILOE I.
Peninsula of St. Joseph
Camarones R.
Peninsula of Tres Montes
Bay of St. George
G. of Penas
C. Blanco
Wellington I.
Port Julian
FALKLAND IS.
Queen Adelaides Archipelago
W. Falkland
E. Falkland
Str. of Magellan
C. Pillar
TERRA DEL FUEGO
Staten I.
South Georgia I.
C. Horn

viz., the plain of the Orinoco in the north, the plain of the Amazon in the middle, and the plain of the Rio de la Plata in the south. The *llanos*, or savannahs, occupy nearly the whole plain of the Orinoco. These are level grassy tracts without trees, similar to the prairies, or vast meadows, of North America, and are annually inundated by the rivers, like the regions of the Nile. The *selvas*, or forest-plains, extend over the great basin of the Amazon, and, as their name denotes, cover the ground with trees, shrubs, and plants; to which may be added vast tracts similar to those in the basin of the Orinoco, and salt and sandy deserts in the interior. The *pampas*, or immense level plains covered with grass, oats, clover, and other herbage, occupy the plains of the Rio de la Plata, and the regions to the south of it, and in their present wild state form small encouragement for the habitation of man; hence the generally desolate state of the whole of the Patagonian region. The river Orinoco is about 1,200 miles long; it rises in the mountains of Guiana, and falls into the Atlantic on the north of British Guiana. The Amazon, which in the npper part of its course is called the Maranon, rises amidst the elevated parts of the Peruvian Andes, flows first northerly, and then easterly, and, after a course of 3,900 miles, falls into the Atlantic at the eqnator. The basin of the Amazon includes upwards of 1,500,000 square miles, and is supplied with its waters by a number of large tributaries. The Amazon is navigable for large vessels from its embouchure to its junction by the Ucayali, or 2,500 miles from the sea, and for small vessels to the foot of the mountains. Its volume of water is so great, that its freshness is perceptible 500 miles out at sea. To give an idea of the level nature of the basin of this mighty river, we may state that for the space of 600 miles before it discharges its flood into the deep, it has only a fall of 10·5 feet, or about *one-fifth of an inch* per mile, yet it is reckoned to flow into the ocean with about the same velocity as the Ganges. For the whole of this distance the tides of the Atlantic oppose its majestic flow; but above this point, the declivity being about 6 inches per mile, the velocity of its waters surpasses that of our swiftest steamers; and at this point the opposition of its waters to the flow of the tide becoming tremendous, their united action produces waves which somtimes rise to the height of several feet, rolling back upon the rapid stream like the noise of a cataract, and overwhelming all the lowlands above its estuary. This phenomenon, justly called the *bore*, or by the native Indians *pororoca*, will for ever impede the useful navigation of this great river. The main stream of the Amazon receives the waters of many great rivers on the north and south banks. The chief of its affluents on the north are the Pntnmayo, Caqueta, and Negro; on the sonth, the Madeira, Tapajos, and Xingu.

The Rio de la Plata is a broad estuary formed by the junction of the rivers Parana and Uruguay. The length of the Parana is about 2,350 miles from its source to the embouchure of the Rio de la Plata; and that of the Paraguay, a branch of the same, which joins it at the distance of 760 miles from the sea, is abont 1,260 miles. The Uruguay branch is 800 miles in length. The Parana and the Uruguay are navigable for vessels of considerable burden for nearly 1,000 miles. Other rivers of some importance in Sonth America are the Magdalena, 860 miles long, which flows into the Caribbean Sea; and the Atrato, 300 miles long, which flows into the Gulf of Darien. The rivers Essequibo, Demerara, Berbice, Surinam, and others which flow into the Atlantic eastward of the Orinoco, will be remembered chiefly from the important settlements to which they have given their name. The San Francisco, in Brazil, is 1,500 miles long. The Colorado, 600 miles long, and the Rio Negro, 800 miles long, both flow into the Atlantic south of the La Plata. The rivers on the west coast of South America have all short courses, owing to the vicinity of the Andes to the shore.

Lakes.—The lakes of South America are few. The Lake of Titicaca, on the table-land of the same name, and at an elevation of 12,847 feet above the level of the sea, contains about 3,800 square miles; near its shores the depth is 720 feet; its waters are fresh. The Lake of Maracaybo, near the shores of the Caribbean Sea, is connected by a narrow strait with the Gulf of Maracaybo, and its waters are brackish; it contains about 5,000 square miles. The Lake dos Patos, or "lake of the ducks," of the same area, on the south-east coast of Brazil, discharges its waters into the sea by a channel called the Rio Grande do Sul.

SUMMARY OF BOUNDARIES.

NORTH: The Caribbean Sea, etc.
SOUTH: The Straits of Magellan.
EAST: The Atlantic Ocean.
WEST: The Pacific Ocean.

SUMMARY OF ISLANDS.

Gallapagos, W. of Ecuador.
Lobos, W. of Peru.
Juan Fernandez, W. of Chili.
Chiloe, S. of Chili.
Chonos Archipelago, S. of Chiloe.
Wellington, W. of Patagonia.
Madre de Dios Archipelago, S. of Wellington.
Hanover, W. of Patagonia.
Adelaide, S. of Hanover.
Desolation I., S. of Adelaide.
Tierra del Fuego, S. of Patagonia.
Horn, S. of Tierra del Fuego.
Staten Land, E. of Tierra del Fuego.
Falklands, E. of Patagonia.
Georgia, S.E. of Falklands.
Triuidad, E. of Brazil.
Fernando Noronha, N.E. of Cape St. Roque.
Caviana, M. of the Amazon.
Marajo, S. of Caviana.
Margarita, N. of Veneznela.
Tortugas, N. of Venezuela.

SUMMARY OF PENINSULAS.

Patagonia, S. of La Plata.
Tres Montes, W. of Patagonia.
Sau Josef, E. of Patagonia.

SUMMARY OF CAPES.

Point Gallinas, Venezuela.
St. Roque, Brazil.
Frio, Rio Janeiro.
S. Maria, Uruguay.
St. Antonio, Buenos Ayres.
Corrieutes, Buenos Ayres.
Three Points, Patagonia.
Horn, Horn Island.
Ajuja, Peru.
Point Parina, Peru.
San Lorenzo, Ecuador.
San Francisco, Ecuador.

SUMMARY OF MOUNTAINS.

Andes, S. America.
Chimborazo, Cotopaxi, Antisana, Pichinca, } Ecuador.
Chuquibamba, Sorata, Illimani, Cochabamba, Potosi, } Bolivia.
Aconcagua, Chili.
Maravaca, Venezuela.
Sierra do Espinhaço, Cordillera Grande, } Brazil.

SUMMARY OF RIVERS.

Amazon, Brazil.
Orinoco, Colombia.
Rio de la Plata, between Buenos Ayres and Uruguay.
Uruguay, Uruguay.
Parana, Paraguay, } Paraguay.
Pilcomayo, Salado, } Argentine Confederation.

SUMMARY OF LAKES.

Titicaca, Bolivia.
Maracaybo, Venezuela.
Lake dos Patos, Brazil.

LESSONS IN FRENCH.—LXI.

§ 48.—PARADIGMS OF THE AUXILIARY VERBS (*continued*).

(5.) ÊTRE, *TO BE*,—AFFIRMATIVELY (*continued*).

IMPERATIVE MOOD.

Sois,	*be (thou).*
Qu'il soit,	*let him be.*
Qu'on soit,	*let one be.*
Soyons,	*let us be.*
Soyez,	*be (ye or you).*
Qu'ils soient,	*let them be.*

SUBJUNCTIVE MOOD.

SIMPLE TENSES.		COMPOUND TENSES.	
PRESENT.		PAST.	
Que je sois,	*that I may be.*	Que j'aie été,	*that I may*
Que tu sois,	*that thou mayest be.*	Que tu aies été,	*that thou mayest*
Qu'il soit,	*that he may be.*	Qu'il ait été,	*that he may*
Qu'on soit,	*that one may be.*	Qu'on ait été,	*that one may*
Que nous soyons,	*that we may be.*	Que nous ayons été,	*that we may*
Que vous soyez,	*that you may be.*	Que vous ayez été,	*that you may*
Qu'ils soient,	*that they may be.*	Qu'ils aient été,	*that they may* } *have been.*
IMPERFECT.		PLUPERFECT.	
Que je fusse,	*that I might be.*	Que j'eusse été,	*that I might*
Que tu fusses,	*that thou mightest be.*	Que tu eusses été,	*that thou mightest*
Qu'il fût,	*that he might be.*	Qu'il eût été,	*that he might*
Qu'on fût,	*that one might be.*	Qu'on eût été,	*that one might*
Que nous fussions,	*that we might be.*	Que nous eussions été,	*that we might*
Que vous fussiez,	*that you might be.*	Que vous eussiez été,	*that you might*
Qu'ils fussent,	*that they might be.*	Qu'ils eussent été,	*that they might* } *have been.*

§ 49.—Regular Verbs.

FIRST CONJUGATION,—ENDING IN *ER*.

MODEL VERB.

CHANTER, *TO SING*.

Infinitive Mood.

PRESENT.		PAST.	
Chanter,	*to sing.*	Avoir chanté,	*to have sung.*

Participles.

PRESENT.		COMPOUND.	
Chantant,	*singing.*	Ayant chanté,	*having sung.*

PAST.

Chanté, *sung.*

Indicative Mood.

SIMPLE TENSES.		COMPOUND TENSES.		
PRESENT.		PAST DEFINITE.		
Je chante,	*I sing.*	J'ai chanté,	*I have sung.*	
Tu chantes,	*thou singest.*	Tu as chanté,	*thou hast sung.*	
Il chante,	*he sings.*	Il a chanté,	*he has sung.*	
On chante,	*one sings.*	On a chanté,	*one has sung.*	
Nous chantons,	*we sing.*	Nous avons chanté,	*we have sung.*	
Vous chantez,	*you sing.*	Vous avez chanté,	*you have sung.*	
Ils chantent,	*they sing.*	Ils ont chanté,	*they have sung.*	
IMPERFECT.		PLUPERFECT.		
Je chantais,	*I was singing*, or *I used to sing.*	J'avais chanté,	*I had*	
Tu chantais,	*thou wast singing.*	Tu avais chanté,	*thou hadst*	
Il chantait,	*he was singing.*	Il avait chanté,	*he had*	
On chantait,	*one was singing.*	On avait chanté,	*one had*	*been singing.*
Nous chantions,	*we were singing.*	Nous avions chanté,	*we had*	
Vous chantiez,	*you were singing.*	Vous aviez chanté,	*you had*	
Ils chantaient,	*they were singing.*	Ils avaient chanté,	*they had*	
PAST DEFINITE.		PAST ANTERIOR.		
Je chantai,	*I sang* or *did sing.*	J'eus chanté,	*I had sung.*	
Tu chantas,	*thou sangest.*	Tu eus chanté,	*thou hadst sung.*	
Il chanta,	*he sang.*	Il eut chanté,	*he had sung.*	
On chanta,	*one sang.*	On eut chanté,	*one had sung.*	
Nous chantâmes,	*we sang.*	Nous eûmes chanté,	*we had sung.*	
Vous chantâtes,	*you sang.*	Vous eûtes chanté,	*you had sung.*	
Ils chantèrent,	*they sang.*	Ils eurent chanté,	*they had sung.*	
FUTURE.		FUTURE ANTERIOR.		
Je chanterai,	*I shall sing.*	J'aurai chanté,	*I shall*	
Tu chanteras,	*thou wilt sing.*	Tu auras chanté,	*thou wilt*	
Il chantera,	*he will sing.*	Il aura chanté,	*he will*	
On chantera,	*one will sing.*	On aura chanté,	*one will*	*have sung.*
Nous chanterons,	*we shall sing.*	Nous aurons chanté,	*we shall*	
Vous chanterez,	*you will sing.*	Vous aurez chanté,	*you will*	
Ils chanteront,	*they will sing.*	Ils auront chanté,	*they will*	

Conditional Mood.

PRESENT.		PAST.		
Je chanterais,	*I should sing.*	J'aurais chanté,	*I should*	
Tu chanterais,	*thou wouldst sing.*	Tu aurais chanté,	*thou wouldst*	
Il chanterait,	*he would sing.*	Il aurait chanté,	*he would*	
On chanterait,	*one would sing.*	On aurait chanté,	*one would*	*have sung.*
Nous chanterions,	*we should sing.*	Nous aurions chanté,	*we would*	
Vous chanteriez,	*you would sing.*	Vous auriez chanté,	*you would*	
Ils chanteraient,	*they would sing.*	Ils auraient chanté,	*they would*	

Imperative Mood.

Chante,	*sing (thou).*
Qu'il chante,	*let him sing.*
Qu'on chante,	*let one sing.*
Chantons,	*let us sing.*
Chantez,	*sing (ye* or *you).*
Qu'ils chantent,	*let them sing.*

Subjunctive Mood.

SIMPLE TENSES.		COMPOUND TENSES.		
PRESENT.		PAST.		
Que je chante,	*that I may sing.*	Que j'aie chanté,	*that I may*	
Que tu chantes,	*that thou mayest sing.*	Que tu aies chanté,	*that thou mayest*	
Qu'il chante,	*that he may sing.*	Qu'il ait chanté,	*that he may*	
Qu'on chante,	*that one may sing.*	Qu'on ait chanté,	*that one may*	*have sung.*
Que nous chantions,	*that we may sing.*	Que nous ayons chanté,	*that we may*	
Que vous chantiez,	*that you may sing.*	Que vous ayez chanté,	*that you may*	
Qu'ils chantent,	*that they may sing.*	Qu'ils aient chanté,	*that they may*	

IMPERFECT.		PLUPERFECT.		
Que je chantasse,	*that I might sing.*	Que j'eusse chanté,	*that I might*	
Que tu chantasses,	*that thou mightest sing.*	Que tu eusses chanté,	*that thou mightest*	
Qu'il chantât,	*that he might sing.*	Qu'il eût chanté,	*that he might*	
Qu'on chantât,	*that one might sing.*	Qu'on eût chanté,	*that one might*	*have sung.*
Que nous chantassions,	*that we might sing.*	Que nous eussions chanté,	*that we might*	
Que vous chantassiez,	*that you might sing.*	Que vous eussiez chanté,	*that you might*	
Qu'ils chantassent,	*that they might sing.*	Qu'ils eussent chanté,	*that they might*	

§ 50.—Remarks on the Peculiarities of some Verbs of the First Conjugation.

(1.) In verbs ending in **ger**, an *e* mute is placed after *g* when this letter should precede *a* or *o*, to indicate that *g* should be sounded soft even before these vowels:—

Nous mangeons,	*we eat.*
Je mangeai,	*I did eat.*
Jugeant,	*judging.*

(2.) In verbs ending in **oyer** and **uyer**, the *y* is changed into *i*, before *e*, *es*, and *ent*:—

employer,	j'emploie,	il emploiera.
essuyer,	il essuie,	j'essuierais.
nettoyer,	tu nettoies,	ils nettoient.

Note.—This rule applies, in the four conjugations, to *all* verbs the present participle of which ends in *yant*.

However, it does not hold good in the case of verbs of the first conjugation ending in **ayer**. With these verbs, the change of *y* into *i* is optional in the two third persons of the present indicative, and in the whole of the future indicative and of the present conditional; but the *y must* be preserved in *all* the other persons and tenses:—il paye, *or* il paie; ils payent, *or* ils paient; je payerai, je paierai, *or* je pairai, etc.; je payerais, je paierais, *or* je pairais, etc. (Acad.) Therefore it may be said that, in verbs ending in **ayer**, the **y** may be preserved throughout.

Verbs ending in **eyer** preserve the *y* unchanged throughout.

(3.) In verbs terminating in **cer**, in order to preserve its soft pronunciation, a cedilla is put under the *c* (ç) when it comes before *a* or *o*:—

Commençant,	*commencing.*	Nous plaçons,	*we place.*

(4.) In many verbs ending in **eter** and **eler**, the *t* or *l* of the infinitive is doubled, when it comes before *e*, *es*, and *ent*:—

J'appelle,	*I call;*	Ils appellent,	*they call.*
Je jetterai,	*I will throw;*	Tu jettes,	*thou throwest.*

(5.) Many verbs form exceptions to the last rule:—

Acheter,	*to buy.*	Étiqueter,	*to ticket.*
Bourreler,	*to torment.*	Geler,	*to freeze.*
Colleter,	*to collar.*	Harceler,	*to tease.*
Congeler,	*to congeal.*	Peler,	*to peel.*
Déceler,	*to detect.*	Suracheter,	*to pay dear for.*
Décolleter,	*to uncover the throat.*	etc., etc., etc.	
Dégeler,	*to thaw.*		

In the above verbs, when the *t* or *l* comes before *e*, *es*, or *ent*, a grave accent (`) is put over the *e* which precedes the *t* or *l*:—

Je pèle,	*I peel;*	Je pèlerai,	*I shall peel.*
J'achète,	*I buy;*	J'achèterai,	*I shall buy.*

(6.) In verbs of the 1st Conjugation (not ending in *eler*, *eter*; see 4, 5 above) which have *e* mute in their last but one syllable, a grave accent is put over that *e*, when the consonant following it comes before *e*, *es*, or *ent*:—

semer,	je sème,	nous sèmerons,	qu'ils sèment.
lever,	tu lèves,	il lèverait,	lève.

(7.) In verbs of the 1st Conjugation which have *é* in their last but one syllable, the acute accent is changed into a grave one, when the consonant following *é* comes before *e*, *es*, or *ent*, except, however, in the future and conditional present:—

céder,	il cède	je céderai,	vous céderez.
protéger,	tu protèges,	ils protégeraient,	qu'ils protègent.

(8.) Verbs ending in ier, being perfectly regular, have two *i*'s together (one being the last letter of the root, and the other the first of the ending), in the first two persons plural of the imperfect indicative of the present subjunctive:—

prier,	nous priions,	vous priiez.
étudier,	que nous étudiions,	que vous étudiiez.

(9.) In verbs ending in yer, the final *y* of the root in these two persons of the same tenses is of course followed by *i*:—

employer,	nous employions,	vous employiez.
essuyer,	que nous essuyions,	que vous essuyiez.

Nota Bene.—This is found in *all* verbs, of whatever conjugation they may be, the present participle of which ends in *yant*.

§ 51.—Regular Verbs.—Continued.

SECOND CONJUGATION,—ENDING IN *IR*.

MODEL VERB.

FINIR, *TO FINISH*.

Infinitive Mood.

PRESENT.		PAST.	
Finir,	*to finish.*	Avoir fini,	*to have finished.*

Participles.

PRESENT.		COMPOUND.	
Finissant,	*finishing.*	Ayant fini,	*having finished.*

PAST.

Fini, *finished.*

Indicative Mood.

SIMPLE TENSES.		COMPOUND TENSES.		
PRESENT.		PAST INDEFINITE.		
Je finis,	*I finish.*	J'ai fini,	*I have finished.*	
Tu finis,	*thou finishest.*	Tu as fini,	*thou hast finished.*	
Il finit,	*he finishes.*	Il a fini,	*he has finished.*	
On finit,	*one finishes.*	On a fini,	*one has finished.*	
Nous finissons,	*we finish.*	Nous avons fini,	*we have finished.*	
Vous finissez,	*you finish.*	Vous avez fini,	*you have finished.*	
Ils finissent,	*they finish.*	Ils ont fini,	*they have finished.*	
IMPERFECT.		PLUPERFECT.		
Je finissais,	*I was finishing*, or *used to finish.*	J'avais fini,	*I had finished.*	
Tu finissais,	*thou wast finishing.*	Tu avais fini,	*thou hadst finished.*	
Il finissait,	*he was finishing.*	Il avait fini,	*he had finished.*	
On finissait,	*one was finishing.*	On avait fini,	*one had finished.*	
Nous finissions,	*we were finishing.*	Nous avions fini,	*we had finished.*	
Vous finissiez,	*you were finishing.*	Vous aviez fini,	*you had finished.*	
Ils finissaient,	*they were finishing.*	Ils avaient fini,	*they had finished.*	
PAST DEFINITE.		PAST ANTERIOR.		
Je finis,	*I finished, did finish.*	J'eus fini,	*I had finished.*	
Tu finis,	*thou didst finish.*	Tu eus fini,	*thou hadst finished.*	
Il finit,	*he finished.*	Il eut fini,	*he had finished.*	
On finit,	*one did finish.*	On eut fini,	*one had finished.*	
Nous finîmes,	*we finished.*	Nous eûmes fini,	*we had finished.*	
Vous finîtes,	*you finished.*	Vous eûtes fini,	*you had finished.*	
Ils finirent,	*they finished.*	Ils eurent fini,	*they had finished.*	
FUTURE.		FUTURE ANTERIOR.		
Je finirai,	*I shall finish.*	J'aurai fini,	*I shall have*	
Tu finiras,	*thou wilt finish.*	Tu auras fini,	*thou wilt have*	
Il finira,	*he will finish.*	Il aura fini,	*he will have*	
On finira,	*one will finish.*	On aura fini,	*one will have*	*finished.*
Nous finirons,	*we shall finish.*	Nous aurons fini,	*we shall have*	
Vous finirez,	*you will finish.*	Vous aurez fini,	*you will have*	
Ils finiront,	*they will finish.*	Ils auront fini,	*they will have*	

Conditional Mood.

PRESENT.		PAST.		
Je finirais,	*I would finish.*	J'aurais fini,	*I should*	
Tu finirais,	*thou wouldst finish.*	Tu aurais fini,	*thou wouldst*	
Il finirait,	*he would finish.*	Il aurait fini,	*he would*	
On finirait,	*one would finish.*	On aurait fini,	*one would*	*have finished.*
Nous finirions,	*we should finish.*	Nous aurions fini,	*we should*	
Vous finiriez,	*you would finish.*	Vous auriez fini,	*you would*	
Ils finiraient,	*they would finish.*	Ils auraient fini,	*they would*	

Imperative Mood.

Finis,	*finish* (*thou*).
Qu'il finisse,	*let him finish.*
Qu'on finisse,	*let one finish.*
Finissons,	*let us finish.*
Finissez,	*finish* (*ye* or *you*).
Qu'ils finissent,	*let them finish.*

Subjunctive Mood.

SIMPLE TENSES.			COMPOUND TENSES.		
PRESENT.			PAST.		
Que je finisse,	*that I may*		Que j'aie fini,	*that I may*	
Que tu finisses,	*that thou mayest*		Que tu aies fini,	*that thou mayest*	
Qu'il finisse,	*that he may*		Qu'il ait fini,	*that he may*	
Qu'on finisse,	*that one may*		Qu'on ait fini,	*that one may*	
Que nous finissions,	*that we may*	*finish.*	Que nous ayons fini,	*that we may*	*have finished.*
Que vous finissiez,	*that you may*		Que vous ayez fini,	*that you may*	
Qu'ils finissent,	*that they may*		Qu'ils aient fini,	*that they may*	
IMPERFECT.			PLUPERFECT.		
Que je finisse,	*that I might*		Que j'eusse fini,	*that I might*	
Que tu finisses,	*that thou mightest*		Que tu eusses fini,	*that thou mightest*	
Qu'il finît,	*that he might*		Qu'il eût fini,	*that he might*	
Qu'on finît,	*that one might*		Qu'on eût fini,	*that one might*	
Que nous finissions,	*that we might*	*finish.*	Que nous eussions fini,	*that we might*	*have finished.*
Que vous finissiez,	*that you might*		Que vous eussiez fini,	*that you might*	
Qu'ils finissent,	*that they might*		Qu'ils eussent fini,	*that they might*	

§ 52.—Regular Verbs.—Continued.

THIRD CONJUGATION,—ENDING IN *OIR*.

MODEL VERB.

RECEVOIR, *TO RECEIVE*.

Infinitive Mood.

PRESENT.		PAST.	
Recevoir,	*to receive.*	Avoir reçu,	*to have received.*

Participles.

PRESENT.		COMPOUND.	
Recevant,	*receiving.*	Ayant reçu,	*having received.*

PAST.

Reçu, *received.*

Indicative Mood.

SIMPLE TENSES.		COMPOUND TENSES.		
PRESENT.		PAST INDEFINITE.		
Je reçois,	*I receive.*	J'ai reçu,	*I have received.*	
Tu reçois,	*thou receivest.*	Tu as reçu,	*thou hast received.*	
Il reçoit,	*he receives.*	Il a reçu,	*he has received.*	
On reçoit,	*one receives.*	On a reçu,	*one has received.*	
Nous recevons,	*we receive.*	Nous avons reçu,	*we have received.*	
Vous recevez,	*you receive.*	Vous avez reçu,	*you have received.*	
Ils reçoivent,	*they receive.*	Ils ont reçu,	*they have received.*	
IMPERFECT.		PLUPERFECT.		
Je recevais,	*I was receiving*, or *I used to receive.*	J'avais reçu,	*I had received* or *been receiving.*	
Tu recevais,	*thou wast receiving.*	Tu avais reçu,	*thou hadst received.*	
Il recevait,	*he was receiving.*	Il avait reçu,	*he had received.*	
On recevait,	*one was receiving.*	On avait reçu,	*one had received.*	
Nous recevions,	*we were receiving.*	Nous avions reçu,	*we had received.*	
Vous receviez,	*you were receiving.*	Vous aviez reçu,	*you had received.*	
Ils recevaient,	*they were receiving.*	Ils avaient reçu,	*they had received.*	
PAST DEFINITE.		PAST ANTERIOR.		
Je reçus,	*I received* or *did receive.*	J'eus reçu,	*I had received.*	
Tu reçus,	*thou receivedst.*	Tu eus reçu,	*thou hadst received.*	
Il reçut,	*he received.*	Il eut reçu,	*he had received.*	
On reçut,	*one received.*	On eut reçu,	*one had received.*	
Nous reçûmes,	*we received.*	Nous eûmes reçu,	*we had received.*	
Vous reçûtes,	*you received.*	Vous eûtes reçu,	*you had received.*	
Ils reçurent,	*they received.*	Ils eurent reçu,	*they had received.*	
FUTURE.		FUTURE ANTERIOR.		
Je recevrai,	*I shall receive.*	J'aurai reçu,	*I shall have*	
Tu recevras,	*thou wilt receive.*	Tu auras reçu,	*thou wilt have*	
Il recevra,	*he will receive.*	Il aura reçu,	*he will have*	
On recevra,	*one will receive.*	On aura reçu,	*one will have*	
Nous recevrons,	*we shall receive.*	Nous aurons reçu,	*we shall have*	*received.*
Vous recevrez,	*you will receive.*	Vous aurez reçu,	*you will have*	
Ils recevront,	*they will receive.*	Ils auront reçu,	*they will have*	

NATURAL HISTORY OF COMMERCE.

CHAPTER IV.

THE UNITED KINGDOM: IRELAND—RAW PRODUCE, MINERAL, VEGETABLE, ANIMAL.

Relation between Raw Produce and Industry—Geological Conditions of Mineral Produce—Application of Principles to Ireland—Ireland not noted for Minerals—Pre-eminently Pastoral—Vegetable Produce—Natural Advantages of Ireland—European Analogues.

THE industrial occupations of the people of the United Kingdom have been proved in the preceding pages to be the result of natural laws, and not of chance. The seats of mining and of manufactures are determined by the local mineral deposits, and the importance of the one is proportionate to the richness of the other—especially so in relation to iron and coal. Given the geological character of the rocks and soil, with the physical distinctions of highland, lowland, plain, and marsh, and the climatic phenomena, we may infer much of the raw produce, organic and inorganic.

The mountain borders of Ireland give occupations to labourers in mines and quarries, and copper and lead are produced in the counties of Wicklow, Cork, and Waterford. Iron is more widely dispersed, but for want of coal is unprofitable to smelt. Peat is almost the only fuel. Limestone is the principal rock of the interior; statuary marble of fine quality is met with in Galway and Donegal, and granite in many parts. Nevertheless, Ireland is not noted for its minerals. The special feature of its geology is the dreary expanse of bog, occupying 3,000,000 acres, or a tenth of the central plain of the kingdom. The great bog of Allen, once a forest, spreads through four counties. These bogs are considerably above the level of the sea, and sometimes very deep. They lie upon vast deposits of clay and drift, which overspread the mountain limestone, and, in steep impervious embankments, form the confines of stagnant reservoirs of saturated vegetable soil, unsafe in places for the smallest quadruped to walk upon. The structure of the bogs indicates the proper method of drainage, but notwithstanding a river system unusually complete, little has been reclaimed; and, since bog earth is deficient in mineral constituents, it is doubtful if drainage would ever repay, in produce, the cost of reclamation. Ireland is pastoral, and there appears no limit to its dairy and grazing capabilities. Pastures cover two-thirds of the country, and four-fifths of the people depend upon field labour. As a rule, however, the farming is inferior, the tillage slovenly, and the implements rude. The production of butter and provisions for export is, nevertheless, prodigious. Salt beef, pork, bacon, lard, and many millions of eggs, are consigned to England. Cork has, virtually, the victualling of our navy. Waterford dispatches abroad over 100,000 casks of butter yearly, and slaughters every week an average of 5,000 swine, while the quays, a mile long, swarm with live stock for embarkation.

The eastern provinces are more flourishing than the western. The Curragh of Kildare competes with the English downs as a grazing-ground, and sheep have fed for ages upon its sweet herbage. In the open country corn intervenes between the breadths of potato, and meal and milk are used for food. The fields smile with the blue-flowered flax, which the cotters grow for their families and weave in the hand-loom. The people of these districts are of English or Scotch descent, and have carried their native skill and thrift into the country of their adoption. They command higher wages, and can pay higher rents for less propitious soil, than the native Erse.

Ireland's resources are, to a great extent, undeveloped. With a coast-line of 2,000 miles, and inlets penetrating the land from opposite coasts, with a matchless system of rivers and lakes, the surface is a dissected map, every dividing line being a means of production or a facility for trade. The ill-fated Lord Strafford, more than 200 years ago, saw how well the flatness of the country and the slow flow of the rivers suited inland communication, and he devised a great scheme of intersecting canals, as yet but partially carried out.

Oats have in recent years become the largest tilled crop, while wheat has so increased as sometimes to leave a surplus for exportation: nevertheless, the humidity of Ireland will ever render the harvests capricious. The native sheep was covered with a coarse hair, but by intermixture with English breeds is now improved. The production of wool is valuable and abundant, but the manufacture is confined to coarse goods, and carried on with insufficient capital. For cattle-rearing and dairy produce, Ireland might be matchless. Her only European analogues are Denmark* and the Netherlands, where the prevalence of water shrouds the plains with vapours, which clear away before the summer winds, to reveal meadows covered with kine. The quays and jetties of the Hanse Towns and the Dutch ports resemble those of Cork and Waterford, swarming with stock, and filled to repletion with cheese and "provisions." While Ireland has languished, however, and a fifth of her inhabitants have disappeared, Denmark and the Netherlands, with disadvantages from which Ireland has never suffered, have grown prosperous and opulent.

CHAPTER V.

THE UNITED KINGDOM: GREAT BRITAIN—RAW PRODUCE, MINERAL, VEGETABLE, ANIMAL.

General Description—Relation between Industrial and Geological Features—Mineral Produce of England and Scotland contrasted—British Mineral Produce compared with European—Animal and Vegetable Produce of Great Britain—Population.

ENGLAND is more a mining and manufacturing than an agricultural country, although the mineral region occupies but a third of the surface. The mining and manufacturing industries of Scotland assume larger proportions, with a still more confined space for their operation. The chief mineral products of Scotland, as in England, are coal and iron, the beds of which, together with limestone and sandstone, cover nearly a thousand square miles lying south of a line joining the estuaries of the Clyde and the Tay—the densest, wealthiest, and most busy part of the kingdom. Rich mines of lead, with which a small quantity of silver is intermixed, are worked in the Lowther Hills. The Highlands are deficient in metals. The Grampians, especially, are as destitute of ores as their summits are of vegetation.

The most important quarries of granite are those of Kircudbright and Aberdeen. Whole towns in Scotland are granite-built, and with the improvements in the machinery for cutting and preparing this stone, its use has greatly extended in England. Many of the new buildings which adorn London are decorated with polished shafts and columns of coloured granites. Its great weight prevents its more general adoption for monumental and national designs. Monoliths of any size are rare. Felt in the greatest depths and found in the highest peaks, underlying the ocean and overtopping the cloud, unyielding in substance but variable in colour and in chemical constitution, this primeval rock has sometimes been called a type of truth, and an emblem of the virtues, faith, hope, and charity.

Roofing-slates, also, are extensively quarried in a few parts of Scotland.

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* "When the plains of Germany are brown and ashy with the summer heat, the isles of Denmark delight the eye with a fresh bright green, and as truly deserve the title of Emerald Isles as our sister kingdom. Vegetation is everywhere luxuriant, and long retains a vernal appearance, owing to the humidity of the atmosphere and of the soil."—*Milner's "Baltic,"* p. 82.

Oolite is quarried in Somersetshire and Portland. The city of Bath, St. Paul's Cathedral, Somerset House, and many London churches show with what favour it is regarded for building. Lime is made from the chalk that stretches from the South Downs to Lincolnshire. Fuller's earth is dug at Reigate; and millions of bricks, for railways, sewers, and buildings, are made from the London clay.

In the mining region, properly so called, we observe that Cornwall has scarcely any manufactures and very limited agriculture: its commerce and shipbuilding are comprised within the smallest bounds; but it has an apparently exhaustless supply of tin and copper, which make the country both interesting and important.

The South Wales coal-field is the parent of several industries. Besides the smelting of copper from Cornwall, and also from Ireland and abroad, and its production of fuel, it is the seat of the iron manufacture, Merthyr Tydvill and Cardiff being the most important towns thus engaged, while Swansea is the centre of copper-smelting. Our other coal-fields, with one exception, are also productive of ironstone, and originate the characteristic pictures of the "Black Country" covering the Dudley coal-field, and of the congeries of iron-works, collieries, and factories which give to South Lancashire the aspect of one densely-populated town. The celebrated coal-field of Northumberland is deficient in ironstone, although the neighbourhood of Hexham produces iron of very fine quality.

The wonderful supply of coal and iron casts every other mineral into the shade, or Great Britain would be called rich in lead, zinc, and the minor metals. The precious metals are rare, and seldom worth the working. Burât has computed that the production of the useful metals and coal in Great Britain is four times that of France and Russia, six times that of Austria, eight times that of Spain or Scandinavia, nine times that of Prussia, and eleven times that of Belgium. What is the result? The metal and coal of Great Britain, transformed into machines, are computed to equal in productive power the hand-labour of every human being living. It is as if the population of a second world were contributing to lessen the toil of the thirty millions in this small corner of Europe. Manchester and Liverpool were small towns till machinery made our gigantic cotton industry possible. The imports of raw cotton have been over a thousand millions of pounds yearly, and are rapidly returning to that amount.

Eastward of a line drawn between the Tees and Exe, the surface exhibits fertile plains, varied by rivers, valleys, and green undulations, by a few wild and sterile heaths, and in the north by bogs. The Bedford Level and the Lincolnshire fens are the principal marshes. The soils, like the rocks upon which they lie, are not distinguished by their extent so much as by their variety. Clay loam, sand, chalk, gravel, peat, are all represented, simply and in many forms of combination, and impress distinctive characters upon an indefinite number of districts. The largest tracts of uniform soil are in Norfolk and the wealds of Kent and Sussex. Surrey, for its size, has more beds of sand than any other county, of which the heaths—Bagshot, Wimbledon, Weybridge, Woking—and the suburban commons of London are illustrations. Few of the plains are quite barren, and none of the sandy tracts are so large as the Landes of France. South of the wealds, from Beachy Head to Salisbury Plain, runs a low line of chalk downs, with a velvet pile of herbage, trodden and cropped by sheep of the finest breeds, famous both for flesh and wool. Kent is the garden of England. The trailing hops of Canterbury and Farnham vie with the vineyards of France, and the scene at hop-picking resembles the animation of the vintage. Between Sussex and the Wash, wide tracts wave with corn. Barley for malting is a great object of culture in the same tracts and in the midland counties, while oats grow chiefly in the fens and in the north. Potatoes thrive in Leicestershire and Cheshire, and the turnip tribe has spread from Norfolk all over the kingdom. Pulse grows everywhere. Flax and coarse hemp of excellent quality are cultivated, though the quantity is small.

The husbandry of Scotland ranks very high even within the mineral lines, but the soil capable of tillage is limited. Comparing one kingdom with another, England has half its surface in pasture, a third under tillage, and a sixth in wastes, towns, roads, and waterways; while Scotland has only one-fourth under cultivation, with three-fourths in wastes and ways. For the operations of husbandry a granitic district offers few facilities: the bare pinnacles weather slowly, and form too scanty a soil for cultivation. The Grampians are naked and sterile, as are also the broken islands of the north; while large counties, such as Sutherland, can only be laid out in sheep-walks. The most fertile parts of Scotland are the tract between Perth and Dundee, Teviotdale, Fife, the Lothians and Berwick. From climatic causes the Scotch crops arrive at less perfection than they do in England: the solar heat is inconstant, and, as in Ireland, often insufficient to ripen grain and secure harvest. Barley of the same weight as English barley contains less sugar, and does not malt well. Fruits which ripen in one division seldom mature in the other, and never become so choice; but different berries acquire in Scotland somewhat of the delicious flavour which distinguishes them in still higher parallels of latitude.

Owing to the broken nature of the Welsh counties, sheep and cattle are pastured upon the hills, which, unlike the Scottish highlands, are covered with grass to their summits, and tillage and dairy work are carried on in the valleys. Welsh mutton is small, but renowned for the delicacy of its flavour.

Food products are the special objects of British husbandry. Barley and hops for beer, cider apples and flax, are exceptional; but none assume the importance of the vine in France or of flax in Holland.

LESSONS IN LATIN.—XLIII.

IRREGULAR VERBS.

We now come to those verbs which custom characterises as the *Irregular Verbs*, inasmuch as they greatly depart from the models supplied in the four conjugations; and first we present Possum.

I.—POSSUM, POSSE, POTUI, *to be able.*

Possum consists of potis, *able*, and sum, *I am*. The potis is contracted into the stem pot, and pot before the s in sum, becomes pos; whence comes pos-sum.

INDICATIVE.	SUBJUNCTIVE.	INDICATIVE.	SUBJUNCTIVE.
Present.		*Perfect.*	
Pos-sum, *I am able.*	Pos-sim, *I may be able.*	Pŏt-ui, *I have been able.*	Pot-uerim, *I may have been*, [*etc.*
Pŏt-es.	Pos-sis.	Pot-uisti.	Pot-ueris.
Pot-est.	Pos-sit.	Pot-uit.	Pot-uerit.
Pos-sumus.	Pos-simus.	Pot-uĭmus.	Pot-uerĭmus.
Pot-estis.	Pos-sitis.	Pot-uistis.	Pot-uerĭtis.
Pos-sunt.	Pos-sint.	Pot-uērunt (-uēre).	Pot-uerint.
Imperfect.		*Pluperfect.*	
Pot-ĕram, *I was able.*	Pos-sem, *I might be able.*	Pot-uĕram, *I had been able.*	Pot-uissem, *I might have been able, etc.*
Pot-eras, etc.	Pos-ses, etc.	Pot-uĕras, etc.	Pot-uisses, etc.
1st Future.		*2nd Future.*	
Pot-ĕro, *I shall be able.*		Pot-uĕro, *I shall have been able.*	
Pot-ĕris, etc.		Pot-uĕris, etc.	
Infinitive.		*Participle.*	
Pres. Pos-se, *to be able.*		Pot-ens (only as an adjective [*powerful*).	
Perf. Pot-uisse, *to have been able.*		(*None.*)	
Fut. (*None.*)		(*None.*)	

No Imperative.

It is thus seen from the preceding conjugation that with the aid of potis the verb is formed by sum and its parts, of which the *ui* is for *fui*, the *f* or aspirate being dropped in combination to prevent the harshness of two consonants coming together, as pot-*fui*, etc.

VOCABULARY.

- Adeo, *to such a degree, greatly.*
- Casus (cado, *I fall*), -ūs, m., *chance.*
- Celare (aliquem aliquid), 1, *to conceal.*
- Constituĕre, 3, *to appoint, ordain*
- Desistĕre, 3, *to stand back from, desist, cease.*
- Effector, -ōris, m., *a creator.*
- Enumerare, 1, *to number.*
- Inducĕre, 3, *to lead in, induce.*
- Meditari, 1, dep. (with acc.), *to meditate on.*
- Mitescĕre (no perf., no supine), 3, *to become mild, tame.*
- Pejĕrare (in its original form perjūro, from per, *through*; and jus, *right*), *to swear falsely.*
- Proinde quasi, *just as if.*
- Quam potuit maximis itineribus, *with the utmost speed.*
- Situs, -ūs, m., *place, position.*

EXERCISE 163.—LATIN-ENGLISH.

1. Pergite, pueri, atque in id studium, in quo estis, incumbĭte, ut et vobis honori et amicis utilitati et republicæ emolumento esse possitis. 2. Nemo adeo ferus est ut non mitescĕre possit. 3. Hoc quotidie medĭtare, ut possis æquo animo vitam relinquere. 4. Quidam idcirco Deum esse non putant, quia non appāret nec cernitur; proinde quasi nostram ipsam mentem videre possimus. 5. Universum mundum quum cernimus, possumusne dubitare quin ei præsit aliquis effector et moderator? 6. Nihil tam diffĭcĭle est quin (= ut non) quærendo investigari posset. 7. Sic cogitandum est tanquam aliquis in pectus intĭmum inspicere possit, et potest. 8. Satis nobis persuasum esse debet, etiamsi Deum hominesque celare possimus, nihil tamen injuste esse faciendum. 9. Potestisne dubitare quin Deus universum mundum gubernet? non possŭmus. 10. Cur nobiscum ambulare non potes? 11. Alcibiădes Athenas Lacedæmoniis servire non potĕrat pati.

EXERCISE 164.—ENGLISH-LATIN.

1. We cannot conceal wickedness from God. 2. You cannot doubt that the world is governed by a mind. 3. Can the world be from nothing? out of nothing, nothing can arise. 4. What can arise out of confused masses? 5. Can order arise out of chance? 6. They could not allow good men to be punished. 7. I will return home with the utmost speed. 8. They will return home with the utmost speed. 9. Before I could speak I was seized. 10. The world cannot be more beautiful. 11. Can those women be more fair? 12. I will give thee a book if I am (*shall be*) able. 13. He was unable to subdue his grief, but he will be able to conceal it. 14. Only among good men can friendship exist. 15. If I could have come I would have told you all. 16. Unless they had been able to come we should have known nothing.

II.—EDO, EDERE, EDI, ESUM, *to eat.*

This verb in its irregularities has an apparent identity with parts of the verb esse, *to be.* This arises from the changes required with regard to sound. The *e* in sum is short; in the parts of edere it is long, inasmuch as it involves a contraction.

Present Indic.: Edo, edis (*es*), edit (*est*); edimus, editis (*estis*), edunt.
Imperf. Subjunc.: Ederem (*essem*), ederes (*esses*), ederet (*esset*); ederemus (*essemus*), ederetis (*essetis*), ederent (*essent*).
Imperative: Ede (*es*), edite (*este*),
edito (*esto*), editote (*estote*), edunto.

The other parts are regular; only for editur, estur is found; and for ambedens, ambens, *eating round.* So the compounds, comedo, comĕdis, comēs (*to eat up*), exedo, exedis, exēs (*to eat up or out*). Comedo has comesus, as well as comestus.

VOCABULARY.

- Adolescentulus, -i, *a young man.*
- Argentum vivum, *quicksilver.*
- Curculio, -ōnis, *the corn-worm.*
- De symbolis esse, *to eat at the common expense, to enjoy a pic-nic.*
- Familiaris, -e, *belonging to the family.*
- Modicē, *moderately.*
- Moles, -is, f., *a mass.*
- Perrumpĕre, 3, *to break through, break into.*
- Res familiaris, *property, substance.*
- Symbŏla, -æ, *a contribution.*
- Væ, *woe! alas!*

EXERCISE 165.—LATIN-ENGLISH.

1. Esse oportet ut vivamus, non vivere ut edamus. 2. Modĭce bibite et este. 3. Heri aliquot adolescentuli convenerunt ut de symbolis essent. 4. Hæc herba acerba esu est. 5. Ægritudo lacĕrat, exest animum planeque conficit. 6. Curculiones frumentum exesse incipiunt. 7. Argentum vivum exest ac perrumpit vasa. 8. Majores nostri cavere non potuerunt, ne vetustas monumenta exesset. 9. Quæ unquam moles tam firma fuit quam non exessent undæ? 10. Væ vobis qui omnem rem familiarem luxuriā comestis! 11. Fabulæ narrant Saturnum liberos ex se natos comesse solitum esse, consūmit enim ætas temporum spatia.

EXERCISE 166.—ENGLISH-LATIN.

1. Saturn did not devour his children. 2. Do you think that Saturn devoured his children? 3. The waves eat away rocks. 4. Thou livest to eat. 5. Thou oughtest to eat in order to live. 6. They eat very little. 7. We are going into the country in order to enjoy a pic-nic. 8. This bread is bitter to eat. 9. Corn-worms have eaten up the corn. 10. Old age devours all things. 11. Grief will devour the mind, and destroy life. 12. They have eaten and drunk moderately. 13. A wise man will eat little.

KEY TO EXERCISES IN LESSONS IN LATIN.—XLII.

EXERCISE 161.—LATIN-ENGLISH.

1. These words are inscribed on the king's tomb, "He lived virtuously, he bound bad men, he conquered his enemies." 2. The enemies having been conquered and bound with chains, were led away into slavery. 3. Authority ought to be supported by just laws. 4. The king, having concluded a peace, sustained the tottering republic by his virtue. 5. Virtue is hard to find, and requires a ruler and a guide. 6. Innumerable arts have been discovered by the teachings of nature. 7. Life, if replete on all sides with good things, is said to be happy. 8. The men have enclosed the cities by walls. 9. Hidden enmities are more to be dreaded than open ones. 10. Who is so wretched as not to have perceived the goodness of God? 11. The gods, clothed in human form, furnished abundance of fables for the poets, but crammed the life of man with every kind of superstition. 12. The hopes of the republic have been exhausted by continual wars. 13. The more abundantly any one has drunk in pleasures from every quarter, the more deeply and eagerly will he thirst for them. 14. I hope that you will agree with me.

EXERCISE 162.—ENGLISH-LATIN.

1. Rex, quum moreretur, dixit, "Probe vixi; imprŏbos vinxi; hostes vici." 2. Miles victus in vincula conjectus est. 3. In servitutem abducentur. 4. Labefactam rempublicam fulcit. 5. Labefactam fulciet domum. 6. Ars scribendi reperta est. 7. Librum aperuerunt. 8. Vita mea apud bonos acta est. 9. Occultos timeo inimicos. 10. Pace compositâ, domum revertar. 11. Felicitas difficilis est inventu. 12. Agricolæ pratum dumetis sepserunt. 13. Campus dumetis vepribusque refertus est. 14. Exploratores adventant. 15. Cæsar per exploratores comperit hostes adventare. 16. Sol oriens diem aperit. 17. Munificentiam Dei senserunt. 18. Pallium tuum tuâ manu confecisti? 19. Pallium quo amictus sum meâ manu confeci.

CONSTRUCTION AND USAGES OF AGO.

1. He, as a shepherd, leads the she-goats through unfrequented country places. 2. Let poems be delightful, and let them lead the mind of the hearer whither they please. 3. Many thousands of armed men having been driven out of that district into which he had been sent. 4. Where are you going? 5. If the army should be willing to march more quickly. 6. Wherever he went, he laid waste and plundered cities and fields. 7. That the eager dogs might hunt the stag. 8. The hurdles having been rapidly brought up to the town. 9. A person unacquainted with ships is afraid to steer a ship. 10. May he not drive these chariots? 11. He levied a public tax in Asia. 12. And he shall send forth from his mouth bloody foam. 13. For we say both animam agere (to drive out the soul) and efflare (to expire). 14. Oaks strike their roots far down. 15. The huts open in chinks. 16. The husbandman was driven headlong to glory. 17. Merciless fates pursue the Romans. 18. He pleaded this cause before the judges. 19. Augurs are said to take an augury. 20. He can compose something, but not perform it; as the poet writes a play, but does not act it: on the other hand, the actor personates the characters, but does not write; and thus the play is written, not acted by the poet; by the actor it is acted, not written. 21. Scipio Africanus was wont to say that he was never doing more than when he was doing nothing; that he was never less at leisure than when he was at leisure. 22. You have no effect, O Grief, although you are troublesome; I will never confess that you are an evil. 23. Consider whether you prefer to state in conversation, or to carry on by correspondence what you wish. 24. My mind is considering something or other unusually great. 25. Say that I am thankful to the king. 26. When my father was in ill health he generally spent his time here in literary pursuits. I am in my eighty-fourth year. 27. Who determined to carry on war in a way far different from the rest of the Gauls. 28. Recollect, I pray, what I said in the senate concerning you. 29. To plead with the people is to ask for what the people either order or forbid by their votes. 30. He accused them of theft. The glory of the Roman people and the safety of our allies are at issue. 31. Which sentiments, it was allowed, were so delivered by him, by his eyes, his voice, and his gestures, that the tears of his antagonist could not restrain themselves. 32. The more savagely they acted before, the more eagerly they drank in the unwonted pleasures.

GEOMETRICAL PERSPECTIVE.—XVII.

PERSPECTIVE OF SHADOWS.

We now propose to consider the projection of shadows as they appear under the *second* conditions mentioned in Lesson XVI.; viz., *when the sun is before, or in front of the picture; that is, when it is behind the spectator, or when the spectator is between the sun and the object.*

Rule.—Draw a line from the station-point, or E, to the horizontal line at the *same angle with the picture plane* at which the *horizontal direction* of the shadow is said to be inclined; this will give the VP for the sun's inclination. The *length* of the shadow is determined according to the sun's elevation (or height in the heavens). *Therefore the angle of elevation must be constructed by drawing a line, at the given angle of elevation, from the distance point of the vanishing point of the sun's inclination* to meet the perpendicular line drawn through the VP of the sun's inclination. This will be the VP for the sun's elevation, and will be the point of direction to determine the lengths of the shadows, by drawing to it lines from the angles and projecting parts of the object, to cut those drawn from the object in the direction of the VP for the sun's inclination. When the position of the sun is, as in the present case, before the picture, the line forming the angle of the sun's elevation is drawn downwards. When the sun is behind the picture, the line of the angle is drawn upwards; this latter case will be treated upon in a future lesson. To render the above rule as clear as possible, we have introduced a very simple example (Fig. 79), giving only the vanishing points for the representation of the shadow. Let AB be a pole in a perpendicular position, VPSI is the vanishing point for the sun's inclination at an angle of 35°, and VPSE, the vanishing point for the sun's elevation, is at an angle of 30° with the horizon; therefore the shadow of the pole on the ground retires towards its vanishing point on the HL, and its length is determined by a line drawn from the top of the pole towards the vanishing point of the sun's elevation, producing AC, the shadow of AB. Our pupils will perceive that the principles of the perspective of shadows closely resemble those which belong to horizontal and inclined planes.

Problem XLIX. (Fig. 80).—*A rectangular block of stone 2 feet wide, 6 feet long, and 3 feet high, is lying horizontally on its narrowest side; its face is at an angle of 40° with the* PP, *3 feet within, and 2 feet to the left of the eye. Parallel to it is a long beam standing on its end, and opposite a point 2 feet from the nearest end of the block. The beam is 1 foot 6 inches square at the base, 8 feet high, and 1 foot space between the block and the beam. Sun's inclination 38°; elevation 30°, vanishing point of the sun to the left of the eye. Line of sight 5 feet. Distance from the* PP *6 feet.*

Trusting our pupils will be able to represent the perspective of the solids, we shall limit our instructions, for that part of the drawing, to merely reminding them of some of the leading particulars in the process of construction. *a* is 2 feet to the left of the eye, *b* is 3 feet from *a*, for the purpose of finding the nearest angle of the block within the picture by drawing from *b* to DE. To find the point in the block to which the beam is opposite, rule a line from the near angle of the block to the BP at *c*; make *c d* equal to 2 feet, and rule from *d* back again to the base of the block, directed by DVP^1—this is cutting off from the near angle of the block a distance of 2 feet on the line of its base; rule from the point thus found towards the PP, directed by DVP^2; upon the last line a portion of 1 foot must be cut off to obtain the perspective distance between the block and the beam, this will be between *e* and *f*. The lines for the production of the shadows are dotted, drawn from the projecting angles of the solids to the vanishing point of the sun's elevation (VPSE) to cut the lines drawn from the plans or bases of the projecting angles towards the vanishing point for the sun's inclination (VPSI). The intersection of these lines will limit the extent of the shadows, as shown in Fig. 79.

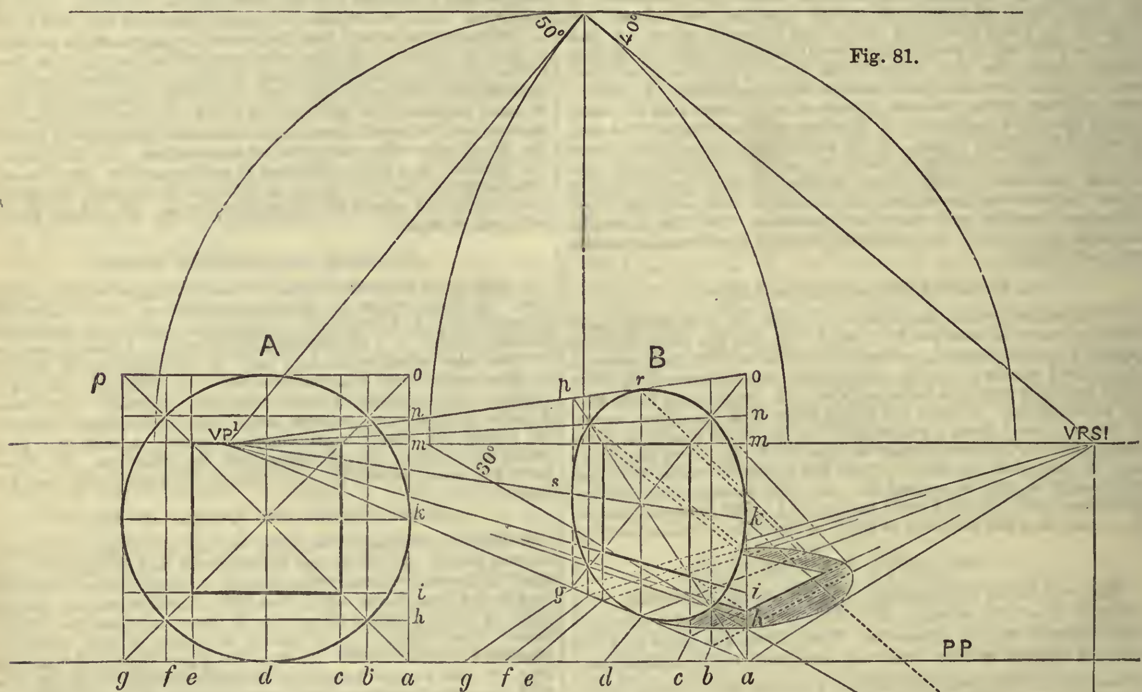


Fig. 81.

Problem L. (Fig. 81).—*A circular board in a perpendicular position, 6 feet diameter, and having a square opening in the centre 3 feet wide. The plane of the board is at an angle of 50° with the picture plane. Sun's elevation 30°, and inclination 40°. Height of the eye, 4 feet 6 inches; other conditions at pleasure.*

After drawing the HL, and determining the station point, vanishing points, and distance points, the plan of the circle (A) must be made with the additional working lines for the purpose of obtaining the true form of the circle when placed in a retiring and perpendicular position B (see Fig. 31, page 8; Fig. 36, p. 73, and Fig. 40, p. 141 in Vol. III.). It will then appear as a circle in a square. If the pupil will turn back to the above figures, he will at once understand why the points in the base of the plan

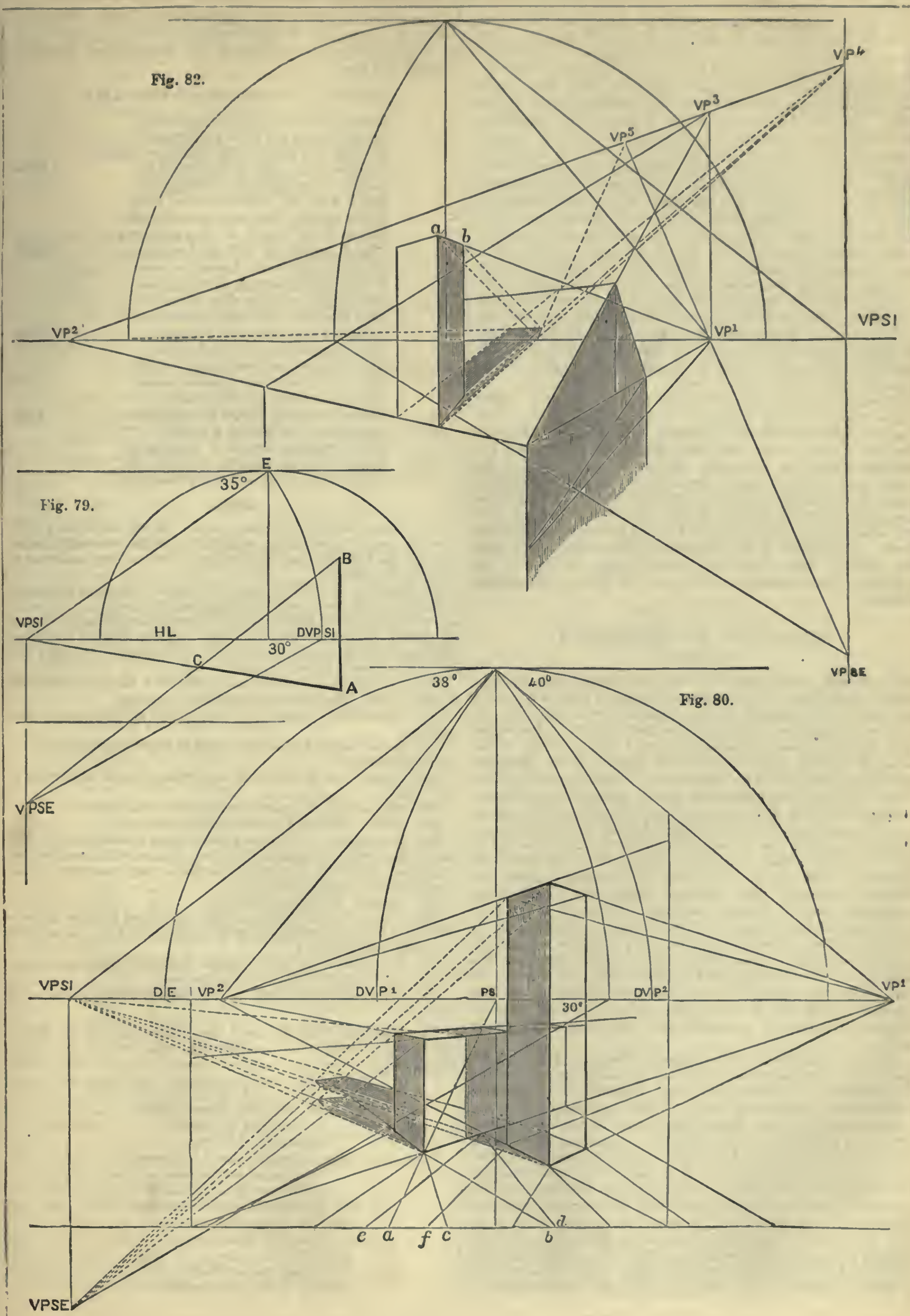


Fig. 82.

Fig. 79.

Fig. 80.

A, viz., *a*, *b*, *c*, *d*, etc., are again set off on the PP, and the points *h*, *i*, *k*, etc., are repeated on the line of contact from *a* to *o* in Fig. B, the former for cutting off the perspective distances on the base of the retiring plane from *a* to VP^1, and the latter for determining the perspective heights upon the same plane, their retiring lines being ruled towards the vanishing point of the plane. Thus will be reconstructed in its perspective proportions the working lines forming the square *a g p o*, and the square opening in the centre of the board. The circle representing the board must be drawn by hand through the points in the retiring plane B, which are found to correspond with the points in the plan A. To determine the extent of the shadow, lines are drawn to the vanishing point of the sun's inclination (VPSI) from all the points in the base of the retiring square *a g p o*, which contains the perspective view of the circular board. The rays of the sun's elevation are drawn from the intersections of the circle with the diagonals, and the sides of the square *a g p o* in *k s r d*. Through the points on the ground where the lines or rays for the sun's elevation intersect those which represent the sun's inclination drawn from the base of the square to VPSI, the extent and form of the shadow must be drawn; the same method of proceeding must be observed with regard to the square opening in the circular board.

PROBLEM LI. (Fig. 82).—*To show how a shadow of a perpendicular object is to be projected on an inclined plane.* Our example is the shadow of a chimney upon a roof. After the perspective view of the roof and chimney is drawn, and the vanishing-points for the sun's inclination and elevation are found, draw a line from VP^2 through VP^3 (the VP for the inclination of the roof) to the perpendicular line from VPSI; this gives the VP for the shadow of the chimney on the roof, viz., VP^4, to which the lines from the base of the chimney must be drawn. For the VP of the shadow of the retiring side, *a b*, of the chimney, rule a line from VPSE through VP^1 to VP^5, the vanishing point required. We trust the figure will explain the rest.

READINGS IN GREEK.—V.

ÆSCHYLUS.

WE come now to the earliest of the three great tragic poets of Greece—Æschylus. Of his relation in point of time to the other two masters of dramatic poetry, Sophocles and Euripides, we have already spoken, and it only remains to say a few words upon his individual characteristics as a poet. Both in his choice of subjects and his method of treating them, Æschylus approaches more nearly to the heroic. To use the words of Mr. Grote, "The passions appealed to are the masculine and violent, to the exclusion of Aphrodite and her inspirations; the figures are vast and majestic, but exhibited only in half-light and shadowy outline; the speech is replete with bold metaphor and abrupt transition—'grandiloquent even to a fault,' as Quintilian expresses it, and often approaching nearer to Oriental vagueness than Grecian perspicuity." For these reasons the plays of Æschylus are more difficult for the student to understand than those of Euripides and Sophocles; and in addition to this, it has happened that there are gaps and imperfections in many of the MSS. which greatly increase this difficulty. In selecting a few extracts from his poems, we shall, however, endeavour to choose such pieces as may not altogether baffle the powers of the reader, but may serve at the same time to give a tolerably fair idea of the style of the author.

The most important of the plays of Æschylus are the three which are generally known as the Orestean trilogy — the "Agamemnon," "Choephoræ," and "Eumenides." The three together form a continuous story. In the "Agamemnon" we find Clytæmnestra, his wife, during the absence of her lord at Troy, living in a guilty union with Ægisthus. Agamemnon suddenly returns, and is murdered by his wife and her paramour. Orestes, by the aid of Electra, escapes the sword of his mother, and in the "Choephoræ" he returns, and avenges the death of his father by slaying Ægisthus, and Clytæmnestra, who comes to the aid of the latter, is also dispatched. In the "Eumenides," which is the last of the series, Orestes appears at the temple of Apollo at Delphi, pursued by the avenging Furies (Eumenides), to seek expiation for the murders from the deity. Apollo promises him protection, and the scene shifts to the court of Areopagus at Athens, where Orestes is tried and finally acquitted. Our first extract is the speech of Clytæmnestra when she appears upon the stage directly after murdering her husband, and defiantly describes the deed:—

ÆSCHYLUS.—"AGAMEMNON," 1372—1394.

Πολλῶν πάροιθεν καιρίως εἰρημένων,
τἀναντί' εἰπεῖν οὐκ ἐπαισχυνθήσομαι.
πῶς γάρ τις ἐχθροῖς ἐχθρὰ πορσύνων, φίλοις
δοκοῦσιν εἶναι, πημονῆς ἀρκύστατ' ἂν
φάρξειεν, ὕψος κρεῖσσον ἐκπηδήματος;
ἐμοὶ δ' ἀγὼν ὅδ' οὐκ ἀφρόντιστος πάλαι
νείκης παλαιᾶς ἦλθε, σὺν χρόνῳ γε μήν·
ἕστηκα δ' ἔνθ' ἔπαισ', ἐπ' ἐξειργασμένοις.
οὕτω δ' ἔπραξα, καὶ τάδ' οὐκ ἀρνήσομαι,
ὡς μήτε φεύγειν μήτ' ἀμύνασθαι μόρον.
ἄπειρον ἀμφίβληστρον, ὥσπερ ἰχθύων,
περιστιχίζω, πλοῦτον εἵματος κακόν.
παίω δέ νιν δίς· κἀν δυοῖν οἰμώγμασι
μεθῆκεν αὐτοῦ κῶλα· καὶ πεπτωκότι
τρίτην ἐπενδίδωμι, τοῦ κατὰ χθονὸς
Ἅιδου νεκρῶν σωτῆρος εὐκταίαν χάριν.
οὕτω τὸν αὑτοῦ θυμὸν ὁρμαίνει πεσών·
κἀκφυσιῶν ὀξεῖαν αἵματος σφαγήν,
βάλλει μ' ἐρεμνῇ ψακάδι φοινίας δρόσου,
χαίρουσαν οὐδὲν ἧσσον, ἢ διοσδότῳ
γανει σπορητὸς κάλυκος ἐν λοχεύμασιν.
ὡς ὧδ' ἐχόντων, πρέσβος Ἀργείων τόδε,
χαίροιτ' ἄν, εἰ χαίροιτ', ἐγὼ δ' ἐπεύχομαι.

NOTES.

1372. Καιρίως, *suitable to the occasion*, καιρός. *Having spoken many words previously merely to gain my purpose* (alluding to the affectionate terms in which she had welcomed Agamemnon), *I shall not now be ashamed to assert the very contrary.*

1375. Ἀρκύστατ' ἄν. The ἄν goes with φάρξειεν—ἀρκύστατα is a space enclosed by a net (ἄρκυς)—and the passage may be rendered, "*How could any one erect a fence of destruction* (like a hunting net, where wild beasts are snared), *too high for them to leap over?* "Υψος is either in apposition with ἀρκύστατα, or follows φάρξειεν, *erect it to a height—to be high*; like διδάσκειν τινὰ σοφόν, to teach a man *to be wise*.

1378. Νείκης, *of an old feud*; σὺν χρόνῳ, etc., *but it has come at last, with the lapse of time.* Γε μήν serves to emphasise συν χρόνῳ.

1379. Ἐπί, with dat., signifies *on the top of*, and so *after—after the deed was done.*

1381. The accusative before φεύγειν may be either ἔμε, or better, αὔτον (sc. Agamemnon).

1382. Ἄπειρον. *Out of which there was no escape—made into a "cul de sac."*—Paley.

1383.—Πλοῦτον, etc., lit., *an evil wealth of robe—a rich fatal robe.*

1385. Μεθῆκεν. *He relaxed his limbs*, αὐτοῦ, *on the spot.*

1386. Τρίτην—χάριν. *A third—as a votive offering to Hades beneath.* The number three was mystical, and there is an allusion to the usual custom of pouring out a third libation to Zeus Σωτηρ (the preserver). Ἅιδου is genitive of the object after χάριν.

1388. Ὁρμαίνει. *He frets out—pants out.*

1391. Χαίρουσαν (sc. με in previous line), *rejoicing no less than the cornfield does in the heaven-sent blessing at the bursting of the bud.* (Λοχεύω is *to bring forth*, akin to λέχος.)

1393. Ὡς ὧδ' ἐχόντων (sc. τούτων, genitive absolute), *wherefore, since these things are so.* Τόδε, etc., *elders of the Argives here.*

1394. Χαίροιτ' ἄν, optative with ἄν, is equivalent to imperative, *rejoice if you will.*

The following lines are from the chorus sung by the Eumenides, when Orestes is awaiting his trial before the Areopagus:—

ÆSCHYLUS.—"EUMENIDES," 307—333.

Ἄγε δὴ καὶ χορὸν ἅψωμεν, ἐπεὶ
μοῦσαν στυγερὰν
ἀποφαίνεσθαι δεδόκηκε,
λέξαι τε λάχη τὰ κατ' ἀνθρώπους
ὡς ἐπινωμᾷ στάσις ἁμά,
εὐθυδίκαιοι θ' οἰόμεθ' εἶναι.
τὸν μὲν καθαρὰς χεῖρας προνέμοντ'
οὔτις ἀφ' ἡμῶν μῆνις ἐφέρπει,
ἀσινὴς δ' αἰῶνα διοιχνεῖ·
ὅστις δ' ἀλιτῶν, ὥσπερ ὅδ' ἁνήρ,
χεῖρας φονίας ἐπικρύπτει,
μάρτυρες ὀρθαὶ τοῖσι θανοῦσιν

παραγιγνόμεναι, πράκτορες αἵματος
αὐτῷ τελέως ἐφάνημεν.
μᾶτερ ἅ μ' ἔτικτες, ὦ μᾶτερ *στρ. α'.*
Νὺξ ἀλαοῖσι καὶ δεδορκόσιν ποινᾶν
κλῦθ'· ὁ Λατοῦς γὰρ ἶνίς μ' ἄτιμον τίθησι,
τόνδ' ἀφαιρούμενος
πτῶκα, ματρῷον ἅγνισμα κύριον φόνου.
ἐπὶ δὲ τῷ τεθυμένῳ
τόδε μέλος, παρακοπά, παραφορά, φρενοδαλίς,
ὕμνος ἐξ 'Ερινύων,
δέσμιος φρενῶν, ἀφόρ-
μικτος, αὐονὰ βροτοῖς.

NOTES.

308. Μοῦσαν, etc., *to unfold our strain of vengeance.*

311. Στάσις ἁμά, *how our company* (ἁμά for ἡμετέρα) *distributes the lots among mankind.*

312. Εὐθυδίκαιοι, etc., *and we think ourselves strictly just.*

313. Προνέμοντα, *who holds out clean hands*—the innocent: opposed to the guilty, who conceals them (ἐπικρύπτει).

318. 'Ορθαί, *straight, unerring.*

320. Τελέως, *following him to the end*, τέλος.

322. 'Αλαοῖσι, etc., lit., *to blind and seeing alike—i.e., to both the dead and the living.*

323. Ἶνίς, *son*, from ἴς, fibre. Apollo is meant.

325. 'Αφαιρούμενος, *if he takes away from me* (for himself). Πτῶκα, *this trembling one* (πτώσσω), usually means *a hare*, in consequence of the excessive timidity of that animal. Ματρῷον, etc., *my own peculiar* (κύριον) *victim, to avenge a mother's murder.* Ματρῷον agrees with ἅγνισμα, instead of φόνου, by the figure of speech entitled *enallage*, or interchange of epithets.

328. Τῷ τεθυμένῳ, *the victim consecrated for the sacrifice.* From ἐπὶ supply ἐπέρχεται.

The "Persæ" (Persians) is about the only instance where a Greek dramatist has chosen contemporary history for his theme. The subjects of almost all the Greek tragedies are taken from a pre-historic period, in almost every case. But the "Persæ" gives the account of the expedition led by Xerxes against the Greeks which met with complete overthrow in the battle of Salamis, B.C. 480, in which the poet himself took part. Here is his vigorous description of the advance of the Grecian fleet on the ships of the Persians:—

ÆSCHYLUS.—"PERSÆ," 398—416.

Θοῶς δὲ πάντες ἦσαν ἐκφανεῖς ἰδεῖν·
τὸ δεξιὸν μὲν πρῶτον εὔτακτον κέρας
ἡγεῖτο κόσμῳ, δεύτερον δ' ὁ πᾶς στόλος
ἐπεξεχώρει, καὶ παρῆν ὁμοῦ κλύειν
πολλὴν βοήν, Ὦ παῖδες 'Ελλήνων ἴτε,
ἐλευθεροῦτε πατρίδ', ἐλευθεροῦτε δὲ
παῖδας, γυναῖκας, θεῶν τε πατρῴων ἕδη,
θήκας τε προγόνων· νῦν ὑπὲρ πάντων ἀγών.
καὶ μὴν παρ' ἡμῶν Περσίδος γλώσσης ῥόθος
ὑπηντίαζε, κοὐκ ἔτ' ἦν μέλλειν ἀκμή.
εὐθὺς δὲ ναῦς ἐν νηΐ χαλκήρη στόλον
ἔπαισεν· ἦρξε δ' ἐμβολῆς 'Ελληνικὴ
ναῦς, κἀποθραύει πάντα Φοινίσσης νεὼς
κόρυμβ', ἐπ' ἄλλην δ' ἄλλος ἴθυνεν δόρυ.
τὰ πρῶτα μὲν δὴ ῥεῦμα Περσικοῦ στρατοῦ
ἀντεῖχεν· ὡς δὲ πλῆθος ἐν στενῷ νεῶν
ἤθροιστ', ἀρωγὴ δ' οὔτις ἀλλήλοις παρῆν,
αὐτοὶ δ' ὑφ' αὐτῶν ἐμβολαῖς χαλκοστόμοις
παίοντ', ἔθραυον πάντα κωπήρη στόλον.

NOTES.

400. Ἡγεῖτο κόσμῳ, *led the array.* 'Ηγέομαι, with dative, has the sense of going before.

401. Παρῆν, *it was possible—one could—hear one loud universal shout.*

405. Θήκας, *the tombs*— where the dead are placed (τίθημι).

406. Παρ' ἡμῶν, *on our side.* It is a Persian messenger who is telling the tale.

408. Στόλον, *ornament, array* (στέλλω), here means the beak of the ship which was used to strike against a foe.

410. Πάντα κόρυμβ', *the whole figure-head.* Φοινίσσης: the Phœnicians were the earliest navigators, and at this time were employed as mercenaries.

412. 'Ρεῦμα. *At first the rush* (charge) *of the Persian host bore up against it.*

416. Παίοντ', for ἐπαίοντο, it being the speech of an ἄγγελος, the augment is, as usual, omitted.

TRANSLATION OF EXTRACT I. IN LAST READING.

Creon. Thee I ask, thee who bendest thy face to the ground, dost thou confess to this deed, or deny it?

Antig. I say I did it, and deny it not.

Creon. As for thee (*to the sentinel*), take thyself off where thou wilt be free from this heavy accusation. But do thou (*to Antigone*) tell me, not at length, but briefly, didst thou know of the proclamation that forbad this deed?

Antig. Know it? Of course I did. It was clear enough.

Creon. And didst thou dare then to transgress a law like this?

Antig. Yes; for it was not Zeus that proclaimed this to me, nor Justice, that sits associate of the gods below (who have determined these laws among men), nor did I deem that decrees of thine had such power, that a mere mortal like thou couldst override the unwritten and surely fixed laws of the gods. For their laws live not merely from one day to another, but ever and ever, and no one knows whence they come. Such laws it was not for me to transgress in the face of heaven, when I feared the will of no man, for I knew that I must die, ay, surely, even if thou hadst never proclaimed thy decree: and if I am to die before my time, I count it but a gain. For one who lives as I do in the midst of many evils by death may surely be said to be a gainer. Wherefore my sorrow at meeting with this fate is as nothing. But if I had endured to see the corpse of him whom my mother bore, lying unburied, then I should grieve. Now I grieve not. But if I seem to thee to be acting folly, it is something like incurring a charge of folly at the hands of a fool.

COMPARATIVE ANATOMY.—XXI.

MAMMALIA.

THE philosophy of the Duke Senior, called forth, as it were, by the grand yet simple beauty of the Arden forest, as contrasted with the turmoil and conflicts of court—which Shakespeare so forcibly illustrates—is little in comparison with the enthusiasm which arises in the mind of the anatomist, as he beholds the successive stages of development evinced by those beings which Nature has endowed with the attributes of life. Artifice can produce a variety of buildings, widely different in shape; but the temples which Nature has created and tenanted are so varied and beautiful that we are lost in a maze as we recognise her power. From the same materials, she builds up form after form, differing in magnitude and beauty; and, by modifying now one tissue and now another, gives origin to beings which apparently differ as much from each other as the earth's poles in distance. But, yet more wonderful still, we find evidences of the same life pervading the whole, differing only in degree in accordance with the facilities bestowed for its manifestation.

We have described beings adapted to live in water; beings capable of living on land or in water; others that can soar in air far above earth's surface; and now it only remains to describe those animals which constitute the final link in so extensive a scale—and being final, in possession of forms the most beautiful, of faculties characterised by the highest degree of intelligence, and of peculiarities which distinguish them from every other division of the great vertebrate kingdom. The chief distinctive peculiarity is that of breasts, which each possess and from whence they take their name, the word mammalia coming from the Latin, *mamma*, a breast. The preceding divisions are, more or less, independent of their parents for support. Not so, however, the mammalian young; helpless when born, they would hopelessly perish, had not bounteous Nature provided the parent with breasts which furnish the secretion milk, and a corresponding degree of affection—the one to nourish, the other to cherish them until sufficiently matured to seek food for themselves. The breasts vary somewhat in position and number. In man and the quadrumana they are situated on the chest; in flesh-eaters, over the chest and belly; in the cow, mare, etc., they are placed close to the hind extremities. They are two in number in the goat, elephant, and ape; four in the horse and cow; eight in the cat; ten in the rabbit and pig; and ten or twelve in the rat. Each breast consists of a number of small lobes bound together by connective tissue. Each of the small lobes is made up of still smaller ones, and each of these terminates in a small tube or duct. The ducts of the smaller divisions of each lobe join to form a common duct. The ducts so formed terminate at the central projecting part (nipple) of the breast. The chief constituents of the milk are: Caseine, butter, sugar of milk, alkaline and earthy salts, with traces of iron.

The lowest order of each great class is represented by beings which partake of the character of the next lowest class, and so we find it here. The Duck-billed Platypus (*Ornithorynchus*), a native of Australia, has certain features which are essentially bird-like in character; *e.g.*, it has a bill like that of a duck, webbed feet, etc. It spends much of its time in water, though it has burrows excavated in the adjacent banks of the stream. A little time ago naturalists had some difficulty in determining whether this animal was a mammal or not. Later researches have, however, satisfactorily settled the question in the affirmative. Closely allied to it is a peculiar hedgehog-like animal, furnished likewise with a bill, and prickly spines on its back, the porcupine ant-eater (*Echidna*).

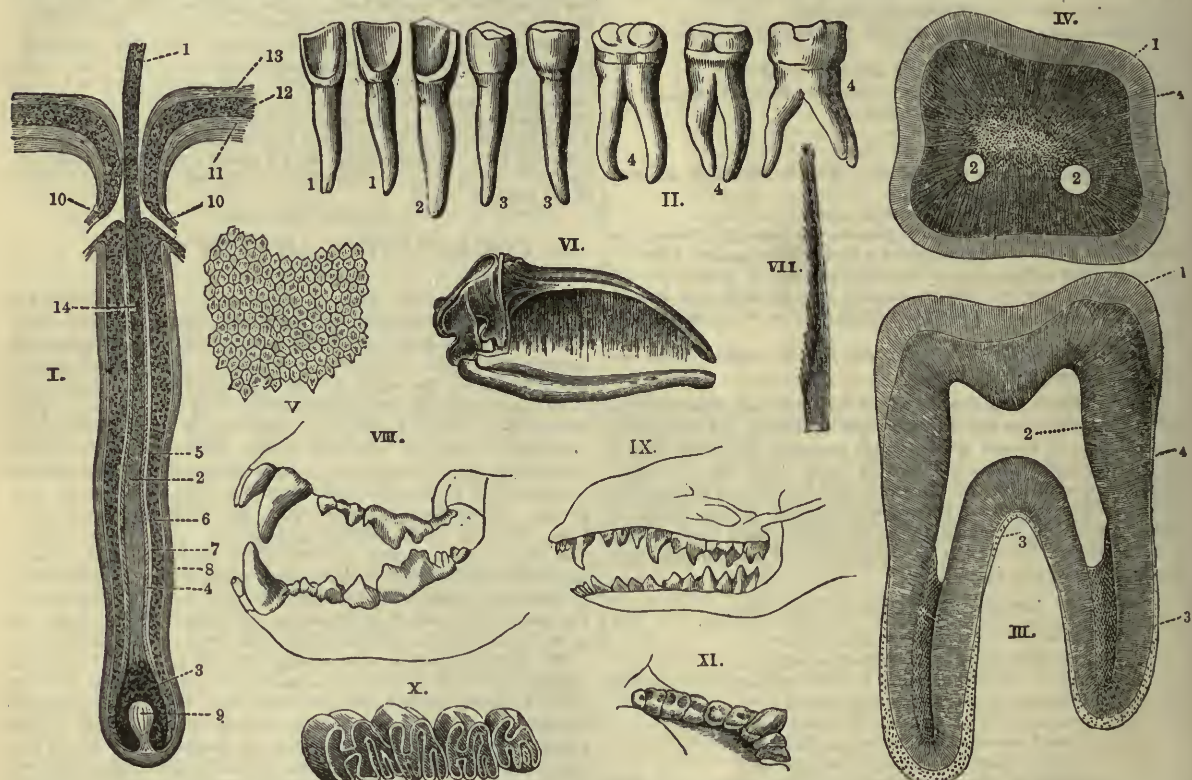
In the next stage towards mammalian perfection, we find an extensive order of animals, principally found in Australia, Van Diemen's Land, and the islands of the Asiatic Archipelago, as far as Java. A few species are found also in America. These are the marsupials, or pouched quadrupeds (kangaroos, opossums, etc.), so named from the presence of a bag, developed from the skin of the belly, in which they carry their prematurely brought-forth young during the helpless condition of infancy. Safe from danger in the pouch, the young are enabled to reach the maternal teats, by which they hang and are fed.*

With few exceptions, the mammalia have their skin protected with hair. In colour, shape, and strength, the hairs vary considerably, from the curly wool which keeps the sheep warm, to the protective spines of the hedgehog. The hair fulfils the following conditions:—Provides warmth to the body, adds to the beauty of the animal, forms a protective covering to the skin, and likewise, as in the timid hedgehog, a spiked coat of mail, a most formidable and invincible barrier to the would-be antagonist. Every hair is divided into a free part, or shaft (Fig. I., 1), with its tapering point, and a root (Fig. I., 2) inclosed within a sac. In straight hairs, the former is generally straight and rounded; in the curly and woolly hairs it is twisted spirally, and quite flat, or slightly ribbed. The root is always straight and cylindrical, and softer and thicker than the shaft; at least, at its lower part. In living hairs it ends in a still softer knob-like enlargement, two to three times thicker than the shaft, the bulb of the hair (Fig. I., 3), which is placed, cap-like, upon a little process of the sac named the hair papilla.* (Fig. I., 9.)

The nails and claws are, like the hairs, modified epidermic processes and, like it, consist of a soft and horny layer.

Some animals, as the elephant, hippopotamus, rhinoceros, hog, horse, ass, etc., have remarkably thick skins, and on this account were formerly classed by Cuvier as a distinct order, under the name Pachydermata ($\pi\alpha\chi\acute{\upsilon}\varsigma$, thick; $\delta\epsilon\rho\mu\alpha$, skin).†

The Teeth.—For variety and beauty, the teeth excel every other part of the mammalian body. They are confined to the jaws, and arranged in an uninterrupted series. Each jaw is hollowed out into a number of pits, or alveoli, in which the teeth are lodged, connected to the bone through the intervention of a membrane called the periosteum, which lines the tooth-socket. Each tooth is composed of dentine, or ivory (Figs. III. and IV., 4, 4), which forms the greater part of its substance. The projecting part, or crown, is covered with a very hard



Mammalia.—I. Hair and Hair Follicle (magnified 50 times). II. Human Teeth. III. Vertical Section of a Human Molar Tooth. IV. Transverse Section of a Human Molar Tooth. V. Surface of the Enamel, with extremities of the Enamel Fibres (magnified 350 times, after Kolliker). VI. Osseous Head of the Greenland Whale, with the whalebone present. VII. The Whalebone. VIII. Teeth of a Carnivorous Animal. IX. Teeth of an Insectivorous Animal. X. Teeth of an Herbivorous Animal. XI. Teeth of a Frugivorous Animal.

Refs. to Nos. in Figs.—I. 1, shaft; 2, root; 3, bulb; 4, epidermis of the hair; 5, inner root sheath; 6, outer root sheath; 7, structureless membrane of the hair follicle; 8, transverse and longitudinal fibrous layers of the same; 9, papilla of the hair follicle; 10, excretory ducts of two sebaceous glands; 11, cutis; 12, mucous and, 13, horny layer of the epidermis—the latter entering a certain way into the follicle; 14, end of the inner root sheath. II. 1, incisive teeth; 2, canine or eye-tooth; 3, small or premolars; 4, large molars. III. and IV. 1, 1, enamel; 2, 2, pulp cavities; 3, 3, cement; 4, 4, dentine.

* Plutarch, in his treatise on the love of parents for their children, mentions these animals as an illustration of affection for their offspring.

* Kolliker.

† The elephants now form the order Proboscidea, the hyrax Hyracoidea, and the remainder may be called Ungulata. (Huxley.)

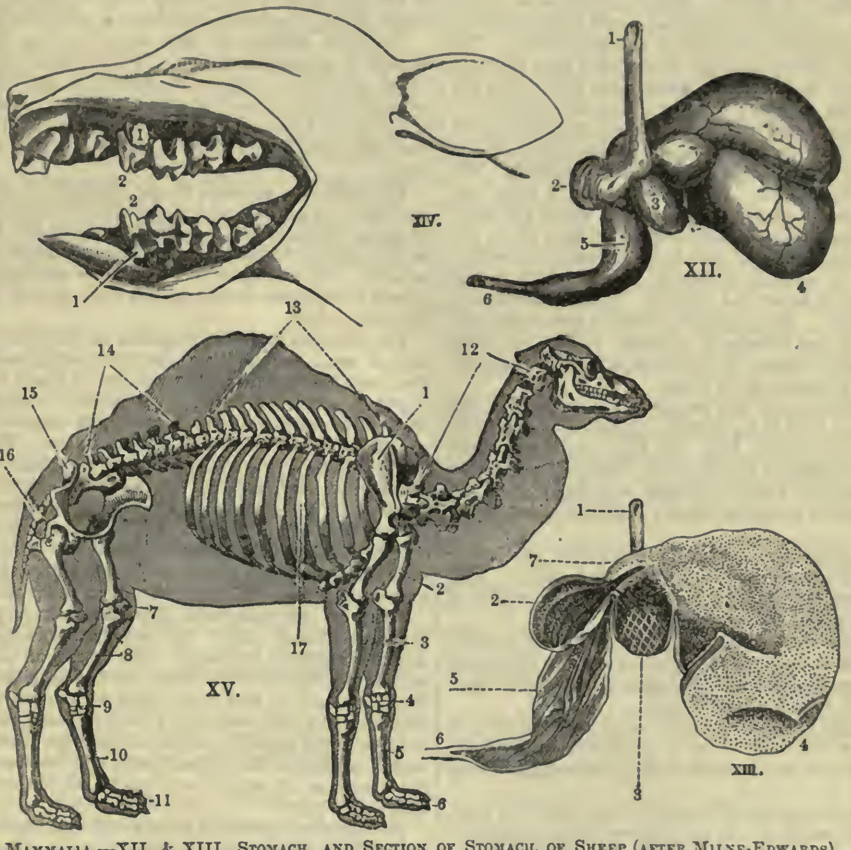
material, called enamel (Figs. III. and IV., 1, 1); and the root with a material which is named cortical substance, or cement (Figs. III. and IV., 3, 3). The enamel, when examined under the microscope, appears like a number of six-sided prisms closely pressed against each other, and directed perpendicularly towards the surface of the tooth (Fig. V.). The dentine is composed of delicate branching tubes, which run from the central cavity (Figs. III. and IV., 4, 4) towards the surface of the tooth. In the whale the teeth are represented by large flexible plates in the upper jaw, called whalebone (Figs. VI. and VII.). In man, and the higher apes, monkeys, etc., there are in each half of each jaw two front teeth, chisel-shaped, named incisors, or cutting-teeth (Fig. II., 1); a more pointed one called the canine, or dog-tooth, for biting, holding, and tearing (Fig. II., 2); two somewhat flattened at the top, with single fangs, called false, or premolars (Fig. II., 3); and three situated behind all the rest, the true molars or grinders (Fig. II., 4). To express the number of teeth in a simple manner, the following table is used by naturalists, and called the dental formula:—

$$i.\frac{2\cdot2}{2\cdot2};\quad c.\frac{1\cdot1}{1\cdot1};$$

$$p.m.\frac{2\cdot2}{2\cdot2};\quad m.\frac{3\cdot3}{3\cdot3}.$$

The incisor teeth are very small in the insectivora, strong and large in the herbivora and rodents. The canines are large in the carnivorous and some other animals. Figs. VIII., IX., X., and XI. show examples of the teeth in the carnivorous, insectivorous, herbivorous, and frugivorous animals. The narwhal has only two teeth. The elephant has six—viz., an entire molar on each side of both jaws, together with two tusks of the upper jaw. In rodents the teeth vary from 12 to 28. In ruminants, apes of the Old World, and commonly throughout the mammalia, there are 32, the typical number, however, being 44 (Owen). The cachelot (spermaceti whale) has more than 60 (which are confined to the lower jaw); and the dolphin 100 to 190.

Animals are said to be monophyodonts that generate a single set of teeth, and diphyodonts that generate two sets of teeth. To the first belong the monotremata (ornithorynchus and echidna), edentata* (sloths, etc.), and cetacea (whales). To the second all the rest, except the marsupials, which the recent researches of Mr. Flower, the present able conservator of the Hunterian Museum, have shown to belong to an intermediate type, shedding only one tooth (Fig. XIV., 2, 2), a fact which has been previously overlooked by observers.



MAMMALIA.—XII. & XIII. STOMACH, AND SECTION OF STOMACH, OF SHEEP (AFTER MILNE-EDWARDS). XIV. SHOWING DENTITION OF A MARSUPIAL (AFTER FLOWER). XV. SKELETON OF A CAMEL.

Refs. to Nos. in Figs.—XII. and XIII. 1, 1, gullet; 2, 2, third stomach; 3, 3, second stomach; 4, 4, paunch; 5, fourth stomach; 6, 6, pylorus and intestine; 7, œsophageal groove. XIV. 1, 1, permanent, and 2, 2, deciduous teeth. XV. 1, blade-bone or scapula; 2, humerus; 3, ulna or cubitus; 4, carpus; 5, metacarpus; 6, phalanges; 7, femur; 8, tibia; 9, tarsus; 10, metatarsus; 11, phalanges; 12, cervical vertebræ; 13, dorsal ditto; 14, lumbar ditto; 15, sacrum or sacral ditto; 16, caudal or ox-tail ditto; 17, ribs.

Alimentary Canal.—The mouth is separated from the upper part of the gullet by a pendulous musculo-membranous fold called the soft palate. This prevents the food, during the act of swallowing, from entering the back part of the nose. The upper part of the gullet is called the pharynx. It is a muscular bag common to both the food and air passages. The opening into the windpipe is protected by a movable leaf-like lid of cartilage, which effectually closes it during the passage of the food into the gullet. The food is propelled along the gullet by the successive action of the muscular fibres of which the tube is mainly composed. This act is beyond the control of the will. In many of the mammalia the stomach is a simple membranous bag, stretched transversely across the upper part of the abdominal cavity, and curved somewhat upon itself. The upper curve is smaller than the lower. The point where the food enters is called the œsophageal opening, and that where it leaves the stomach the pyloric (from the Greek, signifying a *gate-keeper*), because it is constricted by an aggregation of the muscular fibres of the stomach into a circular ring, which effectually guards the aperture until the food is sufficiently digested to permit of its passage into the intestine. In ruminants the stomach is much more complicated, being divided into a number of compartments (Figs. XII. and XIII.). The first stomach is called the paunch (4), the second the king's hood, or honey-combed stomach (3), from being arranged in folds or cells similar to a honeycomb; the third, or manyplies (2), from its inner surface being increased by a number of longitudinal folds; the fourth, or rennet (5), named from its property of curdling milk. The ruminant swallows its herbaceous food partially masticated. It descends into the first stomach, or paunch, which corresponds to the crop of birds. When at leisure, the animal regurgitates the food to the mouth. A part is passed into the second stomach, and there formed into a smooth, moistened mass, and then projected into the mouth, where it is now properly masticated, and again swallowed. This time the morsel passes into the third stomach, and, spreading over its longitudinal folds, is prepared for admission into the fourth or true digestive stomach, and thence into the small intestine. In the camel and

* Edentata (*e* and *dens*), without teeth. In many of the species the teeth are entirely absent; in others only partially so.

dromedary the walls of the first and second stomachs are excavated into deep cells, wherein water may be retained in considerable quantities. On this account these animals are able to go many days without a fresh supply of water, even during long journeys across the hot, sandy desert. The intestines (like those of man) consist of two portions, of which the first is named the small, and the second the large intestine. The point of separation between them is indicated by a valve formed by the mucous lining of the bowel, and in some animals by a cæcum, to which is attached a tail-like process, termed the vermiform appendix. The relative length of the intestines varies. In the carnivora it is from five to fifteen times the length of the body; in insectivora, from three to six times; cheiroptera, two to seven; ungulata, fifteen to thirty; in the quadrumana, about three to eight times. The division into large and small intestine prevails with few exceptions throughout the mammalia. The membrane lining the small intestine is elevated into valvular folds, for the purpose of increasing the surface over which the digestive material has to pass; there are also embedded in it small glandular organs and villi; the former secrete a fluid which aids the digestive process, and the latter take into the system, as white blood, that already sufficiently prepared. The large intestine is sacculated. It commences by a blind extremity called the cæcum, at the termination of which the small intestines open. The cæcum is not always present, as in the insect-eaters, bats, edentata, and certain of the cetacea; and in other mammals it is variable in length. It is short in the carnivora, yet absent in bears and weasels. In the ruminants it is large and capacious. The appendix exists in man, apes, and gibbons, and also in the marsupial wombat, but in no other animal. In the monotremata (ornithorynchus) the intestinal canal terminates in a cloaca, as in birds.

The glandular organs, liver, and pancreas, and the spleen, are always present. The liver has generally appended to it a gall-bladder, or reservoir for the bile. In the mouth there are usually three pairs of salivary glands, which furnish the secretion to moisten and partially dissolve certain constituents of the food. This fluid readily converts starchy food into sugar, while in the mouth.

The kidneys are situated on each side the lumbar portion of the spine. They eliminate the urine from the blood. This excretion passes from the kidney into the bladder by means of a membranous tube called the ureter.

The abdominal cavity is separated from the chest by a partition-muscle called the diaphragm. This is a very important muscle, and by its contraction and relaxation the principal part of the mechanism of breathing is effected.

The lungs and heart present much the same arrangement as that described in the last lesson. The lungs do not communicate with air-cells in any part of the body in the mammalia, as they do in birds.

The windpipe has surmounting it a larynx, made up of a number of pieces called cartilages, to which are attached numerous muscles and ligaments. It is here that the voice is produced.

The position of the heart is usually in the median line of the chest, lying between the lungs. In man and the higher apes it has an inclination towards the left side.

Nervous System.—As will be anticipated, the brain is found larger and more complicated in these animals than in the preceding classes. It is characterised by the presence of a transverse band of nervous matter, which connects together the two halves of which the brain is composed. This transverse band, or commissure, is called the corpus callosum. It is small (said to be absent) in the monotremata. The convolutions of the brain are more numerous, and increase in complexity, as we ascend towards the higher mammalia, according with the increased intelligence which these animals manifest. The weight of the brain in proportion to that of the body diminishes in the vertebrata generally in the following order and manner:—In mammalia it is as 1 to 186; in birds, as 1 to 212; in reptiles, as 1 to 1,321; and in fishes, as 1 to 5,668 (Leuret). In proportion to the body, the brain is smaller in the larger mammals than in those of less dimensions. Thus, in the ox, it is as 1 to 180; in the elephant, as 1 to 500; in the horse, as 1 to 400; in the sheep, as 1 to 350; in the dog, as 1 to 305; in the cat, as 1 to 156; in the rabbit, as 1 to 140; in the rat, as 1 to 76; and in the field-mouse, as 1 to 31. In man, the average proportion is as 1 to 36·5 (Marshall). With the exception of a few small birds, certain rodent animals, and the smallest of the monkey tribe, man has a larger brain, in proportion to the size of the body, than any other vertebrate.

Sensory Organs.—We find these delicate organs developed to the highest degree of perfection in this class. The pupil of the eye varies in shape. In man, and many of the larger carnivera, it is round. In nocturnal animals, as the cat, it assumes the form of a vertical fissure, and is very large. In many of the herbivorous animals it is transversely oblong. In the whale tribe the eye is similar in shape to that already described in fishes. The eye is moved by six muscles. It is protected by two movable lids. Besides these, there is sometimes a third lid, called the nictitating membrane. The minute structure of the eye is in almost every respect similar to that of man, which will be described elsewhere, as also the organ of hearing.

The nose consists of two lateral halves, the cavity being divided by a vertical septum. It is invested by a delicate membrane (mucous), in which the olfactory nerve filaments, which preside over the sense of smell, ramify. Both cavities communicate with the upper part of the gullet, or pharynx. The sense of smell is very acute in the majority of members of this class.

The proboscis, or trunk of the elephant, is a prolongation of the nose. It consists of a highly flexible tube, surrounded with muscles, through which food and water are conveyed to the mouth, and air to the lungs. It also serves as an organ of prehension. By means of its trunk the elephant is enabled to uproot trees, untie knots, open a lock, or even write with a pen (Rymer Jones).

The Skeleton, in many respects, presents a close analogy to that of man. It undergoes, however, many modifications. The skull and face are formed by a series of bones immovably bound together, and so arranged as to present several complete and incomplete cavities for the lodgment of the delicate organs concerned in the manifestation of the senses. Thus we have one cavity, of variable size, for the brain; another one for the nose; and one on each side of the face for the eyes. The mouth is situated at the base, in the interval between the upper and lower jaws. The size of the face becomes larger, and the cranium smaller, as we recede from man. The jaws are always articulated to the squamosal bone of the skull, without the intervention of a quadrate bone, as in the preceding classes.

Some of the mammalia (ruminants) have horns projecting from the frontal bones. In deer the horns are called antlers, and are replaced annually. The horns of the rhinoceros are mere appendages of the skin. In the goat, ox, and sheep, the horns are hollow, and based upon an osseous process, which is hollowed out into cells. These communicate with certain cavities in the frontal bone, called sinuses. Such horns grow by layers, analogous to ordinary nail, and are never shed. With the exception of camels and musks, all the ruminants are provided with horns.

The vertebral column is made up of bone segments. These are respectively named cervical, dorsal, lumbar, sacral, and caudal, according to their position. The cervical are usually seven in number (Fig. XV., 12). The dorsal (13) vary from eleven to twenty, and give attachment to a corresponding number of ribs. Thus, in man there are twelve dorsal vertebræ, and as many ribs. The horse has eighteen, and the elephant twenty pairs of ribs. The sacral vertebræ are absent in the whale tribe. In other mammals they consist of three or more segments fused together, forming a wedge-shaped bone, called the sacrum (15). The tail (caudal) vertebræ (16) are represented in man by four small segments. In other mammals they vary to sixty in number. In certain rats they are entirely absent. The weight of the head is supported by a strong elastic ligament, vulgarly termed packwax, which extends between the back part of the skull and the neck vertebræ.

Every mammal is provided with four limbs, except the whale tribe, and these have only the two thoracic or anterior limbs. The limbs present many peculiar modifications, according to the habits and sphere of the animal. Thus, the thoracic limbs of the bat act as wings; those of the whale, as oars; in quadrupeds as legs; and in some, as the cat tribe, also as instruments of offence. In monkeys they are indiscriminately used as hands and feet; while in man the hand and arm are emblematical of his skill and prowess—by them he is enabled to accomplish the various duties which the exigencies of life entail upon him.

The bones of the extremities are, first, a broad and expanded bone, called the blade-bone (Fig. XV., 1) in the thoracic, and the innominate bone in the pelvic extremity. The blade-bone may or may not have a clavicle or collar-bone attached to it.*

The arm and thigh bones are single, and called respectively the humerus (2) and femur (7). The fore-arm and leg have each two bones, viz., radius and ulna (3), and tibia and fibula (8). The bones of the hand and foot are very variable (5, 6, 10, 11). Man has five digits; the bat also five, but the thumb is small; while the other digits are very long and connected together by a fold of skin derived from the sides of the body, and continued along the whole length of the hind legs. The horse has only one perfect toe, and two imperfect ones; the perfect toe is inclosed in a mass of horny matter, called a hoof. The toes of the carnivora are armed with claws; and many, as the well-known cat, have their feet padded with an elastic cushion, to enable them to tread noiselessly, and thus take their prey unawares. The ruminants have a cloven hoof, having two toes on each foot. Besides these, there are a variety of modifications. Some animals walk on the sole of the foot, as man, bears, and badgers, and are called plantigrades. Others walk on the extremities of their toes, as the horse, and many of the carnivora; these are called digitigrades. Professor Owen adds a pinnigrade class, as the seal tribe, which have both fore and hind feet expanded into broad webbed paddles for swimming. In our next lesson we shall give the classification of the mammalia, etc.

* The collar-bone is absent in the cetacea, hyrax, elephant, ungulata, and in some of the carnivora it is a mere rudiment.

THE UNIVERSITIES.—IX.

LONDON.—II.

III.—CHEMISTRY.

This branch of the examination will perhaps be found difficult, unless some recourse can be had to experimental teaching. And yet the subjects of the examination are purely elementary in character, and by the aid of experimental teaching *all* difficulty should vanish. In many of our large towns some kind of experimental practice will not be difficult of attainment, and even when such is not the case the apparatus which is absolutely requisite is not very expensive. But the performance of some experiments is very desirable, and cannot be too strongly recommended. Some medical friend will probably be most qualified to suggest the best method in which to proceed for this purpose. The principal subjects of the examination in Chemistry are enumerated in the University Calendar as follows:—

Chemistry of the Non-metallic elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution: effects of Animal and Vegetable Life upon its composition.

Combustion. Structure and properties of Flame. Nature and composition of ordinary Fuel.

Water. Chemical peculiarities of Natural Waters, such as Rain Water, River Water, Spring Water, Sea Water.

Carbonic Acid, Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

One paper is set in Chemistry, for which three hours are allowed. Its proper execution involves a general and accurate knowledge of the elements of Inorganic Chemistry; and, as the subject is comparatively new to most of those who propose to matriculate, and the paper usually somewhat fatal to candidates, it is desirable that preparation for this portion of the examination should be commenced early, and steadily pursued. The subject is exceedingly interesting and practically useful, and the difficulties of its study rapidly disappear. The "Lessons in Chemistry" in the POPULAR EDUCATOR, which have the great merit of simplicity and numerous illustrative diagrams, may be most advantageously read, especially as a general introduction to the subject.

IV.—CLASSICS.

The classical knowledge required consists of one Latin subject, announced in the University Calendar one year and a half prior to each examination. This subject consists of a small portion of Virgil, Horace, Sallust, Cæsar, Livy, Cicero, or Ovid.

Candidates must be prepared to write with facility a fairly literal translation of any passage from the selected author; and for this purpose, in the case of self-teaching students, it may be necessary and even desirable to procure some translation for reference on points of difficulty, and as a test of accuracy. Those published in Bohn's classical series will best answer the end in view. But such works must be used with caution; and, if they can possibly be dispensed with, not at all. There is much reason in the almost universal condemnation of such aids by educational authorities. But there are cases in which some such assistance is indispensable—in those in which there is no master or friend to whom to refer a difficulty, no mutual assistance on the part of members of the same class. Under these circumstances a key may, we think, be used with advantage; but we repeat the caution that it should be rarely resorted to, and only in cases of extreme difficulty, and as a substitute for a master. The student must, in addition to the translation, render himself acquainted with the outlines of the life and times of the selected author, and with the chief allusions—geographical, historical, and mythological—in the text.

The classical papers also include questions in grammar, history, and geography; and a separate paper is set in Latin grammar, which also contains simple and easy sentences of English for translation into Latin prose. The grammatical questions in the classical papers usually have reference to words in the text, and we recommend the student to get up the syntax, etymology, and chief peculiarities of the words made use of. But the questions are not by any means confined to these; and as special stress is laid on accuracy in the answers to the questions in Latin grammar, this subject should be very carefully prepared from a good grammar. In Latin grammar, the declension of nouns, adjectives, and pronouns, with the chief exceptions to the general rules; the formation of the genitive plurals of the third declension; the comparison of adjectives and adverbs; and the chief parts of those verbs whose perfects and supines are irregularly formed, should be committed to memory. The examination in Latin Prose Composition is of the most elementary character, and frequently has reference to the use of the subjunctive mood, Latin numerals and ordinals, and the Roman calendar.

The history of Rome must be carefully and diligently read, and special attention should be paid to the dates of the most important events, the causes and chief battles of the wars, and the leading features of the lives of the chief characters.

Until 1873 Greek was one of the subjects prescribed in the department of Classics at the Matriculation Examination. A resolution, however, has since been passed by the Senate to the effect—"That Greek be no longer compulsory on candidates at the Matriculation Examination, but be ranked as optional with French, German, and Sanskrit or Arabic; so that it shall be sufficient for any candidate to pass in *any two* of these languages."

V.—THE ENGLISH LANGUAGE, AND HISTORY AND GEOGRAPHY.

The English element of the Matriculation Examination will involve considerable preparation, chiefly owing to the want of attention usually bestowed upon the subject at primary and secondary schools. The history and principles of the English language and its grammatical structure must be carefully and methodically studied. The grammatical and logical analysis of sentences; the signification of Anglo-Saxon, Greek, and Latin prefixes and affixes, and of the chief Anglo-Saxon inflections as they influence English forms; and the leading rules of syntax should receive every attention.*

The paper on the outlines of English history is not usually a difficult one. The questions embrace a period commencing with

* See upon all these points the "Lessons in English" in the POPULAR EDUCATOR.

the earliest historical times, and terminating with the end of the seventeenth century. Most of them may be answered from any of the usual school histories. The questions frequently have reference to the dates of the most important events, to points of constitutional importance, to legislation by charter and by statute, to conflicting claims to the Crown, to battles, and to general biography. It is, therefore, desirable that these subjects should be carefully read. Candidates should also be able to draw from memory an outline map of England, and to fill in the most important geographical divisions and places in Roman, Saxon, and modern times.

VI.—FRENCH OR GERMAN.

Either the French or German language must be so far mastered as to enable the candidate to answer grammatical questions, limited to the accidence,* and to translate short and easy passages from prose works not previously announced, and short and easy French and German sentences at sight.

VII.—SANSKRIT OR ARABIC.

In the case of these languages, the candidate must be able to translate passages into English, and to answer questions in grammar. The candidate is also examined on certain Sanskrit books specified in the yearly regulations.

The whole of the subjects required at the matriculation examination have now been mentioned.

It is, of course, impossible to even estimate the time requisite for their preparation, or to lay down any inflexible rule as to the hours and modes of reading. These matters depend upon the previous knowledge, ability, and leisure of individual candidates, but in the majority of cases a year and a half or two years will, with ordinary application, be sufficient for the purpose of preparation. A few words upon the mode of reading may, perhaps, be useful in affording some general hints. They are, however, offered merely as suggestions, and must yield to individual tastes and circumstances. It is, we think, desirable to gain a general acquaintance with each of the subjects before proceeding to acquire a knowledge of those portions of them especially required at the examination. The Greek and Latin grammars, the lessons in Greek and Latin in the POPULAR EDUCATOR, and the first part of Arnold's "Latin Prose Composition," or some similar work, should be thoroughly studied before the translation of the selected authors is commenced; and in the study of French and German it is equally desirable to master the accidence and to gain a general acquaintance with the elements of the language in the first instance. This done, the special subject should be read and re-read until the student is perfectly familiar with it, and able to translate any passage with facility, in order that more time may be devoted at the examination to the consideration of those questions which may not have suggested themselves in the course of reading.

It is, in our opinion, desirable that all the subjects should be read concurrently rather than successively. If, for instance, three hours a day can be spared for study, a portion of the time should be devoted on alternate days to each of the branches of the examination. If this plan be adopted, although the student's progress may be less perceptible, he will, on the eve of examination, find himself familiar with even the details of the whole of the subjects, and fresh from their preparation; while the more usual and ably advocated system of reading each branch separately tends to create an inequality in the candidate's knowledge of the various elements of the examination. In the subjects most recently prepared he is strong, but the details of those studied at an earlier period, and laid aside as finished, will have faded somewhat from the memory—a fatal defect in an examination in which a competent knowledge of all is absolutely essential. The change produced by reading the different subjects contemporaneously furnishes another argument in favour of this system; each forms a relief to the other, and it is possible by judicious variation to read for a much longer period without fatigue, than can be done if one subject only be adhered to.

It is an excellent plan to construct periodically a time-table, allotting to each subject a certain portion of the hours of study in proportion to the progress made and the amount of preparation requisite. Such systematic reading is worth double the amount of cursory study.

* This limitation does not apply in the case of German when that language is taken as an alternative to Greek.

It may be useful to analyse and note down briefly certain subjects of the examination—for instance, the chemistry and history—and to write out the translation of the classical authors. But this course, if adopted at all, should be deferred until the student's knowledge of the subjects is such as to enable him to discriminate those portions which it is desirable to commit to writing. It must also be remembered that the note-book should never be a substitute for the memory, which it is apt to become. A more useful and less dangerous plan is to mark, by perpendicular lines drawn down the margins of the text-books, those passages which are of most importance, and which it is desirable to commit to memory, such as definitions and generalisations; the number of these may be again reduced, either by a parallel line, or by some other distinctive mark; and it is a recommendation of this or some similar system that it enables the most essential points to be referred to at the last moment before the examination.

We advise students who have studied thus systematically to read until the moment of entering the examination-room. In the case of those who possess neither notes nor marked passages, such a course is calculated to produce confusion and nervousness; but it has a reverse effect with those who are in a position to glance over the whole subject in a few hours before the commencement of the examination in each branch.

We add one or two hints for observation in the examination-room. First, let no candidate omit to write his name legibly on each book of his answers to the questions. Such an omission has in more than one instance led to the rejection of competent men. It is desirable to answer each question in consecutive order, and to complete, if possible, the first before proceeding to or even looking at the second. A hasty glance at the whole in the first instance is apt to magnify the difficulties of the paper, which will probably vanish before a little thought, but which at first sight may seem insuperable, and so give rise to a paralysing nervousness. It is generally necessary to write quickly, and it is a good rule, though the paper may be finished, to remain in the examination-room and to carefully revise it. Such a course may lead, as it often has done, to the detection of errors and to the remembrance of answers previously forgotten.

Lastly, we recommend our students to avoid merely cramming the minimum of knowledge requisite to pass this or any other examination. Such a course is neither a safe nor a useful one; on the contrary, an extensive acquaintance with each branch will not only prove of service at future examinations and in the world, but is an insurance of success. It may be stated for the encouragement of nervous candidates, that half the marks in each subject will suffice for a mere pass, but such an equivocal position as that of the second class should be carefully avoided. A place in the Honours Division must be an object of aspiration to one and all our readers; and it is to be hoped that the more material rewards promised to the first six candidates at each matriculation examination, in the shape of scholarships of £30, £20, and £15 each, tenable for two years, and prizes of books, philosophical instruments, or money, may be awarded frequently to the self-taught students to whom these remarks have been especially addressed.

HYDROSTATICS.—I.

OBJECTS OF THE SCIENCE—PRINCIPLE OF EQUALITY OF PRESSURE.

THE branch of Natural Philosophy the study of which we are now about to commence is called Hydrostatics, and it is concerned in examining the conditions of equilibrium in liquids, the pressures they exert, and their motions; just as Mechanics was concerned with solid bodies.

All matter exists in one of three states—the solid, the liquid, or the gaseous; and the sciences of Mechanics, Hydrostatics, and Pneumatics treat respectively of its motions and the forces which act upon it in these three states. We must not, however, imagine that a body can exist in only one of these conditions, for many assume at different times all three. To take the simplest illustration, water is best known to us in a liquid state, that being the one in which we most commonly meet with it, but if a certain amount of heat be taken away from it, it will become changed into a solid, which, though to distinguish it, we call ice, is not a new substance, but merely the water in a different state. So also an increase of heat will change the water into an invisible gas or vapour which we call steam. In this case heat is the agent which produces these changes of state, and it does so by driving the ultimate particles of the substance farther apart from each other. Many of the metals, as is well known, assume the liquid state under the influence of heat, and hence can be melted and cast into moulds of any desired shape. If they be exposed to a much higher degree of heat, as may be done in the electric lamp, they, too, will become converted into vapour.

The difference between these states depends upon the relations existing between the ultimate particles of which the masses are composed. In a solid these particles have a strong attraction for each other, that is, cling closely together, and resist any effort to separate them. Many of the metals can be drawn out into fine wires, and yet will sustain considerable weight before the attraction or cohesion, as it is termed, is overcome. If we take two lead bullets, and scrape a portion of the surface of each so as to render them even, and then, by pressing them firmly together, drive out the air, this cohesion will cause them to cling to each other so tightly as to require a considerable degree of force to separate them. Another property of solids which results greatly from this, is the amount of friction with which their ultimate particles move over one another. In some solids this is so great that no moderate degree of force will suffice to move them or to alter the form of the mass. In this respect there is, however, a great difference between solids, for they merge so gradually into liquids that it is difficult to draw a well-defined line separating them.

In liquids both these properties are present in a much smaller degree. The cohesion of the particles is so much less that scarcely any force is required to separate a mass of liquid into portions; in fact, it falls apart from its own weight, unless it be put into some vessel capable of containing it, and it immediately assumes the shape of such vessel. The same, however, might be said of a heap of fine powder: how then does this differ from a liquid? The difference consists, first, in the fact that there is a large amount of friction between the atoms of powder, so that if placed in a heap they do not spread themselves out as particles of liquid would; and next, in the ultimate atoms of the liquid being so minute as even under the most powerful microscope to be invisible, while those of the powder have a definite size. The property the particles have of moving over one another with scarcely any friction is one of very great importance, and accounts for several of the phenomena we shall meet with.

If we now look at the case of a gas, we shall find that not only is there no cohesion between the particles, but they repel one another, and, unless confined, will fly apart as far as possible. If a cubic inch of any gas be placed in a large box, it will immediately fill it and become equally distributed in every part. There is also this further difference between liquids and gases, that whereas a gas may be compressed almost indefinitely, regaining its former bulk on the pressure being removed, a liquid is for all practical purposes incompressible.

It was for a long time believed to be absolutely so, but it has since been found that a pressure equal to that of the atmosphere, or 15 pounds per square inch, will cause a compression in water to the extent of 40 or 50 millionths of its bulk. The simplest way of ascertaining this is to procure a cylinder closed at one end, and having a piston fitting very tightly into it. This is filled with water, and a spring ring placed just under the piston, so that if it be driven in at all, the ring will remain at the part of the cylinder which it reached, and thus show the extent of the compression. The apparatus thus arranged is fixed to a heavy weight, and by means of a chord lowered to a known depth in the sea. The pressure, as will be seen, increases with the depth, and the position of the ring will indicate the extent of the compression.

Having thus cleared our way, we can enter more directly on the science itself. It is usually divided into two branches—Hydrostatics proper and Hydrodynamics; the former treating of the equilibrium of liquids and the pressures they produce, while the latter has to do with their motions. The term hydraulics, derived from two Greek words meaning "water" and "a pipe," is sometimes used instead of hydrodynamics, but it is more strictly applied to the raising of water by means of pipes; we shall, however, use it in its more extended meaning.

Water is by far the most common of all liquids, and hence will be taken as a type. In its physical properties, however, it differs little from other liquids, and what is said of it may, with the necessary modifications, be applied to liquids generally.

We found in Mechanics that though the lever and other mechanical powers possessed weight, we could understand their principles better by neglecting it at first; just so here it is easier to omit at first all notice of the weight of the liquid.

The fundamental principle of hydrostatics is that of the quality of pressure, or, as it is sometimes called, after the philosopher who first stated it, Pascal's law. It is as follows:—

It any pressure be exerted on any part of a liquid, that pressure is transmitted equally and with equal force in all directions. A little explanation will make this clear. If we have a solid cylinder made to fit exactly and move without friction in a tube, and we press with any force against one end of it in a direction parallel to its length, the pressure will be transmitted undiminished to the other end, and will there act against any obstacle just as if the cylinder were not interposed; no pressure will, however, be exerted against the side of the tube. If now the cylinder be removed and the tube filled with water, a piston being made to fit each end of it, any pressure exerted on one end will, as before, be transmitted to the other, but a similar pressure will also be exerted against every part of the inner surface of the tube. If the surface of the piston have an area of one square inch, and a pressure of 10 pounds be exerted on it, every square inch of surface in the cylinder will sustain a similar pressure; and if we insert into any part of it a tube with a piston one square inch in area, this piston will be forced out with a pressure of 10 pounds. If the tube be bent or twisted in any direction, the pressure is still transmitted exactly as if it were perfectly straight. This property of liquids follows from the fact of their particles moving without friction, and is of great practical importance. In Mechanics, even with the best and more flexible ropes and chains, there is always a great loss from friction and rigidity, but by means of a liquid a pressure can be transmitted in any required direction without sensible loss.

Similarly, if we have a closed vessel with several equal openings in it, in each of which a piston of one inch diameter works, a pressure of 10 pounds on one will cause a similar pressure on each of the others. If now another piston be fitted to the vessel, 10 inches in diameter, a pressure of 10 pounds will be exerted on every portion of its surface equal in area to the smaller piston. Now the areas of circles are proportional to the squares of their diameters; the area of the larger piston is therefore 100 times that of the small one, and the total pressure on it is therefore 100×10, or 1,000 pounds. We have thus what we may consider as another mechanical power, a gain being effected by the use of it as there was by the lever. The principle of virtual velocities holds good here as well as in the powers we previously considered; for if the small piston be forced in 1 inch, it is clear that the other will only be moved to the extent of $\frac{1}{100}$th of an inch, and thus, though 100 times the pressure is exerted, it is only through $\frac{1}{100}$th part of the space. A simple experiment can easily be tried to show that this pressure is transmitted upwards as well as in other directions. Procure a tube of large diameter, and grind one end of it flat, so that it can be closed by a disc of glass fitting closely against it. Fasten a piece of string to the middle of this disc, and pass the end up through the tube, so that by holding the string it may be kept in its place. If the whole be now lowered into a vessel of water, the upward pressure will keep the disc in its place without the string being held; but on the tube being gradually raised till the end comes nearly to the surface, the pressure will diminish until it will be unable any longer to sustain the disc, which will then fall to the bottom.

This principle of equality of pressure leads to many strange and important results, which we will consider fully in our next lesson.

LESSONS IN GERMAN.—LII.

§ 14.—THE NEW DECLENSION.

TERMINATIONS.

	Singular.	*Plural.*
Nom.	-.	-en or n.
Gen.	-en or n.	-en or n.
Dat.	-en or n.	-en or n.
Acc.	-en or n.	-en or n.

NOTE.—When the singular ends in e, el, or er, the plural takes n only.

EXAMPLES.

	Singular.	*Plural.*
Nom.	Der Graf, the count.	Die Grafen, the counts.
Gen.	Des Grafen, of the count.	Der Grafen, of the counts.
Dat.	Dem Grafen, to the count.	Den Grafen, to *or* for the counts.
Acc.	Den Grafen, the count.	Die Grafen, the counts.
Nom.	Der Falke, the falcon.	Die Falken, the falcons.
Gen.	Des Falken, of the falcon.	Der Falken, of the falcons.
Dat.	Dem Falken, to the falcon.	Den Falken, to the falcons.
Acc.	Den Falken, the falcon.	Die Falken, the falcons.

(1.) Feminine nouns which are indeclinable in the singular, are, for the most part, of this declension. Those ending in the suffix in in the singular, double the n in the plural.

EXAMPLES.

	Singular.	*Plural.*
Nom.	Die Schuld, the debt.	Die Schulden, the debts.
Gen.	Der Schuld, of the debt.	Der Schulden, of the debts.
Dat.	Der Schuld, to the debt.	Den Schulden, to the debts.
Acc.	Die Schuld, the debt.	Die Schulden, the debts.
Nom.	Die Hirtin, the shepherdess.	Die Hirtinnen, the shepherdesses.
Gen.	Der Hirtin, of the shepherdess.	Der Hirtinnen, of the shepherdesses.
Dat.	Der Hirtin, to the shepherdess.	Den Hirtinnen, to the shepherdesses.
Acc.	Die Hirtin, the shepherdess.	Die Hirtinnen, the shepherdesses.

Mutter, mother, and Tochter, daughter, are in the plural Mütter and Töchter. They add n to the dative.

Feminine nouns were originally in the singular declined according to the New Declension. These old inflected forms are still preserved in certain phrases. Thus: mit or in Ehren, with or in respect or honour—Ehren, from Ehre; auf Erden, on earth—Erden, from Erde; mit Freuden, with joy—Freuden, from Freude; von or auf Seiten, on the part of—Seiten, from Seite; meiner Frauen Schwester, my wife's sister.

§ 15.—OBSERVATIONS ON THE DECLENSION OF COMMON NOUNS.

(1.) Some have no singular, as in the following list:—

Aeltern (Eltern), parents.	Fußstapfen, footsteps.	Masern and Rötheln, measles.
Ahnen, ancestors.	Gebrüder, brothers.	Molken, whey.
Alpen, alps.	Geschwister, brothers and sisters.	Ostern, Easter.
Beinkleider, small clothes.	Gliedmaßen, the limbs.	Pfingsten, Whitsuntide.
Blattern, smallpox.	Händel, quarrels.	Ränke, tricks.
Briefschaften, letters, papers.	Hosen, trousers.	Repressalien, reprisals.
Einkünfte, revenue.	Insignien, marks, badges.	Träber or Treber, husks, less.
Fasten, Lent, fasts.	Kosten and Unkosten, costs.	Trümmer, ruins.
Ferien, holidays.	Leute, people, folks.	Weinachten, Christmas

NOTE.—Leute merely expresses plurality of persons. In this it differs from Menschen (human beings), which has regard to the kind or species, as also from Männer (men), which denotes particularly the sex. Those compounds, however, of which, in the singular, Mann forms the last part, take generally, in the plural, Leute instead of Männer; thus:—

Singular.	*Plural.*
Arbeitsmann, workman.	Arbeitsleute, workpeople.
Edelmann, nobleman.	Edelleute, noblemen.
Kaufmann, merchant.	Kaufleute, merchants.
Landmann, countryman.	Landleute, country people.

The distinctive difference between Leute and Männer may be forcibly shown by reference to the words Eheleute and Ehemänner: Eheleute means married *people*; Ehemänner signifies married *men*, *i.e.*, husbands.

(2.) Some have no plural, according to the following heads:—

a. Generic names of material substances; as:—Das Gold, gold; Silber, silver; Eisen, iron, etc.

b. General terms and those expressive of abstract ideas; as:—Raub, pillage; Ruhm, glory; das Vieh, cattle; Vernunft, reason; Stolz, pride; Kälte, cold, etc.

c. Some names of plants; as:—Der Kohl, the cabbage; Hopfen, hops; Kresse, cresses, etc.

d. All infinitives employed as nouns, as also all neuter adjectives so employed; as:—Leben, life; Verlangen, wish; das Weiß, white, etc.

e. Nouns denoting quantity, number, weight, *or* measure; as:—Bund, bundle; Dutzend, dozen; Grad, degree; Pfund, pound; Zoll, an inch, etc.

Thus, in German, we say, neun Klafter, nine fathoms; hundert Grad, a hundred degrees, etc. Feminines ending in e and words denoting periods of time, as also the names of coins, are, in general, excepted from this rule.

(3.) Some, in the plural, have two forms; conveying, in general, different, though kindred significations; as in the following examples:—

Singular.	*Plural.*	
Das Band,	Bande, bonds, fetters.	Bänder, ribbons.
Die Bank,	Bänke, benches.	Banken, banks of commerce.
Der Bogen,	Bogen, sheets of paper.	Bögen, arches, bows.
Das Ding,	Dinge, things in general.	Dinger, little creatures.
Der Dorn,	Dornen, thorn-bushes.	Dörner, thorns (more than one).
Der Fuß,	Füße, feet.	Fuße, feet (as measures).
Das Gesicht	Gesichte, visions, sights.	Gesichter, faces.
Das Horn,	Horne, sorts of horn.	Hörner, horns (more than one).
Das Holz,	Holze, sorts of wood.	Hölzer, pieces of wood.
Der Laden,	Laden, shutters.	Läden, shops.
Das Land,	Lande, regions.	Länder, states.
Der Mann,	Männer, men.	Mannen, vassals.
Der Mond,	Monden, months.	Monde, planets.
Der Ort,	Orte, places (any).	Oerter, places (particular).
Die Sau,	Sauen, wild boars.	Säue, swine.
Die Schnur	Schnüre, tapes.	Schnuren, daughters-in-law.
Der Strauß,	Sträuße, nosegays.	Straußen, ostriches.
Das Wort,	Wörter, words unconnected (as in a dictionary).	Worte, words (in a sentence).
Der Zoll,	Zolle, inches.	Zölle, tolls.

§ 16.—FOREIGN NOUNS.

(1.) Some nouns introduced from foreign languages retain their original terminations; as:—Der Medicus, a physician; plur. Medici, physicians; Factum, deed; Facta, deeds.

(2.) Some masculines and neuters from the French and the English merely affix s to the genitive singular, which is retained in all the cases of the plural; as, nom. der Lord, the lord; gen. des Lords, of the lord; plur. die Lords, the lords, etc.; der Chef, the chief; gen. des Chefs, of the chief; plur. die Chefs, the chiefs, etc.

§ 17.—FOREIGN NOUNS OF THE OLD DECLENSION.

(1.) Foreign nouns of the neuter gender, as also most of the masculines, are of the Old Declension.

(2.) Among the masculines must be noted those appellations of persons ending in the following terminations:—

al; as, Kardinal, cardinal.
ar; as, Notar, notary.
an; as, Kastellan, castellan.

To which may be added Abt, abbot; Propst, provost; Papst, pope; Bischof, bishop; Bürgermeister, mayor; Spion, spy; Patron, patron; Offizier, officer.

(3.) Some have, in the plural, the form er (e + r); as:—Hospital, hospital; Spital, hospital; Kamisol, waistcoat; Regiment, regiment; plur. Hospitäler, hospitals; Spitäler, hospitals, etc.

(4.) Some, in the plural, soften the radical vowels; as:—Abt, abbot; Altar, altar; Bischof, bishop; Chor, choir; Choral, choral-song; Hospital, hospital; Spital, hospital; Kanal, canal; Caplan, chaplain; Kardinal, cardinal; Kloster, cloister; Marsch, marsh; Morast, morass; Palast, palace; Pabst, pope; Propst, provost; plur. Aebte, abbots; Altäre, altars; Bischöfe, bishops, etc.

§ 18.—FOREIGN NOUNS OF THE NEW DECLENSION.

(1.) To the New Declension belong all foreign nouns of the feminine gender, and nearly all masculines which are the appellation of *persons*; as:—Der Student, the student; der Jurist, the lawyer; der Elephant, the elephant; der Dukat, the ducat; der Komet, the comet; der Planet, the planet; der Konsonant, the consonant; der Prinz, the prince; der Tyr......, the tyrant, etc.

§ 19.—FOREIGN NOUNS PARTLY OF THE OLD AND PARTLY OF THE NEW DECLENSION.

(1.) These are, *first*, neuters ending in siv; as:—Das Passiv, the passive; gen. Passivs, of the passive; plur. Passiven, the passives; *secondly*, titles of males in or; as:—Doctor, a doctor; gen. Doctors, of a doctor; plur. Doctoren doctors; *thirdly*, neuters ending in al, il, and um, which also often have i before the en of the plural; as:—Kapital, a capital; plur. Kapitalien, capitals; Fossil, a fossil; plur. Fossilien, fossils; Studium, study; plur. Studien, studies; *fourthly*, the following masculines:—Fasan, pheasant; Kapaun, capon; Konsul, consul; Pantoffel, slipper; Präfekt, prefect; Psalm, psalm; Rubin, ruby; Staat, state; Traktat, treatise; to which add Insekt, insect; Atom, atom; Pronom, pronoun; Statut, statute; and Verb, verb; which are neuters.

RECREATIVE NATURAL HISTORY.

SOME LAND, SEA, AND FRESHWATER SHELLS—WORMS, AND TUBE-DWELLERS (*continued*).

On the eggs deposited at the bottom of the thorn-coated tube by the oiketicus grub giving forth their tiny brood, the young worms immediately crawl forth, and at once proceed to spin silken sheaths for themselves. These they bear with them as convenient overcoats as they travel through the tangled and thorn-decked twigs and branches of the tree, feeding and gathering together such thorns as may be found adapted to castle-building purposes. These, as they are gleaned, are arranged in order, point downwards and side by side; a powerfully adhesive fluid and a layer of silken filaments completing the union. The growth of the worm is rapid, and it soon becomes large enough to fully occupy its bayonet house, and carry out the destiny we have already shown it as fulfilling. Of worms dwelling without the protection afforded by sheaths we shall find numerous examples in the earth, the river's bed, the sea's bottom, and in the tissues and cavities of living organisms.

Let us pay a visit to the clear, shell-strewn rock pools, and open stretches of tide-deserted sand, and should good fortune favour us, we shall find food for observation and research; and as we peer down into the clear water, or lift some weed-grown pebble or fragment of broken rock, some beautiful and marvellously perfect examples of the Creator's wisdom will be brought to light. Strange, weird, grotesque, and anomalous as some of these ocean creatures may, to the heedless or casual observer, appear, they only require the investigation of the observant and thoughtful to prove them worthy of our keenest interest and deepest admiration.

Down amongst the sea-weed stems and pointed rocks we perceive a long, black, tangled string, like a giant's leather bootlace set to soak; let us trace it in its various folds and twists, and disentangle some of it; we shall then have in hand a tough, slippery, india-rubber-like substance, which might well be pronounced a sea string, and classed with the long trailing weeds amongst which we have found it. A sea string it is, but not a weed; in fact, a living lasso, capable of consuming the prey it encloses within its treacherous folds. From twenty to thirty feet is no uncommon length for this artful animated fishing-line to reach, but its diameter rarely exceeds an eighth of an inch. It has a mouth, however, capable of considerable distension and holding power. What can appear more innocent than this delicate-looking creeper trailing here and there as the heaving water wells and flows as the tide comes in? Let an unwary tube-dweller, lulled into a false security, stretch forth its tentacles to meet the welcome wave, and a pointed head is adroitly insinuated. The mouth effects its tenacious grasp on the yielding tissues, and the tenant of the tube becomes food for the *Nemertes Borlasii*, for such is the name of this cord-like freebooter. Mr. Kingsley appears to have taken more than ordinary interest in the habits of this strange creature. Speaking of it, he inquires, "Is it alive? it hangs helpless and motionless, a mere velvet string, across the hand. Ask the neighbouring annelids, and the fry of the rock fishes; or put it in a vase at home, and see. It lies motionless, trailing itself among the gravel. You cannot tell where it begins or ends. It may be a strip of dead sea-weed—*Himanthalia lorea* perhaps, or *Chorda filum*—or even a tarred string. So thinks the little fish who plays over and over it, till he touches at last what is too surely a head. In an instant a bell-shaped sucker mouth has fastened to its side; in another instant, from one lip, a concave double proboscis, just like a tapir's (another instance of the repetition of forms), has clasped him like a finger. And now begins the struggle, but in vain. He is being 'played' with such a fishing-rod as the skill of a Wilson or a Stoddart never could invent; a living line, with elasticity beyond that of the most delicate fly-rod, which follows every lunge, shortening and lengthening, slipping and twisting round every piece of gravel and stem of sea-weed with a tiring drag, such as no Highland wrist or step could ever bring to bear on salmon or trout. The victim is tired now, and slowly yet dextrously his blind assailant is feeling and shifting along his side till he reaches one end of him; and then the black lips expand, and slowly and surely the curved finger begins packing him end foremost down into the gullet, where he sinks inch by inch, till the swelling which marks his place is lost among the coils, and he is probably macerated into a pulp long before he has reached the opposite extremity. Once safe down, the black murderer contracts again into a knotted heap, and lies like a boa with a stag inside him, motionless and blest." Our illustration represents the living line in the act of capturing its prey.

Here, then, to his siesta and the enjoyment of his ruthlessly gained spoils we will leave the *Nemertes Borlasii*, and see what that long-eared, brown, odd-looking, slug-like creature is, which we observe crouching like a hare in its seat just above the home of our greedy friend the worm. This is the sea-hare, or sea-cow (*Aplysia punctata*). The terms "hare" and "cow" have been given to it in consequence of the two horn or ear-like appendages to the head. It is curious sometimes to note how strangely appropriate some of these trivial designations are found to be. In this case the resemblance to a grass-feeding and ruminating animal extends beyond the mere fanciful contour of the creature's external form. The interesting researches of Professor Grant have brought to light the fact that the *Aplysia punctata*, like its fur-clad and horned namesake, the cow, has three stomachs, the first being formed by an opening out or dilatation of the bottom of the gullet. This food-sack is of a curved form, not unlike the air-chamber of a set of bagpipes; and in it is generally found the particles of freshly-gathered sea-weed on which our tiny cow has been feeding. The next or centre stomach is the smallest of the three, and performs much the same kind of duty as the gizzard of a bird; being, in fact, a sort of internal grinding mill, in which, by the aid of a set of hard, dense, and tooth-like processes, the food is comminuted, crushed, and pressed until in a fit condition to pass on to the third receptacle, which is of most curious construction, being furnished within with a rake or comb-like arrangement of teeth or spiculæ, which card and rake the ground-up substances, and fit them for the action of the gastric fluids and final digestion and assimilation.

Few marine productions have had a greater number of odd and wild superstitions associated with them than the *Aplysia punctata*. Some of these have no doubt arisen from the fact of its pouring out from its tissues, when placed in a goblet of water, a large quantity of a most peculiar fluid, which tinges the surrounding water of rich full purple tint; this, although beautiful to a degree, has been found to be too unstable and liable to change to admit of its being successfully made use of as an artist's colour. The term *depilans* has been conferred on one kind of sea-hare, from an idea which prevailed amongst the ancients, and is still in force amongst the coral-finders and fishermen of the Mediterranean, that wherever the fluid exuded by it touches the human head, the hair, being at once destroyed, falls off, leaving a bare spot; added to this, a variety of ailments, more or less formidable, were supposed to fall to the lot of any person rash enough to handle the much dreaded hare.

Bohadsch describes a most oppressive vapour or exhalation, which he says he found given off by the Aplysia when laid on a plate for investigation. Darwin speaks of his finding some of the hare family at the Cape Verd which possessed the power of causing a sharp stinging sensation to the fingers when brought in contact with the secretions they threw off. Amongst the ancient Romans the sea-hare was held in the most dire dread, and nothing was too baneful to lay to its door. It is related of Locusta that she made use of the sea-hare as one of her most potent ingredients in the preparation of the poisons destined to remove the secret enemies and plotters against Nero, and that at length, when fully conversant with the qualities of a hare potion, she prepared an extra strong one for the especial delectation of royalty itself. It will also, perhaps, be borne in mind that Domitian was openly charged with having given sea-hare poison to his brother Titus. Rigid laws were enacted prohibiting even the search after this dreaded slug of the sea, whose formidable qualities existed only in the fertile and perverted imaginations of those who preferred dread to investigation, and mythical romance to plain reality.

As we wander on, and prosecute our stone-mining operations, we shall scarcely fail to uncover one or more members of an exquisitely beautiful class of annelids, known as the pearly nereis (*Nereis margaritacea*). These curious creatures in form somewhat resemble small centipedes, but a little close scrutiny will serve to bring under the observation of the investigator a rich and varied collection of tints, pearl, opal, violet, and metallic green. Look closely along the line where, in a vertebrated animal, the back bone should be, and you will see a deep red linear marking, as though drawn beneath the skin with a red crayon. Mark its action closely, and you will see, at intervals of a few seconds of time, that it gradually fades from the sight, again dilates, ebbing and flowing as the tide of minute life wells through it. This is the creature's grand central blood-tube, or heart, conveying and propelling the red or arterial blood from behind forwards, whilst beneath the body another duct, equal in importance but not so plainly seen, conveys the blood through the system in the opposite direction. In addition to these two great longitudinal blood channels, there are four others, so arranged that one traverses above the intestinal canal, one below it, one on the right side, and another on the left. These are all placed in communication by branching or "anastomosing" vessels, running like the centre line in the letter H. Here, then, in this apparently insignificant worm, we have a beautifully perfect form of double circulation. Added to this, we find that the *Nereis margaritacea* is possessed of two pairs of eyes of a deep, rich blue colour; a pair of singularly formed and ball-tipped horns, and eight delicately fine and sensitive feelers, or whiskers, between which is situated a flexible and retractile proboscis, or snout, by the aid of which food is gathered from holes and crevices too small for the admission of the body of the worm.

THE LIVING LINE (NEMERTIS BORLASII).

As we travel onwards, where the ripple mark left by the receding tide still holds a silken thread of sea-water between its waved grooves, we shall see before us tiny heaps of sand cast up, as though some diminutive mole of moist habits had been at work below. Most of these will be found to be the work of a much larger member of the family of annelids, in form and habits closely resembling the *lumbricus*, or earth-worm of our fields and gardens; but we must reserve a consideration of them and their sea cousins, whose works we have just been examining, until our next lesson.

LESSONS IN ASTRONOMY.—VI.

THE SUN AND MOON—MOTIONS OF THE EARTH—ITS FIGURE—FLATTENING AT THE POLES—PROOFS THAT THE EARTH IS ROUND—HOW SUPPORTED IN SPACE—RATIONAL AND SENSIBLE HORIZONS.

THE great apparent size of the sun and moon, as compared with the rest of the heavenly bodies, often leads us to overlook them when we think or speak of the stars, and to regard them as belonging altogether to a different class. Hence we usually look upon astronomy as a science to be studied only by night, when in reality the star on which we are most dependent, and whose movements with regard to us are of the greatest importance, is the sun whose presence causes our day. We use the term "star" here advisedly, for the sun is in reality to be classed as one of the fixed stars, the reason of its great apparent size and brilliancy being merely that it is very much nearer to us than any of the rest, its distance being reckoned by millions of miles only, while that of even the nearest fixed star requires billions to express it.

The moon, though ranking next to the sun in its importance to us, is in reality the smallest of all our neighbours in space which can be detected by the unaided eye. It will, however, be at once understood that both it and the sun will, on account of their importance to us, claim a large share of our attention.

Now, as we have already stated, the sun, the moon, and all the stars appear to be in constant revolution around us, and most of the phenomena we referred to in our last lesson would be explained by imagining all these bodies to be fixed to the inner surface of a hollow sphere in the centre of which the earth was situated, and then supposing this sphere to be in constant rotation. One end of the axis on which it turned would in this case be close against the pole-star, and the other in the part of the sky diametrically opposite to it. This was, accordingly, for a long time the received notion, and it is the one which would naturally strike an observer at first, for the earth seems to be at rest, nor can we in any way by our senses discover that this is not the case. The reason of this is that motion is to us a relative idea, and if we ourselves and the objects around us are moving along together at exactly the same rate, we do not observe the motion. If, for example, we are seated in the cabin of a boat when the water is perfectly calm and the vessel is being propelled at a uniform rate, we are quite unconscious of the movement. If, however, the motion be not uniform, but consist of a succession of jerks and shakes, as when travelling in a railway train, or if we look on the fixed and stationary objects around, we shall soon become conscious of the fact that we ourselves are being carried along. Now, as the motion of the earth is perfectly uniform, and all terrestrial objects, including the air, move with it, it is only by looking to the stars that we become conscious of our movement.

We cannot here go into all the reasons which prove that this is the case, but we can easily see enough to satisfy any thoughtful mind. We have only to look at the earth as a globe about 8,000 miles in diameter, and to remember that the diameter of the sun is 111 times as great, and that all the stars are large globes situated at enormous distances from us, and then ask which is the more probable, that these mighty orbs should all travel at an utterly incredible speed around this small globe on which we live, or that the earth should itself turn round on its axis? If the former is true, the more remote stars must dash through billions of miles in a single second of time, and all the rest must be in rapid motion, round a body very much smaller than themselves; by the latter theory, all this is done away with, and we simply see the earth rotating so that a spectator on its surface is turned in the course of a day and night towards all parts of the sky.

Having thus settled in our minds the fact of the motion of the earth on its axis, we must next inquire as to its shape. To some this may seem a question pertaining rather to geography than to astronomy. It is, however, intimately connected with both sciences; and, as the earth is our stand-point of observation, it is of paramount importance to understand something about it first of all.

The form of the earth, then, is almost spherical, but not absolutely so; for it is somewhat flattened at the poles, so that a section passing through them would be slightly elliptical instead of circular. This deviation from the spherical form is, however, very slight; so slight, indeed, that it would not be seen in any model that we could make. Suppose, for instance, we made a globe with a diameter of thirty inches, the difference would only be $\frac{1}{10}$ of an inch, too small for even the keenest eye to detect.

The real dimensions are almost as follows:—

Greater or Equatorial Diameter . . .	7925½ miles.
Lesser or Polar	7899 „

showing a difference of a little over twenty-six miles.

Several important effects arise from this. The surface of the earth near the equator is, of course, further from the centre than the surface near the poles; and as the attraction of gravitation diminishes with the increase of distance, it is weaker at the equator than it is further north or south.

If a pendulum be accurately adjusted so as to beat seconds in the latitude of London, and then be moved further south, it will, from this cause, beat more slowly. So likewise, if a spiral spring be suspended from a hook and a weight hung from its lower end so as just to touch the stand, it will be found, if we convey it carefully, that as we approach the equator the spring will be somewhat shortened, and the weight will no longer touch the stand as it did before; the weight, in fact, appears to be less than it was in the higher latitude.

Fig. 5.

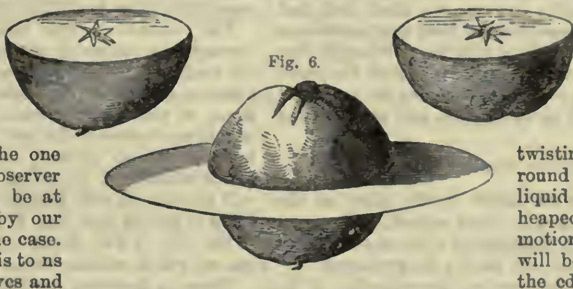


Fig. 6.

A little consideration will soon show us the cause of this flattening of the earth. If we suspend a child's pail, filled with water, by a piece of string, and then by twisting the string cause it to turn round rapidly, we shall at once see the liquid leaving the centre and becoming heaped up against the sides, and, if the motion be sufficiently rapid, a portion will be thrown off and scattered from the edge. A similar but more conclusive experiment may be tried with a common hoop, which for this purpose should be made as thin as possible. Let it have two holes drilled through its sides opposite to one another, and let it be placed vertically on a pivot in such a way that it can be caused to rotate rapidly; the upper side, however, must not be fastened to the pivot. On spinning it rapidly, it will at once be seen that the hoop becomes longer and flatter from the action of centrifugal force upon it.

The same reasoning applies to the earth. It is a body in rapid rotation on its axis, and hence there is a tendency in all the particles of matter composing it to become heaped up at the equator, for the motion there is manifestly more rapid than at the other parts of its surface. Careful calculation confirms this theory, by showing that the difference between the two diameters of the earth is just the amount that would be produced by this cause.

There are many familiar proofs of the rotundity of the earth. One of the simplest of these is afforded by watching the departure of a vessel from a seaport town. As a large object is always visible at a greater distance than a small one, we should naturally expect that the masts and rigging would disappear first in the distance, while the hull would be the last thing to fade from sight. Observation, however, soon shows us the contrary. The whole ship remains visible till it has left the shore some little distance, and then it seems to be gradually sinking; the lower part of the hull being the first to disappear, and then the bulwarks, while the tops of the masts are the last things hidden, as seen in Fig. 5, which is, however, purposely exaggerated. The reason of this evidently is that something is interposed between the observer and the vessel, and that something is the bulge or curve of the earth's surface. When the hull has just begun to disappear from a person standing on the surface of the ground. the whole will be visible to an observer on an elevated building; and if there be a lofty mountain near by, the vessel will be seen from this after every portion of it is hidden from those on the beach. This shows that the surface of the earth is curved, and, in fact, a rough estimate of the size of the earth may be formed in this way. We have only to fix upon two elevations of equal height—as, for instance, marked places on the masts of two vessels—and ascertain the exact distance at which they are hidden from one another by the curvature of the earth. We must know also the elevation of the places on the masts above the level of the sea, and then by a simple proportion we shall obtain the diameter of the earth. The question will be stated thus:—As the height of the station of observation is to the distance of the visible horizon (which is half the distance between the two stations), so this distance is to the diameter of the earth.

There are considerable difficulties attending this plan, which prevent our arriving at very accurate results by it. When it is tried at sea, there is great difficulty in ascertaining the exact distance of the vessels, as well as in choosing a day when the surface of the water is sufficiently smooth; and on land it is seldom that a large tract can be chosen sufficiently level to answer the purpose, as, even in large plains, there are frequently undulations or slopes which would materially interfere with the accuracy of the results. In addition to this there is another cause of error introduced by the action of the air on the rays of light, or, as it is termed, *refraction.* The effect of this is, as will shortly be seen, to bend the rays out of their straight course, and thus to render the object visible when in reality the curvature of the earth intervenes between it and the observer. It enables us, in fact, to see to a certain extent round the bend.

From these causes, this plan of measuring the earth has not been fully carried out. Roughly, however, we shall find that two places elevated ten feet become hidden from one another at a distance a little under eight miles; that is, a straight line drawn from one of these to the other would just touch the earth midway between them. The curvature, then, may be set down as ten feet in three miles and seven-eighths, and we state our sum in the following way:—

As 10 feet : $3\frac{7}{8}$ miles : : $3\frac{7}{8}$ miles : diameter of the earth.

We shall find that this gives us about 8,000 miles as the diameter of the earth, which is not far from correct. The more accurate mode of ascertaining its dimensions is by measuring an arc of the meridian in a way that will shortly be explained.

There is another very conclusive proof of the rotundity of the earth which should just be referred to—namely, that afforded by the shape of its shadow. The earth is an opaque body, and must therefore throw a dark shadow; but the shape of this can only be seen when there is some object on which it can be thrown. Now, there is only one object which ever comes near enough to us to receive this, and that is the moon. We must wait, therefore, till the moon comes directly in a line with us and the sun, and then we shall see the shadow. Now when this happens, it is called a lunar eclipse; and if we watch the moon as it enters the shadow of the earth, and again as it leaves it, we shall find that the dark line is always curved to an arc of a circle. The earth, therefore, must either be a globe or a flat circular disc; and at first sight we might incline to the latter view, and imagine, with some of the ancients, that we dwelt on a flat surface like the top of a round table. When, however, we notice that, in whatever position we happen to be with regard to the sun at the time of an eclipse, the shadow is *always* circular, we soon are assured that the earth must be globular, as no other figure would always cast a circular shadow.

Having clearly realised the fact of the earth's rotundity, we have next to look upon it as a body suspended freely in space without any support. According to ancient ideas, Atlas bore up the world on his shoulders; and many of the Hindoos of the present day assert that it is supported by a serpent and a tortoise. It is clear, however, that these attempted solutions of the difficulty only remove it one step further, for we should have to seek some support for the man or the serpent. The real difficulty arises from our not clearly understanding that the reason why a body falls to the earth is simply because the earth has an attraction for it. Hence, if we want to sustain any object some distance above its surface, a support of some kind must be used to resist this attraction.

Now the only body which exerts a sufficiently powerful influence on the earth to have much effect is the sun: to it, accordingly, the earth would speedily fall were it not that its own momentum in its orbit is just sufficient to overcome this attraction. These two forces are so beautifully balanced that under their joint influence the earth moves evenly round in its elliptical orbit. At a certain part of the year—namely, in the middle of winter—the earth is nearer the sun than at any other time; and, as we saw in our lessons on Mechanics, attraction increases inversely as the square of the distance, the attraction of the sun is therefore greater at this period, and we should at first expect that since this is the case, the earth would approach it nearer and nearer with ever-increasing speed, till at last the momentum would be quite overcome, and it would fall into the sun and be consumed.

No such result, however, happens, for as soon as the earth begins to approach the sun, it is, as it were, rolling down hill; its speed, therefore, increases, and with this its momentum, so as to more than overcome the increased attraction; and thus the earth, having passed the end of the ellipse, begins to recede again. During the next half of its orbit it is receding from the sun, which is therefore drawing it back, and checking its speed; so that gravitation again becomes the more powerful force, and the earth commences again to approach the sun. In this way the two forces alternately preponderate, and by their joint action the earth constantly keeps to its orbit.

Let us, then, all through our lessons bear in mind these facts —that the earth is an almost spherical body, rotating constantly on its axis, and that it is suspended freely in space, while it describes its journey round the sun in the course of a year.

As we have several times spoken of the horizon, it will be well for us distinctly to know what we understand by it, as sometimes there is a little confusion on this matter.

The *rational* or true horizon is an imaginary plane drawn through the centre of the earth, so that the line where it cuts the surface is everywhere equidistant from the observer. If we take an orange or an apple, and divide it into two equal portions, or place a ring round it as shown in Fig. 6, so that it is midway between the eye and the stalk, it will represent the horizon. In an ordinary celestial globe, if the pole be elevated to the latitude of the place, the situation of the wooden horizon will correspond with that of the rational horizon to the observer. Thus it will be seen that if this plane be extended on all sides to the sky, it will divide it into two exactly equal hemispheres, one of which will be visible to the observer.

There is, however, another sense in which the word horizon is used. On ascending any height a line will be seen all round us, where the earth and sky appear to touch, and this is called the *sensible* or visible horizon.

At sea, or on a level plain, this line will be seen to be a perfect circle; on land, the elevations of the country usually interfere with the outline: still we can perceive that it is of a circular form, and that our point of observation is situated exactly in the middle of it.

The size of this circle increases with our elevation above the earth. Hence, when a sailor wants to know if any vessel is in sight, he ascends to the mast-head, where his view is much more extensive than if he had remained on the deck of the vessel. In the same way, if we ascend any lofty mountain, we gain a very extensive view of the country round. If we could be placed at a great distance from the earth—as, for instance, on the surface of the moon—we should see just one-half of the globe, and the rational and sensible horizons would then exactly coincide. This, of course, cannot be, and the highest elevation ever yet reached by man, or that in all probability ever will be attained, is so small in comparison with the diameter of the earth, that only a small portion of the earth has ever been visible at once. The largest amount ever thus seen was by Messrs. Coxwell and Glaisher, when they attained in a balloon an elevation of about six and a-half miles, and then about $\frac{1}{1250}$ of the surface of the globe was in sight.

The following general rule will enable us to calculate approximately the distance of the visible horizon when the height of the station of observation is known:—Express the height in feet and increase it by a half, then extract the square root, and this will give the distance in miles. Thus. if a tower be 18 yards high, we call it 54 feet, then add 27 to it, making it 81; the square root of which is 9. The visible horizon is therefore distant nine miles.

We have spoken of the earth as being round, but some will perhaps call to mind the elevated mountain ranges and table-lands on the one hand, and some deep depressions on the other, and imagine that these interfere with the general shape. If we remember, however, what a small proportion these amounts bear to the actual diameter of the earth, we shall see that they in no way interfere with its general outline. The greatest elevations are only about five miles, and there are only a few of these, while the diameter of the earth is about 8,000 miles. If, then, we would accurately represent these on a globe having a diameter of 16 inches, we must make them $\frac{1}{100}$ of an inch high; they might, in fact, be well represented by small grains of sand. The thinnest tissue-paper would fully represent the elevation of table-lands, and minute scratches, almost invisible without a microscope, would show the valleys of rivers or mountain gorges. For all ordinary purposes, then, the earth may be considered as absolutely spherical.

LESSONS IN ITALIAN.—XVIII.

THE PREPOSITION *IN*.

THE preposition *in* denotes being, continuance, or motion *in the interior* of a thing. It also denotes any kind of motion or penetration *into* it. The idea of existence *in a time* or *in a certain condition*, particularly *in a certain state or disposition of the mind*, likewise requires the use of *in*. The preposition *a*, on the contrary, merely expresses presence *near* or *about* a thing, or motion, approach, and tendency *to* it. For example:—

E'-gli è nel giar-dí-no, in quél-la cá-me-ra, in cit-tà, in piáz-za, he is in the garden, in that room, in the town, in the square.

E'-gli an-drà in In-ghil-tér-ra, in I-spá-gna, he will go to England, to Spain.

Nèll' án-no míl-le sét-te cén-to, in the year 1700.

Sog-gior-nò al-quán-to in Ró-ma, he stayed a while in Rome.

Ge-sù Crí-sto ná-cque in Be-te-lém-me, Jesus Christ was born in Bethlehem.

E'-gli mo-rì nel míl-le tre cén-to, he died in 1300.

Im-mér-ge-re ú-no nell' á-cqua, to plunge one in the water.

E'-gli é-ra qui in quest' i-stán-te, he was here (in) this moment.

E'-gli è in a-go-ní-a, he lies in the agonies of death.

És-se-re in cól-le-ra, in gió-ja, in af-fli-zió-ne (*i.e., nél-lo stá-to di cól-le-ra, di gió-ja, di af-fli-zió-ne*), to be angry, cheerful, sad (*i.e.*, in a state of anger, joy, affliction).

A-vér quál-che có-sa in bóc-ca, in má-no, to have something in one's mouth, in one's hand.

És-se-re, stá-re in cam-pá-gna, to be, reside in the country.

An-dá-re, en-trá-re in ú-na chié-sa, to go into, enter a church.

Ca-scá-re in ú-na fós-sa, to fall into a pit or hole.

Mét-te-re le má-ni in tá-sca, to put or thrust one's hands into one's pocket.

Me-ná-re il ca-vál-lo in i-stál-la, to lead a horse into the stable.

Sa-lí-re in cá-me-ra, to go up into the room.

Vi-vé-va in un sé-co-lo di bar-bá-rie, he lived in an age of barbarity.

I have already remarked that the proper names of towns and similar localities are exceptions to the above-stated rule, for they have the preposition *a* as well as *in* placed before them, whenever a stay or arrival *in* them is expressed; for example, *é-gli stét-te per tre án-ni in* (or *a*) *Ró-ma*, he lived for three years in Rome; *la stá-te pas-sá-ta i-o stét-ti dú-e mé-si a* (or *in*) *Fi-rén-ze*, last summer I lived two months in Florence. There is, however, a shade of difference between the employment of *a* and *in* in such cases, which will be at once understood by the following examples: *è in Lón-dra*, in the strictest sense of the word, means a person being or an occurrence taking place within the precincts properly called London; while *è a Lón-dra*, in the more enlarged or general meaning of the word, means a person not necessarily being in, or an occurrence not necessarily taking place within those precincts, but perhaps in the neighbourhood of London—*e.g.*, Kensington.

The motion to or towards a *town* or *village*, conformably to the nature of the preposition, is always expressed by *a*. Motion to or towards (and, naturally, being or staying *in*) *parts of the world, countries, provinces, and islands*, requires the preposition *in*. For example:—

An-diá-mo con lui a Pie-tro-búr-go, let us go with him to St. Petersburg.

E'-gli par-tì da Mó-na-co per re-cár-si a Vi-én-na, he departed from Munich to go to Vienna.

I-o vá-do in I-scó-zia, in I-své-zia, I go to Scotland, to Sweden.

Il Ba-scià fu e-si-li-á-to nell' í-so-la di Cí-pri, the pasha was exiled to (the island of) Cyprus.

E'-gli è in Frán-cia, nél-la Chí-na, he is in France, in China.

Ná-cque nell' í-so-la di Lé-sbo, he was born in the island of Lesbos.

Usage allows the omission of the article after *in* before many nouns familiarly known and constantly recurring in conversation; for example, *é-gli va nél-la cá-me-ra, nél-la cit-tà, nél-la chié-sa, nél-la can-tí-na*, etc.; or, *é-gli va in cá-me-ra, in cit-tà, in chié-sa, in can-tí-na*, etc., he goes to the room, to town, to church, to the cellar, etc.

Before the words *day, week, month, year, morning, evening*, when *time* is the subject, it is customary to omit the preposition *in*; for example, *l' án-no che mo-rì il Ga-li-lé-o, ná-cque il Newton*, in the year in which Galileo died, Newton was born; *il mé-se ven-tú-ro*, (in the) next month; *la set-ti-má-na scór-sa*, (in the) last week; *la nót-te che vié-ne*, (in the) next night, etc.; instead of *nell' án-no, nel mé-se*, etc.

The words *cá-sa, cór-te, pa-láz-zo, teá-tro, lét-to*, and *scuó-la* have a proper or original and a figurative signification. In the former case they demand the preposition *in*; in the latter, the preposition *a* (without an article) before them. For example:—

E'-gli è nél-la cór-te, nel pa-láz-zo, in teá-tro, in lét-to, in i-scuó-la, in cá-sa.	He is in the court-yard, in the palace, in the theatre, in the bed, in the school (*i.e.* building), in the house.
E'-gli è a cór-te, a pa-láz-zo, a teá-tro, a lét-to, a scuó-la, a cá-sa.	He is at court, at Guildhall, at the play, sick in bed at school, at home.
I'-o vá-do nél-la cór-te, nel pa-láz-zo, nel teá-tro, nel lét-to, nél-la scuó-la, nél-la cá-sa.	I go into the court-yard, into the palace, into the theatre, into the bed, into the school (*i.e.* building), into the house.
I'-o vá-do a cór-te, a pa-láz-zo, a teá-tro, a lét-to, a scuó-la, a cá-sa.	I go to court, to Guildhall, to the play, to bed (*i.e.* to sleep), to school, home.

In addition to these uses, *in* has some indefinite meanings, which will admit of several prepositions or adverbial expressions for the purpose of translating them into English. For example, by *in*:—

No-mi-ná-re, dí-re quál-che có-sa in la-tí-no, to name, say something in Latin.

Spe-rá-re in Dí-o, to hope in God.

In ma-nié-ra tá-le, in such a manner.

By *on* or *upon*:—

Por-tá-re quál-che có-sa in dós-so, in té-sta, in cór-po, to carry something on one's back or shoulders, or about one's self, on the head, on the body.

Por-tá-re scár-pe in pié-di, to wear shoes on one's feet.

By *round*:—

Gli git-tò il brác-cio in cól-lo (for *in-tór-no il cól-lo*), he clasped him with the arm round his neck.

Més-so-li ú-na ca-té-na in gó-la (for *in-tór-no la gó-la*), after having put a chain round his neck.

By *to*:—

Le cac-ciò di cól-le in cól-le, he chased them from hill to hill.

Di tém-po in tém-po, from time to time.

Con-fic-cá-re in ú-na cró-ce, to fasten or nail something to a cross.

By *towards*:—

In me mo-vén-do de' bé-gli óc-chj i rá-i, turning towards me the rays of her beautiful eyes.

By *against*:—

Ví-de in se ri-vól-to il pó-po-lo, he saw the people rebelling against him.

By *at*:—

Guar-dá-re in ú-no, to look at one.

By *in place of*:—

A-dot-tá-re ú-no in fi-gliuó-lo, to take one in place of a son, to adopt one.

By *as*:—

Dá-re quál-che có-sa in dó-no ad ú-no, to give one something as a present.

Dí-re quál-che có-sa in sú-a scú-sa, to plead something as one's apology or excuse.

O Dí-o, non m' im-pu-tár-lo in pec-cá-to, O Lord, do not impute it to me as a sin.

By adverbial expressions :—

In av-ve-ní-re, in future, for the future, henceforth.
In fát-to, indeed, iu fact, in reality.
In frét-ta, in a hurry, hastily.
In ó-gni cón-to, at auy rate, at all events.
In fác-cia, to one's face.

VOCABULARY.

Abitava, he lived.
Adesso, now.
Alquanto, m., *alquanta*, f., some, several.
Anno, year (*il fior degli anni* or *dell' età*, the bloom of youth, flower of life, prime of one's age).
Antonio, Anthony.
Avete avuto, you have had.
C' è nissuno, there is nobody.
Camera, chamber, room
Campagna, country.
Cantina, cellar.
Capacità, ability, talent, skill.
Carrozza, coach, carriage.
Carta, f., paper (*carta pecora*; vellum).
Collera, anger.
Copia, f., abundance, plenty; occasion; copy.
Cortile, court-yard.
Cucina, kitchen.
E' andato, he is gone.
E' partito, he has departed.
E qui l' aspetto, and here I wait till he comes.
Egli va, he goes.
Essi sono sortiti, they have gone out.
Fiore, flower, bloom, prime.
Fretta, haste, hurry, precipitatiou.
Io mi riposo, I repose myself, sit dowu; I rely.
Letto, bed.
Lo prevenni, I came before him.
Lo trovai, I found him.
Mano, f., hand.
Me, me.
Morirono amendue, both died.
Ora, hour.
Osteria, public-house, tavern, inn.
Piazza, market-place, square.
Piede, foot, leg (*punta del piede*, end or point of the foot, *i.e.*, toe).
Porto, port, harbour.
Potremo andar, we shall be able to go.
Punta, point (of anything).
Punto, point, point of time, moment.
Quasi, almost, nearly, well nigh.
Scozia, Scotland.
Se ne parla, they talk of it.
Se ne stamperanno, will be printed.
Siete, you are.
Slitta, sledge.
Sono, I am.
Stanza, f., room, chamber.
Teatro, theatre, playhouse.
Tempo, time, leisure, weather.
Tu eri, thou wast.
Turchia, Turkey.
Vi è andato, he is gono there.
Viaggio, journey.
Vícino, m., *vicina*, f., neighbouring, contiguous, adjoining, adjacent.
Villegiatura, summer season, for pleasure or recreatiou spent in the country (*essere in villegiatura*, to spend the summer season in the country).
Voi sietc, you are.

EXERCISE 18.

1. E'l-la è nél-la stán-za vi-cí-na. 2. Só-no quá-si in pôr-to. 3. E'-gli è in A'u-stria, in I-tá-lia, in cam-pá-gna, in vil-leg-gia-tú-ra. 4. E'-gli va nel giar-dí-no; in quél-la cá-me-ra; in Frán-cia; in cam-pá-gna; in I-scô-zia; in Tur-chí-a. 5. Mo-rí-ro-no a-men-dú-e in un giór-no e in un' ó-ra. 6. Tu ê-ri in chiê-sa. 7. C' è nis-sú-no in cá-sa? 8. E'-gli è nel cor-tí-le, nél-la cu-cí-na, nél-la can-tí-na. 9. E' an-dá-to in chiê-sa, in cit-tà, in piáz-za, in o-ste-rí-a, in teá-tro. 10. A-bi-tá-va in quél-la cá-sa. 11. Lo tro-vá-i in lêt-to. 12. An-tô-nio è in côl-le-ra con me. 13. Se ne pár-la in tút-ta la cit-tà. 14. E' par-tí-to in frét-ta. 15. Vi è an-dá-to in car-rôz-za. 16. Do-má-ni po-tré-mo an-dár in i-slít-ta. 17. E's-si só-no sor-tí-ti in qué-sto pún-to. 18. A-dês-so siê-te nél-le mí-e má-ni. 19. Lo pre-vên-ni in pún-ta di piê-di e qui l' a-spêt-to. 20. I'-o mi ri-pô-so nél-la ca-pa-ci-tà di mí-o fra-têl-lo. 21. Al-quán-te cô-pie se ne stam-pe-rán-no in cár-ta pe-cô-ra. 22. Voi siê-te nel fiór dé-gli án-ni. 23. A-vé-te a-vú-to bêl têm-po nel vô-stro viág-gio.

EXERCISE 19.—COLLOQUIAL.

1. My uncle's garden is very large. 2. We have seen thy father's table and bed. 3. Have you found thy father's umbrella? 4. I have received this cloak from my aunt. 5. Have you received a book from this child? 6. We have lent our umbrella to your brother. 7. Have you found this pen in your school? 8. We have written a letter to our uncle and to our aunt. 9. Your mother has given a cap to my sister. 10. Have you seen a little child in our garden?

VOCABULARY.

Agreeable company, *ag-gra-dé-vo-le com-pa-gní-a*, f.
Auger, *côl-le-ra*, f.
Book, *lí-bro*, m.
Castle, *ca-stêl-lo*, m.
Cellar, *can-tí-na*, f.
Consolation, *con-so-la-zió-ne*, f.
Count, *cón-te*, m.
Direction, *in-di-ríz-zo*,
Drunkenness, *ub-bria-chéz-za (ts)*, f.
Find, *tró-va-no*.
Fine weather, *bêl têm-po*, m.
Has gone out, *è u-scí-to*.
He hid, *é-gli na-scó-se*.
Hope, *spe-rán-za*, f.
In some respects, *per di-vêr-si ri-guár-di*.
Is not, *non è*.
Is there nobody? *c' è nis-sú-no?*
Key, *chiá-ve*, f.
Kitchen, *cu-cí-na*, f.
Man, *uó-mo*, m.
Means, *mêz-zi*, m.
Never is better known than, *non si co-nó-sce má-i mê-glis che*.
Passes very quickly, *pás-sa as-sá-i prê-sto*.
Play, *giuó-co*, m.
Room, *cá-me-ra*, f.
Shall we go to take our breakfast? *vo-gliá-mo an-dá-re a far co-la-zió-ne?*
She must either have gone—or, *êl-la sa-rà an-dá-ta o—o*.
Steward, *fat-tó-re* (or *ca-stál-do*), m.
Summer-house, *ca-si-nét-to*, m.
That sideboard, *quell' ar-má-dio*, m.
This moment, *qué-sto pún-to*, m.
This note, *quê-sto bi-gliét-to*, m.
Time, *têm-po*, m.
To become learned, *per di-ve-nír dót-to*.
Unfortunate, *in-fe-lí-ce*, m.
We find, *si tró-va-no*.
You have had, *voi a-vé-te a-vú-to*.
You will have, *voi a-vréte, ella avra.**
Your journey, *il vô-stro viág-gio*, m.

EXERCISE 20.—COLLOQUIAL.

1. The unfortunate find consolation in hope. 2. In books we find the means of becoming learned. 3. Your sister is not in the room, she must either have gone into the kitchen or into the cellar. 4. Shall we go to take our breakfast in the summer-house? 5. In an agreeable company time passes very quickly. 6. Is nobody in the castle? 7. No, the steward has gone out (*in*) this moment. 8. You have had fine weather for your journey. 9. You will have in this note the count's direction. 10. He hid the key in that sideboard.

KEY TO EXERCISES IN LESSONS IN ITALIAN—XVII.

EXERCISE 15.

1. He has returned from the wood. 2. He has already departed from Naples. 3. I am betrayed by you, by all. 4. He is descended from a uoble family. 5. Far from my parents. 6. Ou whom do you depend? 7. One does not distinguish the one from the other. 8. He has not yet gone out of the city. 9. He descends, he falls from the roof. 10. The water flows down the mountain. 11. Everywhere. 12. From one side. 13. They did not want to go out through this place. 14. She returned lately from Prussia. 15. He is from Glasgow. 16. I have been to my sister. 17. To-day I shall dine at the merchant's. 18. After dinner I shall go to him. 19. He came this morning to me. 20. He lives (lodges, resides) at his father's (*or* in his father's house, or with his father).

EXERCISE 16.

1. Where have you lost your book? 2. In this garden. 3. My father has received a letter from our aunt. 4. Hast thou received this present from thy sister? 5. My mother has bought this cap from your sister. 6. The penknife which we have received from our uncle is good aud handsome. 7. I love my sister. 8. This mother loves her son. 9. I think of my brother. 10. My aunt thinks of her son and daughter. 11. This child has written a letter to his mother. 12. My uncle has sold his beautiful horse to my father. 13. I have given my penknife to my sister. 14. Have you lent your umbrella to my brother? 15. Our aunt's son is very tall. 16. We have written a long letter to our father. 17. My aunt has received this cap from her daughter. 18. Have you sold your snuff-box to my father? 19. I have lent to thy brother the penknife which I have received from my uncle. 20. We have given a cloak to this child. 21. Hast thou lent thy book to this good child? 22. Have you found this pen in the school? 23. I think of this son and of this daughter.

EXERCISE 17.

1. Egli viene dalla cavallerizza e non dal giardino. 2. Da Amburgo a Parigi ci sono cento novanta miglia francese. 3. Osfordia uon è lontano da Londra. 4. Vien' egli dalla bottega? 5. Non, Signore, egli viene dallo scrittojo. 6. Venite voi dalla commedia? 7. No, veuiamo dal ballo. 8. I mobili del Signor Hall sono stati venduti da suoi eredi. 9. Venite voi dal giardino? 10. No, Io vengo dal caffè. 11. Dónde vengono questi signori? 12. Alcuni ritornano dalla caccia, altri dal passeggio, e questi ultimi dalla pesca. 13. Ecco il danaro che mi è stato spedito dal padre. 14. Questo dipende dalla madre, e non dal fratello. 15. Il passaggio dalla virtu al vizio è assai piu corto che non è il passaggio dal vizio alla virtu. 16. Io aspetto una risposta da Giovanui; egli è gia stato tre mesi in Loudra. 17. Guglielmo è ritornato oggi da Parígi, e suo fratêllo viêne a spettato da Cambrigge.

HISTORIC SKETCHES.—XLV.

ALVA'S MASTER.—THE NETHERLANDS.

MANY a stout heart quailed, and many a brave man feared, in the cities of the Netherlands, when it was known there, towards the close of the year 1567, that Ferdinand, Duke of Alva, was coming with an army from Spain to assume the government of the provinces. Under the regency of the Duchess of Parma, daughter of their beloved Charles Quint (Charles the Fifth,

* This second form, in which the third persou singular feminine is used for the second person plural, is inteuded to express respect or politeness.

Emperor of Germany, King of Spain and the Indies, Duke of Burgundy and the Low Countries), they had lived contented enough, save that occasionally they complained of the number and weight of the taxes, and resented grumblingly any attack that was made upon their old commercial and municipal privileges. They adored the memory of Charles the Fifth, the grandson of their own Mary of Burgundy. Charles had dwelt among them, known them as it were intimately, preferred to live in their country rather than in any other spot in his dominions, and ever got back to it again as soon as he could when the exigencies of public business took him out of it. His rule was kindly, though it did not brook rebellion, but then no one wanted to rebel against Charles Quint. Under his rule the Netherlands were happy and flourishing, more so than they had been at any previous period of their history. When he abdicated in favour of his son, Philip II. (in 1556), and it was found that the new king intended to live in Spain, the Netherlanders thought themselves fortunate in having so Charles Quint-like a resident ruler as Charles's daughter, the Duchess of Parma.

Notwithstanding that she was obliged, in order to carry out Philip's policy, which was much less liberal than his father's, to govern the people somewhat more sternly than they had been wont to be governed, the duchess was popular enough; and as she had many ties of sympathy with the people, she was a guarantee to the Netherlanders that so long as she ruled they would not be oppressed.

But the Duke of Alva! That was a very different matter. Although his name was not so famous, or infamous, as it became after he retired from the Low Countries, it was known to the people as that of a bigoted Spanish soldier, who had narrow ideas of his duty, but a tremendous energy in carrying out those ideas—as the name of one who made no secret that he considered his highest duty to God and man was to root out heresy wherever he had the chance, not stopping to criticise the means adopted, so the end were attained. Well might the Lowlanders fear when such a man was coming, with a numerous and well-appointed army at his back, to supersede the duchess-regent. They knew not what instructions he carried, what power his commission gave him, but they could read the signs of the times as well as any statesman in Europe, and they saw in Alva and the Spanish army nothing but oppression, and most likely bloodshed, to come. The political and municipal institutions of the country were far too free to be to the liking of an absolutist like the King of Spain or his lieutenant, and the people feared lest assaults should be made upon those institutions accordingly. But still more they feared for what the new governor might bring against that freedom to worship God according to the dictates of their consciences, which they had hitherto virtually enjoyed.

With very many of the Netherlanders the doctrines of the Reformation had found a cordial welcome, so that it is not perhaps exceeding to say that one-third of their number were Protestants. Charles the Fifth, himself a rigid Catholic, half allowed, while he disapproved, the spread of the Reformation among his people. No persecuting measures had been taken to secure uniformity during his reign; and though the Catholics complained of toleration, and did what they could to stir up war against it, the Protestants were allowed to meet in their own places of worship. But now it was felt—and there had been several straws showing which way the wind was likely to blow—that all this was about to be changed. What had been attempted in France was to be attempted in the Netherlands, and, as it seemed, with much better chances of success. The Inquisition was to be imported as part of the baggage of the Spanish army, and the Protestants of the Low Countries were to be brought into slavery by it. In France, where the Huguenots numbered over two millions, and included among their ranks some of the most influential of Frenchmen, the attempts of the League—with its Guises, its Lorraines, and its Mayennes—to thrust the Inquisition upon the land, were met by a stubborn organisation of singularly brave men, who had moreover the countenance, and could procure the material support, of several foreign powers, enemies to their enemies.

In the Netherlands there was not any such organisation, at least not then, nor was there, as it seemed, the slightest prospect of one being formed. It seemed at first sight that the provinces were utterly at the mercy of the Spaniards, men in whose composition the quality of mercy was left out—bigots, sincere in their bigotry, and cruel by their nature against everything that thwarted it. Only those whose trust was not in the arm of flesh only, who believed indeed that there was a God who judgeth the earth, One who could "mock the counsel of the wise and valour of the brave"—only such men did not despair. Long and bitter was the struggle, dark and frightful was the night, but with the morning came joy, albeit a subdued one, and the result of the struggle was to show the world once again that the victory is not always to the strong.

Alva came, the Duchess of Parma was superseded, and the worst fears of the Netherlanders were justified. Both in politics and religion their liberty was to be taken away, and that by means which showed an almost brutal indifference to all their tenderest susceptibilities. The system of local self-government was changed for government by soldiers, troops were quartered in all the large towns, and the smaller places followed of necessity the example of submission into which their larger brethren were surprised. The Netherlands were occupied as a hostile country; the irresponsible prerogative of martial law was substituted for the known laws of the land; and the harshness and insolence of military commanders usurped on the judgment-seat the place of magisterial calmness and equity.

This was meant only as a foundation on which to build the hateful Inquisition. When the people were bound hand and foot by an army, it was supposed they might be made to accept this darling project of Philip. But there was a limit to the patience even of the Dutchmen and Belgians.* There was a line over which they could not be pushed without resistance; and when the people found that the Inquisition was among them, they rose in spite of the presence of the Spanish soldiery, so that throughout the provinces there was nothing but tumult. It was a state of things well pleasing to Alva, whose cruel disposition took delight in the prospect of dragooning the people into submission, of getting rid, by the way, of sundry inconvenient nobles, and at the same time of doing what his bigotry told him was a service acceptable to God, viz., the punishment and eradication of heresy.

Alva's powers were of the fullest. There was no need to send to Madrid for instructions, though reinforcements were demanded and sent. The risings which took place in most of the large towns were put down with Spanish cruelty; men were hanged summarily over their own doors; the prisons were not crowded, for the Spanish system was too "thorough" to be hampered with prisoners, its judicial procedure too simple to be fettered with a sliding scale of punishments according to offences, and so Death got his due, and more; and there was mourning of widows and orphans wherever the Spanish officers set up their courts. These first risings were the expression of spontaneous, natural resistance to tyranny, not the result of organised rebellion. The Netherlanders formerly, under their counts and dukes, had been so tetchy and independent as to have acquired a notoriety in Europe as the most rebellious and unmanageable of subjects, and had dared on several occasions to provoke and resist the wrath of so hard and haughty a lord as Charles the Bold, of Burgundy. But under more judicious and larger-hearted government, especially that of their now persecutor's father, they had forgotten the art of factiousness, and scarcely knew what it meant to rebel. Now they had to learn hurriedly, and in the face of cruel necessity, the long disused science, and to unite heart and hand in a common cause, which was not only the cause of patriotism, but of humanity. It was seen very clearly that unless a stop were put, or at least a protest raised, against the policy of which the Duke of Alva was the exponent, both the name and form of political independence were gone, and the hitherto free Netherlanders must become the slaves of Spain. This fact brought over to the ranks of the malcontents even those who, being Catholics, might not have been disposed to stir against the Inquisition. The attempt to subvert civil liberty struck a chord in all hearts which vibrated right through the land. But most of the Catholics resented the Inquisition with nearly as much anger as the Protestants, the result being that every

* The existing kingdoms of Holland and Belgium were at this time included in the Netherlands, of which there were seventeen provinces.

man, woman, and child in the Low Countries, with a few ignoble exceptions, was ready, from one motive or the other, to rebel against Alvaism. Remonstrants were treated as mutineers, deputations to Spain to beg the interference and protection of Philip were insulted and maltreated, and orders were given to the Duke of Alva to "quiet" the provinces.

The spirit of rebellion unguided, not concentrated but diffused, could only expose those in whom it dwelt to revengeful destruction, without in any way helping them to the goal they aimed at. Organisation, and some definite object to be gained through it—these were necessary to success; and for these the people looked, naturally enough, to the nobles, their countrymen, who lived among them, knew their ways and thoughts, and were thoroughly identified with themselves. At first the nobles held back. They were shy of entering upon an enterprise wherein the alternative of success—success against the power and resources of the mightiest empire in the world—were death for themselves and their followers, and ruin, thorongh and complete, for their families. A few generous spirits, and a few with little save their own heads to lose, entered precipitately into the strife, and came promptly to an untimely end. But the great nobles, the men of influence and fortune, hesitated to guide the storm of their countrymen's indignation against the oppressors, until they were satisfied that nothing was to be got by other means, and until, when satisfied of that, things were actually ready for the tremendous contest. There was no lack of patriotism, of self-denial, self-sacrifice, or personal courage in the Dutch, Flemish, and Brabant nobles, but they felt themselves constrained to hope, almost against hope, that so dreadful a sorrow as that which threatened, would not be thrust npon their country. They felt it to be their duty, in spite of what was daily going on through Spanish instrumentality, to try—as the Long Parliament did in England before the Civil War—every constitutional means of easing the people's burdens before they committed themselves and the country to open war with the government. They tried and failed. The crafty Spaniard who governed pretended to lend an attentive ear to their remonstrances, and made a show of asking their advice, but he simply wanted to gain time, and to mature his plans for getting them into his net.

Greatest of all the noblemen in the provinces was the Prince of Orange, known in history as William the Silent. Of vast estates and fortune, second to none in rank, of extraordinary ability and indomitable will, he was eminently fitted to be the leader of his country. He was of those who tried everything rather than rebellion to bring the Spaniards to their senses. He was the first to see that nothing but rebellion would do, the first who set seriously to work to organise and draw to a head that spirit of resistance which was rife throughout the country. Being a man who kept his own counsel, and who never made a feint till he was ready to strike, he succeeded in keeping clear of Alva's toils, though not of his suspicion. Convinced when he saw the Inquisition actually established, its victims of both sexes publicly burned by scores, whole townships ruthlessly butchered, in return for trivial signs of disaffection, and a reign of terror begun, that there could be but one end of it all, he kept out of the Spanish monster's way, and gave himself heart and soul to the cause which, bnt for him—unless a miracle had been wrought—must have perished miserably.

The spark which fired the train of every Netherlander's fury was the seizure, mock trial, and execution of Counts Egmont and Horn at Brussels. These noblemen fell victims to their own generous impetuosity, which led them, in the discharge of what they deemed to be their duty, to place themselves at the mercy—save the mark!—of the Duke of Alva. They were exceedingly popular, and in their blood was quenched the last spark of allegiance towards the Spanish king. Many merchants and skilled artisans left the country, and brought to England the wealth and industry which helped so materially to enlarge the commercial prosperity of that country during the time of Elizabeth; but there remained enough of willing hearts and strong bodies to bear the cause of the Prince of Orange stiffly up, and to resist even to death, and beyond the power of death, the wicked attempts of the Spaniards to tread down their brethren.

In 1572 William the Silent put himself at the head of the Beggars, as the insurgents were contemptuously called, and gave the Spanish soldiers something else than unarmed burghers and defenceless women to practise on. Alva took the field, and made preparations on an extensive scale for crushing the rebellion; but his wary opponent, possessing an intimate knowledge of the country, and having the sympathies of all non-combatants—all the fighting men were with him—avoided any decisive actions, and practised his troops in skirmishes and small engagements with the enemy. Aware, however, of the importance of securing the sea-coast, in order to keep up his communications with England and to ensure supplies, he made a dash at Brille, captured it, and having fortified the place, immediately began fitting out cruisers to prey upon Spanish commerce.

The war went on with dreadful fury. The raw levies of the insurgents were no match in the open field for the splendidly-trained troops of Spain, and they had more courage than discretion even in the defence of their besieged towns. The result was that the Netherlanders experienced defeat after defeat, each loss being followed up by barbarous executions of prisoners, and the captured towns being exposed to all the brutality of a licentious soldiery. But no disaster could daunt the spirit of the Prince of Orange: bowed down though he was with the weight of cares and responsibilities, grieved and shocked for the sufferings which the rebellion had brought upon the people, he never gave way to despair. Quietly, doggedly, trustfully, he applied himself to his work, convinced of the righteousness of his cause, and willing to leave the issue in His hands with whom are all things. Generally defeated, he set the example which his descendant, William the Third of England, followed, of immediately showing front again, and of snatching from the enemy the fruits of victory. Alva fretted like a galled horse, but he could not make any impression. All his cruelty, all his cunning, all his energy went for nothing; he had found his master; and after two years spent in incessantly trying, with enormous means, to win back the revolted provinces, he was obliged to give up in despair, and return to Spain with the (to him) grim satisfaction that during his term of office he had destroyed some 18,000 of the Netherlanders by public executions.

Requesens succeeded him, and after carrying on a desolating war for three years, during which the people of the provinces suffered horribly, he was obliged to come to terms with some of the states, eleven of which agreed for peace on condition of Alva's laws being repealed, all foreigners being expelled, and the power of the States-General being restored. Don John of Austria, brother to Philip of Spain, succeeded Requesens, and artfully wrought upon the southern provinces to desert the northern by appealing to their anti-Protestant prejudices. The Prince of Orange knew what he was doing, and anticipated the result by forming, in 1579, the Confederacy of Utrecht, which was the foundation of the Dutch Republic, known as the Republic of the United Provinces.

The war continued, the Belgians joining with the Spaniards, under the first generals of the age, to crush the Hollanders. The sufferings of the devoted people were horrible, but they never talked of surrender; they were often brimful of despair, but they never allowed it to find vent. In 1581 they offered the crown to the Duke of Anjou, brother of the French king, but he could not take it; then they offered it, in 1585, to Queen Elizabeth, who also declined, but she helped them with an army, in which Sir Philip Sidney fought and died, in which Walter Raleigh served, and which the Earl of Leicester commanded. In 1584, when the murder of William of Orange seemed to render the cause of the patriots utterly hopeless, the Hollanders gave Maurice, the dead man's son, the supreme command; and he, emulating the wisdom and valour of his father, strove so well, in conjunction with his English allies, that he beat back the oppressors of his country, weary and exhausted, and compelled Spain, in 1609, to acknowledge the independence of the Republic.

The other provinces which made peace with Spain remained to that power till 1714, when they were made over to the Austrian Hapsburgs, who kept them till 1791. In that year the French annexed them, and they formed part of the empire till the overthrow of Napoleon. On that occasion they were added to the kingdom of Holland, with which they remained till 1830, when the existing kingdoms of Holland and Belgium were marked out and recognised.

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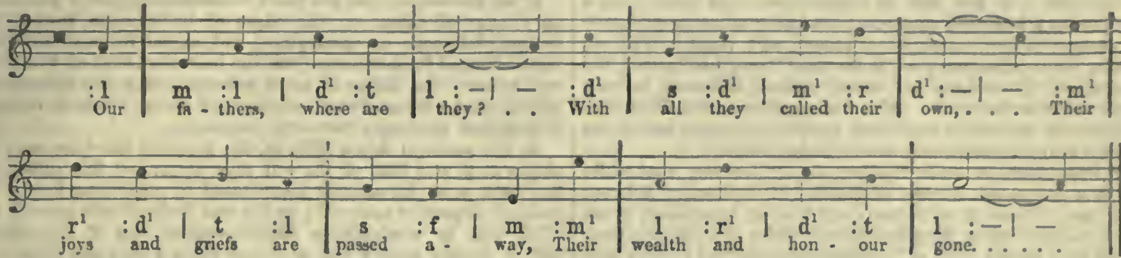
LESSONS IN MUSIC.—XXV.

EXAMPLES OF MINOR TUNES.

In addition to the examples given in a previous lesson, two others (Exs. 1, 2), in the well-known tunes *St. Bride's* and *Wirksworth*, will bring more clearly before the mind the effect of Lah when placed in effective positions.

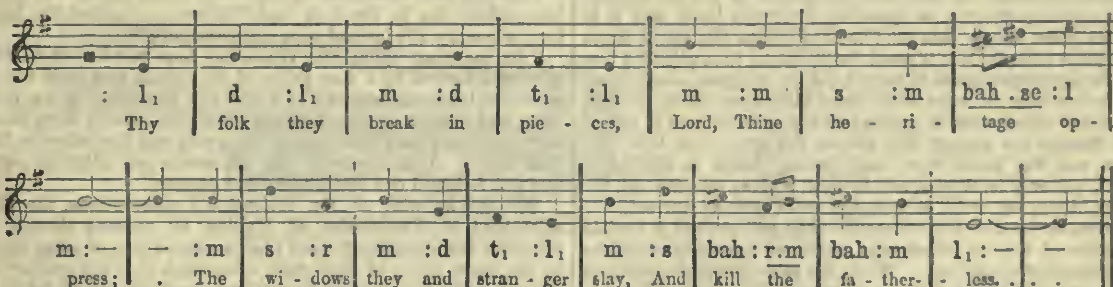
Exercise 47.—THREE EXAMPLES OF MENTAL EFFECT IN MINOR TUNES.

Example 1. Key C. Lah Mode. St. Bride's.



Example 2. Key B *flat*. Lah Mode. Wirksworth.

Example 3. Key G. Lah Mode.



Our pupils will now be prepared for the following exposition of the subject before us:—

a. In some tunes—chiefly those which are intended to express a mournful sentiment—the note LAH is found to predominate. It is necessarily heard both at the beginning and at the end of such tunes, and assumes almost the importance of a governing or key-note, but without changing (as SOH and FAH do when they become key-notes by "transition") its own musical effect. It still leaves on the mind the impression of "sorrowful suspense."

b. Modern musicians, in order to give to LAH a closer resemblance to the ordinary key-note, and to direct the ear to it more decisively as the note on which the tune closes, as well as to increase the general effect of such tunes, introduce a new note, which we shall call SE, a little step below LAH. This note bears the same relation to LAH, which TE bears to DOH. Musicians sometimes introduce another new note, which they then use instead of FAH. It is a tone below SE, or a chromatic part-tone above FAH. We call it BAH. It bears the same relation to SE which LAH bears to TE. BAH, SE, LAH, heard in succession, resemble, in mental effect, LAH, TE, DOH. The learner may sometimes strike BAH more easily by thinking of it as FE. The note SE is in frequent use, but BAH is less often used in ordinary music (Ex. 3).

c. Tunes of this kind are commonly called minor tunes, from their having the interval called a minor (smaller) third immediately above their predominating note LAH—(LAH, DOH), and in distinction from other tunes which have a major (larger) third above their predominating note DOH. They may be said to be in the LAH mode. It is advisable to take their pitch by means of DOH, as in other tunes. The signature may be written in this form, Key A, LAH MODE.

Those who studied with us the modifications in the mental effect of the note LAH, will be quite prepared to understand how this kind of tune may be used in the serio-comic style, and how by quickening the speed they may even express a lively careless abandonment. Of this we have several examples in the old English music. It will be a good vocal exercise for our pupils to learn to sol-fa those which we shall give in our next lesson.

RECREATIVE SCIENCE.—VII.

THE PRISM (A REFRACTING INSTRUMENT), AND DISCOVERIES MADE WITH THE SPECTROSCOPE.

Of all the optical lenses the prism is the most important and instrnetive, and it has enabled philosophers to add another branch of science, called "spectrum analysis," to those already known. With the help of this triangular piece of glass, we are enabled to decompose and analyse a ray of light, and from the knowledge so obtained to account for the cause of colour.

If a ray of sunlight is allowed to pass through a hole half an inch in diameter into a room, the walls of which should be as dark as possible or hung with black calico, and a prism intersect it, as at *a* (Fig. 1), the ray will cease to go forward in the direction *c d*, but will be decomposed, and exhibit on a white screen a beautiful spectrnm, consisting of seven colours—red, orange, yellow, green, blne, indigo, and violet. With an ordinary glass prism, such as those used for glass lustres, the edges of the colours are not clearly defined, but seem to melt or mix one into the other. If a hollow glass prism, filled with bisulphide of carbon, is employed, the seven colours called the "solar spectrum" are much more clearly defined.

Sir Isaac Newton made the important discovery that white light is a compound of rays of various kinds, having different colours and indices of refraction; and that all substances which appear coloured when illuminated with white light derive their colours only from a kind of "natural selection"—*i.e.*, they may reflect certain coloured rays, and transmit or extinguish others. Light is the fountain of all colour; but it does not follow, because a substance known to have a particular colour is visible, that the colour is inherent. This will depend upon the nature of the light used. By the combustion of thallium (a metal discovered by Mr. Crookes), a most beautiful green light is obtained; and if this is directed on to a red substance, such as a stick of red sealing-wax, the latter appears dark—in fact, black. Although there is plenty of light to show the object, the light does not contain the red ray which is necessary for the lighting up of the red substance. On the other hand, if a Tom Thumb geranium is put into the light produced by the thallium, the leaves appear to be most vividly green, whilst the red flower is dark. In this case, the flower or the red sealing-wax completely absorbs or quenches the green light, and it is only the green leaves that send back or reflect the green light. From these experiments it must be apparent that coloured textures or pigments appear to be red, yellow, or green, or whatever their colour may be, when white light falls upon them, because light is the storehouse of colour; and if a substance is red, it must destroy the orange, the yellow, the green, the blne, the indigo, and the violet rays, and having drank in the latter colours, red only is thrown out from it, and so on with all the various tints; or, what is perhaps more strictly correct, the light coming from a red substance may still contain a certain proportion of blue or yellow rays, but these are overpowered by the predominating red ray. When the solar spectrum, obtained as already described, is thrown on to a white screen, it is most amnsing to see the effect of the various coloured rays upon different pigments, and if slips of coloured paper are used, the results are very distinct. By passing the ray of white light through two prisms (instead of one) filled with bisulphide of carbon, the spectrum may be made to stretch much further across the screen, and the sunbeam undergoes by the second refraction a greater amount of "dispersion." The colours are now more decidedly separated, and the experiments with the slips of coloured paper, or other pigments, can be made with much greater facility. The drawing apart or separation of the colours is called "dispersion;" and thus the spectrum may be made shorter or longer by using prisms of different dispersive power. Although it is difficult for the best-trained eyes to point out the exact boundary of each colour, Sir Isaac Newton managed, by repeated experiments, to convince himself that the lengths of the colours with the particular glass prism he used were as follows:—Red, 45; orange, 27; yellow, 40; green, 60; blue, 60; indigo, 48; violet, 80. Total, 360.

He also ascertained that the colours could be brought together again, re-combined, and that the result was the re-composition of white light. This synthesis of the colours is easily shown by using a second prism in an inverted position, as shown by the dotted lines A A A (Fig. 2), or by allowing the coloured rays to fall upon a double convex lens (A B, Fig. 3), when they are brought to a focus at C, and a spot of white light alone is visible.

The experiment may be varied by mixing seven different coloured powders together, the colours, of course, being those of the solar spectrum; or the colours may be painted on a circular piece of cardboard, and when this is properly mounted, and turned with snfficient velocity, the colours all blend together and produce the nearest imitation of white light.

If a sunbeam is sent through a double convex lens, which represents a series of prisms with their bases attached and their thinnest edges outward, it is not surprising that the disc of light obtained should be fringed with colours, because it has been shown that a prism decomposes white light.

If all the colours had the same refrangibility, there would be no fringes of colour on the edges of bodies seen through a common telescope or opera-glass; but as the focus of the red ray is formed further away from the lens than that of the blue ray, because the latter is more refracted than the former, it follows that a separation of colour must occur, which is called, in technical language, *chromatic aberration*.

In the annexed figure (Fig. 4), the focus of the blue rays is shown at B, and that of the red rays at R; but this difficulty has been most ingeniously surmounted by combining lenses of unequal dispersive material; and it was Dollond who proved, in 1757, that by combining a concavo-convex lens of flint glass with a double convex one of crown glass, a lens was obtained which virtually refracts the various coloured rays to one focus, and is therefore free from colour, or *achromatic*.

For absolute achromatism various lenses are necessary, but for all practical purposes two are found to be sufficient, provided their curvatures are such as to combine the yellow and red rays.

There was one feature in the solar spectrum which escaped the notice of Sir Isaac Newton, and it only shows how much knowledge may be lost by performing an experiment in the least perfect manner. Newton allowed his sunbeam to pass through a circular hole, and therefore missed the dark bands and fixed lines which cross the colours from the red to the violet end of the spectrum, at right angles to its length.

Brewster thus describes the discovery, which appears to have been chiefly due to the fact that Wollaston admitted the light from a narrow slit instead of a circular aperture:—

"In the year 1802, Dr. Wollaston announced that in the spectrum formed by a fine prism of flint glass, free from veins, when the luminous object was a slit the twentieth of an inch wide, and viewed at the distance of ten or twelve feet, there were two fixed dark lines, one in the green and the other in the blue space. This discovery did not excite any attention, and was not followed ont by its ingenious author."

Without knowing of Dr. Wollaston's observations, the late celebrated M. Fraunhofer, of Munich, by viewing through a telescope the spectrum formed from a narrow line of solar light by the finest prism of flint glass, discovered that the surface of the spectrum was crossed throughout its whole length by dark lines of different breadths. None of these lines coincide with the boundaries of the coloured spaces. They are nearly 600 in number; the largest of them subtends an angle of from 5″ to 10″. From their distinctness, and the facility with which they may be found, seven of these lines, viz., B, C, D, E, F, G, H, have been particularly distinguished by M. Fraunhofer (Fig. 5).

A very pretty and most useful apparatus has been invented by Mr. John Browning, called the "miniature spectroscope," by which at any time the solar spectrum may be observed in all its beauty of colour, and the dark lines are easily seen by properly adjusting the width of the slit. When this is widely opened the spectrum is more brilliant, because more light is admitted to the prisms contained in the instrument, but the lines are not then visible. By reducing the size of the aperture, it presents the appearance of a striped ribbon, and is found to be crossed in the direction of its breadth by a number of dark lines.

The instrument in its case measures four inches in length, and rather more than three-quarters of an inch in diameter; it is therefore easily carried in the pocket, and thus kept ready for any special use, such, for instance, as observing the bright bands of colour emitted by certain flames or intensely-hot gaseous matter, similar to that coming from the furnace in which the Bessemer process is conducted. And it is by the employment of the spectroscope that the exact moment of the completion of the process for making steel or pure iron may be determined by a person skilled in the use of the instrument.

The miniature spectroscope represented in Fig. 6 is a most interesting illustration of the principle of refraction. Light is allowed to pass through the slit A, and the manner in which the slit is opened or shut is most simple. The mechanical contrivance for doing this cannot get out of order, being entirely regulated by the turning of a milled head at the front of the spectroscope. The slit is covered with a cap, to prevent dust accumulating, as this will cause lines to be apparent in the direction of the length of the solar spectrum. The dust may be removed by opening the slit as wide as possible, and then carefully wiping the edges with the corner of a soft silk handkerchief. After the rays of light have passed through the slit, they are collected by an achromatic lens, B, which renders them quite parallel. The parallel rays are now refracted and dispersed by the five prisms at C. The position of each prism being reversed alternately, the refraction takes place in opposite directions, and in this manner the refracted ray is kept within the axis, or central line of the instrument.

lines. Such a spectrum teaches us nothing beyond the fact that light can be decomposed into seven colours. An observer, looking at such a spectrum, could not tell the exact source of the light, or say whether it was evolved by incandescent charcoal, lime, or platinum. Such a pure band of colours is called a *spectrum of the first order.*

If a spirit lamp, burning pure and good spirit, is used as the source of heat, and a platinum wire, looped at the end and dipped into a solution of common salt, is now held in the spirit flame, it changes yellow; and if the little hand-spectroscope is directed towards it, a yellow line is distinctly apparent, the position of which is towards the red end of the spectrum.

When a more intense heat is used, such as the electric arc, the sodium line is double, and is then exactly coincident with the dark, double solar line known as Fraunhofer's D line, and shown in Fig. 5. If nitrate or chloride of strontium is used, and placed like the chloride of sodium on the looped platinum wire in the flame, and observed with the spectroscope, the coloured bands are more numerous. There are eight remarkable lines—one blue band, one orange, and six red. All the metals, and their salts, which can be converted into luminous

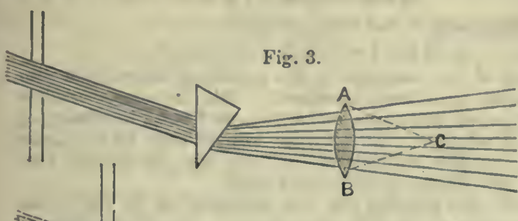


Fig. 3.

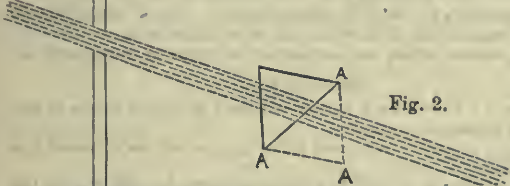


Fig. 2.


Fig. 7.

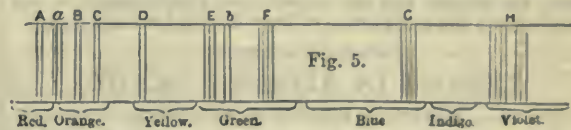


Fig. 5.

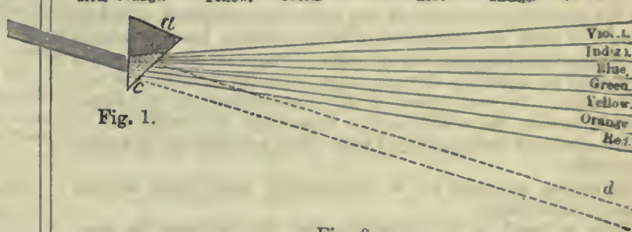


Fig. 1.

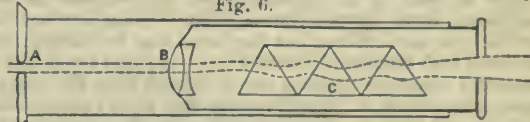


Fig. 6.

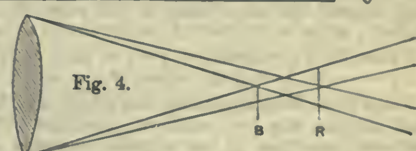


Fig. 4.

As different coloured rays are each refracted with its own index of refraction, a long band of various colour is obtained, comprising red, orange, yellow, green, blue, indigo, and violet.

A partial front view of the instrument, exhibiting the slit, is shown at Fig. 7, which is a perspective view of this most useful and handy spectroscope.

To obtain a pure spectrum, it is necessary that the jaws, or sides, of the slit should be almost closed, so that they only allow a very narrow line of light to pass between them. If the line of light be made too broad, the compound colours will be formed by the overlapping and mixture of the colours, which are widely separated from each other in the pure solar spectrum; for instance, mauve will be produced by the admixture of red and blue, which, although they can in this way be made to overlap, are, as already explained, at the opposite ends of a pure spectrum. If this little instrument is directed to any other source of light, such as gaslight, an electrical spark, or a fixed star, a different set of lines become apparent.

In order to distinguish these lines properly, it is necessary to classify the spectra obtained from the various sources of light.

Thus, the light obtained from the incandescence of two graphite electrodes by the voltaic battery, and called the electric light, provided the graphite is tolerably pure, will exhibit a continuous band of colours, perfectly free from all black

gas, give bright lines instead of dark ones; and the various spectra obtained in this manner are called *spectra of the second order.* The fact that metals and their salts will always give the same coloured bands invariably in some particular part of the spectrum affords a most delicate means of qualitative analysis, which is now generally employed where the presence of a minute quantity of some metallic salt is suspected. By means of spectrum analysis the three-millionth part of a milligramme of soda can be easily detected, of lithium the nine-millionth part, of calcium the ten-thousandth part of a milligramme. The spark from the great induction coil, when passed through the air, is always of a light yellow colour, and when examined with the spectroscope, it gives the yellow line of sodium; and this is derived from the dust always floating in the air, which is constantly supplied with particles of salt from the spray carried by the winds from the ocean.

There is only one more order to discuss, viz., *spectra of the third order,* of which the best type is the solar spectrum crossed by black bands. Mr. Huggins says, "Spectra of this order consist of the spectra of incandescent, solid, or liquid bodies, in which the continuity of the coloured light is broken by dark lines. These dark spaces are not produced by the source of the light. They tell us of vapours through which the light has passed on its way, and which have robbed the light, by absorption, of certain definite colours or rates of vibration. Such spectra are formed by the light of the sun and stars."

If the light producing the yellow lines in sodium by the electric arc is allowed to pass through the vapour of metallic sodium, the yellow lines change to black lines. The sodium vapour absorbs the same kind of light as it emits; and it was by this remarkable discovery that Kirchoff identified many of the dark lines in the solar spectrum with the bright lines obtainable from terrestrial substances, and ascertained that in the solar atmosphere there existed sodium, calcium, barium, magnesium, iron, chromium, nickel, copper, zinc, strontium, cadmium, cobalt, and hydrogen. If the evidence depended only on the coincidence of one or two dark solar lines with the bright bands from the vapours of the terrestrial metals, it would be worth little or nothing; but in a complicated series of sets of lines, such as would be produced by the above metals, all the lines coincide, and in speaking of one of these metals, viz., iron, Kirchoff remarks that "the observations of the solar spectrum appear to me to prove the presence of iron vapour in the solar atmosphere, with as great a degree of certainty as we can attain in any question of natural science." Messrs. Huggins and Miller have continued these observations with the planets, the stars, the nebulæ, and the comets, and added largely to our knowledge of the constitution of these distant heavenly bodies.

LESSONS IN ALGEBRA.—XXIII.

THREE UNKNOWN QUANTITIES.

In the preceding examples of two unknown quantities, it will be perceived that the conditions of each problem have furnished two equations independent of each other. It often becomes necessary to introduce *three* or *more* unknown quantities into a calculation. In such cases, if the problem admits of a determinate answer, there will always arise from the conditions as many equations *independent* of each other, as there are unknown quantities.

Equations are said to be *independent* when they express *different* conditions.

They are said to be *dependent* when they express the *same* conditions under *different* forms. The former are not convertible into each other; but the latter may be changed from one form into the other. Thus $b - x = y$; and $b = y + x$, are dependent equations, because one is formed from the other by merely transposing x. Equations are said to be identical when they express the same thing in the same form expressed or implied; as $4x - 6 = 4x - 6$, or $2(2x - 3) = 4x - 6$.

Example (1).—Given $x + y + z = 12$, $x + 2y - 2z = 10$, and $x + y - z = 4$; to find the values of x, y, and z.

From these three equations, two others may be derived which shall contain only *two* unknown quantities. One of the three unknown quantities in the original equations may be exterminated, in the same manner as when there are at first only two, by the rules already given. Thus, if in the equations given above, we transpose y and z, we shall have,

From the first, $x = 12 - y - z$;
From the second, $x = 10 - 2y + 2z$;
From the third, $x = 4 - y + z$.

From these we may now deduce two new equations, from which x shall be excluded.

By making the first and second equal, we have

$$12 - y - z = 10 - 2y + 2z.$$

By making the second and third equal, we have

$$10 - 2y + 2z = 4 - y + z.$$

Reducing the first of these two, we have

$$y = 3z - 2.$$

Reducing the second, we have

$$y = z + 6.$$

From these two equations one may be derived containing only *one* unknown quantity.

By making the one equal to the other, we have

$$3z - 2 = z + 6.$$

Therefore, $z = 4$. Hence, $y = 10$, and $x = -2$.

To solve a problem containing *three* unknown quantities, and producing three independent equations.

Rule.—*First, from the three equations deduce two, containing only two unknown quantities. Then, from these two deduce one, containing only one unknown quantity. Lastly, find the values of the other unknown quantities as before.*

For making these reductions, the rules already given are sufficient.

Example (2).—Given $x + 5y + 6z = 53$, $x + 3y + 3z = 30$, and $x + y + z = 12$; to find the values of x, y, and z.

Here, from these three equations, in order to derive two containing only two unknown quantities,

Subtracting the second from the first, we have

$$2y + 3z = 23; \quad \text{(the fourth equation)}$$

Subtracting the third from the second, we have

$$2y + 2z = 18. \quad \text{(the fifth equation)}$$

Next, from these two, in order to derive one,

Subtracting the fifth from the fourth, we have

$$= 5$$

To find x and y we have only to take their values from the third and fifth equations.

Reducing the fifth, we have

$$y = 9 - z = 9 - 5 = 4.$$

Transposing in the third, we have

$$x = 12 - z - y = 12 - 5 - 4 = 3.$$

In many of the examples in the preceding lessons, the processes might have been shortened. But the object was to illustrate *general* principles, rather than to furnish specimens of *expeditious* solutions. The learner will do well, as he passes along, to exercise his skill in *abridging* the calculations here given, or *substituting others* in their stead.

He must also exercise his own judgment as to the choice of the quantity to be first exterminated. It will generally be best to begin with that which is most free from *co-efficients*, *fractions*, *radical signs*, etc.—that is, the quantity least involved.

Exercise 39.

1. Given $x + y + z = 12$, $x + 2y + 3z = 20$, and $\frac{1}{3}x + \frac{1}{2}y + z = 6$; to find the values of x, y, and z.
2. Given $x + y = a$, $x + z = b$, and $y + z = c$; to find the values of x, y, and z.
3. Three persons, A, B, and C, purchase a horse for 100 dollars, but neither is able to pay for the whole. The payment would require the whole of A's money, together with half of B's; or the whole of B's with one-third of C's; or the whole of C's, with one-fourth of A's. How much money had each?
4. The sum of the distances which three persons, A, B, and C, have travelled, is 62 miles; A's distance is equal to four times C's added to twice B's; and twice A's added to three times B's, is equal to 17 times C's. What are the respective distances?
5. Given $\frac{1}{2}x + \frac{1}{3}y + \frac{1}{4}z = 62$, $\frac{1}{3}x + \frac{1}{4}y + \frac{1}{5}z = 47$, and $\frac{1}{4}x + \frac{1}{5}y + \frac{1}{6}z = 38$; to find the values of x, y, and z.
6. Given $xy = 600$, $xz = 300$, and $yz = 200$; to find the values of x, y, and z.

FOUR OR MORE UNKNOWN QUANTITIES.

The same method which is employed for the reduction of three equations, may be extended to *four* or *five*, or any number of equations, containing *as many* unknown quantities.

The unknown quantities may be exterminated, one after another, and the number of equations may be reduced by successive steps from *five* to *four*, from *four* to *three*, from *three* to *two*, and so on to *one*.

Example (1).—Given

$$\tfrac{1}{2}y + z + \tfrac{1}{2}w = 8, \quad (1)$$
$$x + y + w = 9, \quad (2)$$
$$x + y + z = 12, \quad (3)$$
$$x + w + z = 10; \quad (4)$$

to find the values of w, x, y, and z.

Here, clearing the first equation of fractions, we have

$$y + 2z + w = 16; \quad (5)$$

Subtracting the second from the third, we have

$$z - w = 3; \quad (6)$$

Subtracting the fourth from the third, we have

$$y - w = 2. \quad (7)$$

Next, adding the fifth and the sixth, we have

$$y + 3z = 19; \quad (8)$$

Subtracting the seventh from the sixth, we have

$$-y + z = 1. \quad (9)$$

Again, adding the eighth and the ninth, we have

$$4z = 20, \text{ or } z = 5;$$

Transposing in the eighth, we have

$$y = 19 - 3z = 4;$$

Transposing in the third, we have

$$x = 12 - y - z = 3;$$

Transposing in the second, we have

$$w = 9 - x - y = 2.$$

EXAMPLE (2).—Given $w + 50 = x$,
$x + 120 = 3y$,
$y + 120 = 2z$,
$z + 195 = 3w$;
to find the values of w, x, y, and z. *Ans.* $w = 100$, $x = 150$, $y = 90$, and $z = 105$.

EXERCISE 40.

1. There is a certain fraction, such, that if 3 be added to the numerator, the value of the fraction will be $\frac{1}{3}$; but if 1 be subtracted from the denominator, the value will be $\frac{1}{5}$. What is the fraction?
2. Divide the number 90 into four such parts, that if the first is *increased* by 2, the second *diminished* by 2, the third *multiplied* by 2, and the fourth *divided* by 2, shall all be equal.
3. Find three numbers, such that the *first*, with half the sum of the *second* and *third*, shall be 120; the *second*, with $\frac{1}{5}$ the difference of the *third* and *first*, shall be 70; and half the sum of the three numbers shall be 95.
4. What two numbers are those whose difference, sum, and product are as the numbers 2, 3, and 5?
5. A vintner sold at one time 20 dozen of port wine, and 30 dozen of sherry; and for the whole received 120 guineas. At another time, he sold 30 dozen of port and 25 dozen of sherry, at the same prices as before, and for the whole received 140 guineas. What was the price per dozen of each sort of wine?
6. A merchant having mixed a certain number of gallons of brandy and water, found that, if he had mixed 18 gallons more of each, he would have put into the mixture 8 gallons of brandy for every 7 of water. But if he had mixed 18 less of each, he would have put in 5 gallons of brandy for every 4 of water. How many gallons of each did he mix?
7. What fraction is that, whose numerator being doubled, and the denominator increased by 7, the value becomes $\frac{2}{3}$; but the denominator being doubled, and the numerator increased by 2, the value becomes $\frac{3}{5}$?

If in the algebraic statement of the conditions of a problem, the original equations are more numerous than the unknown quantities, these equations will either be *contradictory*, or one or more of them will be *superfluous*.

Thus, the equations $3x = 60$, and $\frac{1}{2}x = 20$, are contradictory. For, by the first, $x = 20$; while, by the second, $x = 40$.

But if the latter equation be altered, so as to give to x the same value as in the former, it will be useless, in the statement of a problem. For nothing can be determined from the one which cannot be from the other.

Thus, in the equations $3x = 60$, and $\frac{1}{2}x = 10$, one is superfluous.

But if the number of independent equations produced from the conditions of a problem be *less* than the number of unknown quantities, the subject is not sufficiently limited to admit of a definite answer. If, for instance, in the equation $x + y = 100$, x and y are required, there may be fifty different answers. The values of x and y may be either 99 and 1, or 98 and 2, or 97 and 3, etc. For the sum of each pair of these numbers is equal to 100. But if there be a second equation which determines *one* of these quantities, the other may then be found from the equation already given. As $x + y = 100$, if $x = 46$, y must be such a number as added to 46 will make 100, that is, it must be 54; and no other number will answer this condition.

In most cases, also, the solution of a problem which contains many unknown quantities may be abridged by particular artifices in *substituting* a single letter for several.

EXAMPLE (3).—Suppose four numbers, u, x, y, and z, are required, of which the sum of the first three is 13, the sum of the first two and the last is 17, the sum of the first and the last two is 18, and the sum of the last three is 21.

Here, $u + x + y = 13$,
$u + x + z = 17$,
$u + y + z = 18$, and
$x + y + z = 21$, by the question.

Now, let S be substituted for the *sum* of the four numbers, that is, $u + x + y + z$. It will then be seen that of these four equations,

The first contains all the letters except z, that is,

$$S - z = 13;$$

The second contains all except y, that is,

$$S - y = 17;$$

The third contains all except x, that is,

$$S - x = 18, \text{ and}$$

The fourth contains all except u, that is,

$$S - u = 21.$$

Adding all these latter equations together, we have,

$$4S - z - y - x - u = 69, \text{ or}$$

$$4S - (z + y + x + u) = 69;$$

But $S = (z + y + x + u)$ by substitution.

Therefore, $4S - S = 69$, that is, $3S = 69$, and $S = 23$.

Now, putting 23 for S, in the four equations in which it is first introduced, we have,

$$\left.\begin{array}{r} 23 - z = 13, \\ 23 - y = 17, \\ 23 - x = 18, \\ \text{and } 23 - u = 21. \end{array}\right\} \text{Therefore, } \left\{\begin{array}{l} z = 23 - 13 = 10, \\ y = 23 - 17 = 6, \\ x = 23 - 18 = 5, \text{ and} \\ u = 23 - 21 = 2. \end{array}\right.$$

Contrivances of this sort for facilitating the solution of particular problems, must be discovered by the student's own ingenuity and skill. They are of a nature not to be taught by a system of rules, but by practice and plodding industry, which is genius.

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XXI.

EXERCISE 35.

1. $x^3 + 3x^2y + 3xy^2 + y^3$.
2. $a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$.
3. $a^6 - 6a^5b + 15a^4b^2 - 20a^3b^3 + 15a^2b^4 - 6ab^5 + b^6$.
4. $x^5 + 5x^4y + 10x^3y^2 + 10x^2y^3 + 5xy^4 + y^5$.
5. $x^8 - 8x^7y + 28x^6y^2 - 56x^5y^3 + 70x^4y^4 - 56x^3y^5 + 28x^2y^6 - 8xy^7 + y^8$.
6. $m^7 + 7m^6n + 21m^5n^2 + 35m^4n^3 + 35m^3n^4 + 21m^2n^5 + 7mn^6 + n^7$.
7. $a^9 + 9a^8b + 36a^7b^2 + 84a^6b^3 + 126a^5b^4 + 126a^4b^5 + 84a^3b^6 + 36a^2b^7 + 9ab^8 + b^9$.
8. $x^{10} + 10x^9y + 45x^8y^2 + 120x^7y^3 + 210x^6y^4 + 252x^5y^5 + 210x^4y^6 + 120x^3y^7 + 45x^2y^8 + 10xy^9 + y^{10}$.
9. $x^{13} - 13x^{12}y + 78x^{11}y^2 - 286x^{10}y^3 + 715x^9y^4 - 1287x^8y^5 + 1716x^7y^6 - 1716x^6y^7 + 1287x^5y^8 - 715x^4y^9 + 286x^3y^{10} - 78x^2y^{11} + 13xy^{12} - y^{13}$
10. $a^7 - 7a^6b + 21a^5b^2 - 35a^4b^3 + 35a^3b^4 - 21a^2b^5 + 7ab^6 - b^7$.
11. $a^8 + 8a^7b + 28a^6b^2 + 56a^5b^3 + 70a^4b^4 + 56a^3b^5 + 28a^2b^6 + 8ab^7 + b^8$.
12. $32 + 80x + 80x^2 + 40x^3 + 10x^4 + x^5$.
13. $a^3 - 3a^2bx + 3a^2c + 3ab^2x^2 - 6abcx + 3ac^2 - b^3x^3 + 3b^2cx^2 - 3bc^2x + c^3$.
14. $a^3 + 9a^2bc + 27ab^2c^2 + 27b^3c^3$.
15. $16a^4b^4 - 32a^3b^3x + 24a^2b^2x^2 - 8abx^3 + x^4$.
16. $16a^2b^2 + 40abc^2 + 25c^4$.
17. $27x^3 - 162x^2y - 324xy^2 - 216y^3$.
18. $125a^3 + 225a^2d + 135ad^2 + 27d^3$.

KEY TO EXERCISES IN LESSONS IN ALGEBRA.—XXII.

EXERCISE 36.

1. $x = 5$, and $y = 6$.
2. $x = 10$, and $y = 3$.
3. $x = 6$, and $y = 4$.
4. $x = 15$, and $y = 20$.
5. $x = 11$, and $y = 9$.

EXERCISE 37.

1. $x = 5$, and $y = 2$.
2. $x = 2$, and $y = 10$.
3. $x = 4$, and $y = 20$.
4. $x = 8$, and $y = 12$.
5. 160 and 140 miles.
6. A = 49 years, and B = 21 years.
7. 15 the greater, and 10 the less.

EXERCISE 38.

1. $x = 6$, and $y = 4$.
2. $x = 8$, and $y = 6$.
3. $x = 12$, and $y = 2$.
4. $x = 7$, and $y = 3$.
5. 11,111 = greater army, and 9,999 = smaller army.
6. 120 the greater, and 100 the less.
7. 60 ft. the lower portion, 48 ft. the upper portion, 108 ft. the total height.
8. 10 and 2.
9. 3 and 2.
10. 20 and 12.
11. 32 and 20.
12. 26.
13. 63.
14. 78 gallons of brandy, and 66 gallons of gin.

LESSONS IN ENGLISH.—XLII.

GENDER.

WORDS are said to undergo inflection when they are capable of appearing in different forms according to variations in the sense. Inflection, then, is the general term which denotes this capability. And "the inflections" is a phrase used to signify the changes themselves which the words capable of inflection undergo.

These remarks imply that some words are capable, and that other words are not capable of inflection. *John* is a word capable of inflection, for *John* may become *John's*. But *with* is a term which remains ever the same, and consequently is incapable of inflection.

Inflection (from the Latin in, *upon*, and flecto, *I bend*) is a word of Roman origin, signifying *a bending*, that is, a deviation, and so denotes the deviations or departures of words from their root-form or condition. In the Latin language inflection is a marked feature, and involves many important changes. In English its prevalence is small. In general, the variations and rules of English grammar are somewhat indefinite, undetermined, and variable, wanting the prominence, the fixedness, and the sharp distinctions found in the Latin and the Greek. Some sort of remedy has been sought for in the application to English of the terms, the definitions, and even the laws of classical grammar. The effect has been to augment the trouble of the student, and to conceal or even destroy the natural simplicity of our vernacular tongue. Every language has facts and laws of its own. These it is the business of the philosophical grammarian to collect, systematise, and expound. The Latin grammar is one thing, the Saxon grammar is another, and the English is different from both. Let every language be studied in its own elements; let every grammar be an exposition of the laws of the language which it professes to explain. In grammar let there not be, as there was at Babel, a confusion of tongues. The usages of one language may throw light upon another, but the laws of the Greek must not be thrust on the observance of the student of English. Every language resembles an independent commonwealth, and, as such, is and must be governed by its own laws, and owes obedience solely to one supreme authority—that is, the usages and customs of its best authors.

In order the more exactly and clearly to understand what inflection is, study these examples :—

John	reads	a	book.
I	read	an	epistle
We	read	John's	books.

I will now present these words to you arranged so as to show severally their inflections :—

John	reads	a	book	I
John's	read	an	books	we

In each of these five pairs of words there is, you see, a difference; thus, *John* becomes *John's*, *reads* becomes *read*, *a* becomes *an*, *book* becomes *books*, and *I* becomes *we*. Here, then, are five classes of words, which, admitting of variations, are capable of inflection; these classes are the noun proper, the noun common, the verb, the article, and the personal pronoun.

Nouns are affected by inflection in gender, number, and case. I shall speak of gender in the first place.

Gender is a distinction of nouns in regard to sex. As there are two sexes, the male and the female, so properly there are but two genders, for gender is simply the grammatical term for that which in physiology is termed sex. Accordingly, the very term neuter, as in what is called the third or neuter gender, signifies *neither*, so that *neuter gender* is properly the gender which is *neither* masculine nor feminine. Hence things without life, being neither male nor female, are said to be in the neuter gender.

THE GENDERS KNOWN FROM THE SEXES.

Sex.	Male	Female	Without life.
Gender.	Masculine	Feminine	Neuter.

Compare together these words,

	1	2	3	4
Masculine.	Man	Husband	Lord	Heir
Feminine.	Woman	Wife	Lady	Heiress

and you will not only see what gender means, but learn also how gender in English is denoted. In number one, the feminine is indicated by a change at the beginning of the word, for *man* is made into *woman*; in nnmber four, the feminine is indicated by a change at the end of the word, for *heir* is made into heiress; while in number two, the feminine is indicated by a different word. By a different word also is the feminine in number three indicated in appearance, but in appearance only, for *lady* (Anglo-Saxon læfdie, old Scotch leuedi) is merely the feminine form of the Anglo-Saxon word hlaford, which is our *lord*, signifying master or proprietor.

Gender is marked in various ways. The primitive way of denoting difference of sex is probably the employment of one word for the male and another for the female; this usage seems most in conformity with the simplicity which is an essential characteristic of the English language; for example—

1. SEX SIGNIFIED BY DIFFERENT TERMS.

Masculine	*Feminine.*	*Masculine.*	*Feminine.*
Bachelor	maid (maiden, spinster).	Gentleman	lady.
Boy	girl.	Hart (buck)	doe.
Bridegroom	bride.	Horse (stallion)	mare.
Brother	sister.	Husband	wife.
Buck	doe.	Monk	nun.
Bull	cow.	Milter	spawner.
Bullock (steer)	heifer.	Ox	cow.
Cock	hen.	Ram	ewe.
Colt	filly.	Sir	madam.
Dog	bitch.	Sire	dam.
Drake	duck.	Son	daughter.
Drone	bee.	Stag	hind.
Earl	countess.	Steer	heifer.
Father	mother.	Uncle	aunt.
Friar	nun.	Wether	sheep.

I have intimated that probably this is the original way of denoting difference of sex in English, because the words affected by it are words which must have been in use at the very beginning, such as husband, wife; father, mother; boy, girl; brother, sister.

I subjoin a few explanatory remarks on words in the previous list.

Of *maid* and maiden, the latter, from the Saxon mæden, is the original form, of which maid is a contraction; as is seen in maidenhood, *the condition of a maiden.*

Spinster, that is, *a female spinner*, denotes an unmarried woman by her occupation in her father's house, as maiden designates her with reference to her sex.

Bridegroom is in its original German form, brantigam, which derived from braut, *bride*, and gam, *a male* or *young man* (in old German brutigomo, compare the French gamin, *a young fellow*), signifies literally *the bridesman*—that is, not the bride's attendant, but the bride's betrothed, her intended husband. If, as I believe, this view is correct, this pair of words would properly stand in the ensuing list.

Countess is properly the feminine form of the Latin derivative count, whereas *earl* is of Saxon origin.

There are pairs of words commonly supposed to be different, which in truth are in each case forms of the same word varied according to sex: for example :—

2. SEX DENOTED BY A CHANGE IN THE WORD.

Masculine.	*Feminine.*	*Masculine.*	*Feminine.*
Beau	belle.	Lord	lady.
Bridegroom	bride.	Master	mistress.
Gander	goose.	Nephew	niece.
King	queen.	Sloven	slut.
Lad	lass.	Wizard	witch.

Belle is simply the feminine of beau. Goos in Dutch, and gans in German, give rise to our *goose* and *gander*, the former supplying the general term, which is also feminine, the latter supplying the specifically masculine denomination.

King and *queen* in German are könig and königin; königin in pronunciation became queen. *Queen* is not to be confounded with quean, *a low* or *bad woman*, which comes from the Saxon cwen, *a woman or wife*, as Abrahames cwen, *Abraham's wife.*

Lass (ladess) is, in a contracted form, the feminine of lad; *lad* and *lass* are still commonly used in Lancashire.

Master and *mistress* are related to each other, as are *lad* and *lass*, *mistress* being the softened or feminine form of *master*; the Saxon for master being mæster, which with the feminine ending became mæstress, that is, *mistress.*

So *niece* is nothing more than the softened or feminine form of *nephew*; in German the words are, masculine, neffe, feminine, nichte; in Saxon there are the forms nefa, nefene. The *i* in our *niece* is derived from the *i* found in the German; also in the Dutch nicht, and the Friesic nift.

Sloven and *slut*, the former masculine, the latter feminine, come from the Teutonic schlotto (schlutt), *dirt, filth;* whence schlottern (sluddern), *to hang loosely*, like ill-made, ragged, or foul clothes; *to be slovenly*.

Wizard and *witch* both come from the German wissen (English, *wise, wit, to know*).

A third mode of indicating sex is by a prefix. For example:—

3. SEX DENOTED BY A CHANGE AT THE BEGINNING.

Masculine.	*Feminine.*	*Masculine.*	*Feminine.*
Manservant	maidservant.	Male relations	female relations.
Male	female.	Man	woman.
Male child	female child.	A man cook	a woman cook (cook-maid).

In female, the prefix *fe* is in substance the same as the Greek phu, in φυω (phu-o), *I produce* (found also in the Latin fui), and so denotes the producer. Not dissimilar in its source is the prefix wo, which converts *man* into *woman*.

To the class just spoken of may be referred nouns in which the sex may be considered as doubly indicated; I refer to proper names having before them a complimentary title: as, Master John, Miss Jane, Mr. Seymour, Mrs. Egerton.

In animal names, also, sex is marked by a prefixed word: as,

GENDERS DENOTED BY A WORD PREFIXED.

Masculine.	*Feminine.*	*Masculine.*	*Feminine.*
A male (*a he, a tom*) cat	a she cat.	A he wolf	a she wolf.
		A male elephant	a female elephant.
A jack-ass	a she ass.	A cock sparrow	a hen sparrow.
A dog-fox	a bitch fox.	A cock pigeon	a hen pigeon.
A buck-rabbit	a doe rabbit.		

The usages may, however, be inverted, and a suffix be employed instead of a prefix to denote the gender. For example:—

GENDER DENOTED BY A SUFFIX.

Masculine.	*Feminine.*	*Masculine.*	*Feminine.*
A turkey cock	a turkey hen.	A pea cock	a pea hen.

4. More commonly, gender is denoted by a suffix. For example:—

GENDER DENOTED BY A WORD APPENDED.

Masculine.	*Feminine.*	*Masculine.*	*Feminine.*
Bridegroom	bride.	Landlord	landlady.
Gentleman	gentlewoman.	Nobleman	noblewoman.
Grandfather	grandmother.	Widower	widow.
Grandsire	grandam.		

These instances require no explanation, except one: *Widow* (from the Latin vidnus, our *void*, and the Sanscrit vidhava, *a widow*), denoting a woman who has lost her husband, becomes, by the masculine suffix *er* (as in baker, builder, reader), widower, *a man who has lost his wife*

5. The last remark may lead to the question whether the terminations which denote sex might not be more correctly set forth as suffixes rather than as changes in the root or inflections. By such changes, however, gender is signified. The terminational changes employed to denote the feminine gender are *a, ess, ix, ine*.

GENDER INDICATED BY SEX-ENDINGS.

Masculine.	*Feminine.*	*Masculine.*	*Feminine.*
Abbot	abbess.	Governor	governess.
Actor	actress.	Heir	heiress.
Administrator	administratrix.	Hero	heroine.
Ambassador	ambassadress.	Host	hostess.
Arbiter	arbitress.	Hunter	huntress.
Auditor	auditress.	Jew	Jewess.
Author	anthoress.	Landgrave	landgravine.
Baron	baroness.	Launderer	laundress.
Benefactor	benefactress.	Lion	lioness.
Caterer	cateress.	Margrave	margravine.
Chanter	chantress.	Marquis	marchioness.
Coheir	coheiress.	Master	mistress.
Count	countess.	Mayor	mayoress.
Czar	czarina	Mediator	mediatrix.
Dauphin	dauphiness.	Monitor	monitress.
Deacon (dean)	deaconess.	Murderer	murderess.
Director	directress.	Negro	negress.
Duke	duchess.	Palsgrave	palsgravine.
Emperor	empress.	Patron	patroness.
Enchanter	enchantress.	Peer	peeress.
Executor	executrix.	Poet	poetess.
Giant	giantess.	Priest	priestess.
Prince	princess.	Sorcerer	sorceress.
Prophet	prophetess.	Sultan	sultana.
Shepherd	shepherdess.	Tiger	tigress.
Signor	signora.	Traitor	traitress.
Singer	songstress.	Viscount	viscountess.

Of these feminine terminations, namely *a, ess, ix,* and *ine*, only one, that is *ess*, can be said to be strictly English. For instance, *ine* in landgravine is German, as landgraf, landgrafin. So the *a* in czarina and sultana are of foreign origin. The termination *ix* is the regular Latin feminine ending. So also, according to Latham, is *ess*, being *ix* in another form; *ess* (or *es*), however, comes from the Saxon feminine nouns in *es, nes, nys,* or *nis*, having a representation in the *niss* of the Germans, as erlaubniss, f., *a permission*.

If *ess* is vernacular, it ought properly to be applied only to masculine nouns of Teutonic origin, otherwise hybrids are produced. Abbess is a hybrid, being a cross between the Teutonic and the Hebrew. Hybrids are numerous in English.

Though *ess* is vernacular it cannot at pleasure be employed. The tendency seems to be to restrict its use. Words which of old appeared in the feminine form of *ess*, are no longer so employed. The list I have given contains no words but such as are still in use. Nevertheless of some it may be said that their employment is not common. *Authoress*, for instance, is rarely heard from the lips of a well-educated Englishman, or found in writings of unquestionable authority; its employment seems to be restricted to the case when you wish to give prominence to the fact that the person spoken of is a female; for example,

"*The author of that book*, did you say? rather speak of the *authoress*, for only a woman could have so penetrated the inner folds of the heart and described the most delicate emotions so chastely, yet so truly."

EXERCISE IN PARSING.

The task of a schoolmaster, laboriously prompting and urging an indolent class, is worse than his who drives lazy horses along a sandy road.

The, the definite article qualifying *task*.

Task, a common noun, made to refer to a particular task by the use of the limiting or definite article *the; task* is a noun neuter, in the singular number; the subject to the verb *is*.

Of, a preposition forming with *schoolmaster*, the Norman-French, or false genitive.

A, from *an*, the indefinite article qualifying *schoolmaster*.

Laboriously, an adverb qualifying *prompting*.

Prompting, a present participle, known by its ending in *ing*, and agreeing with *schoolmaster*.

And, a conjunction, connecting together *prompting* and *urging*.

Urging, a present participle from the transitive verb *to urge*, agreeing with *schoolmaster*.

An, the indefinite article, which before a consonant becomes *a*.

Indolent, an adjective qualifying *class;* indolent is made up of two Latin terms, in, *not*, and doleo, *I am in pain*, so that indolence is *taking no pains*.

Is, a part of the verb *to be*, present time, having for its subject *task*, or, in full, "the task of a schoolmaster," etc.

Worse, an adjective qualifying *task*.

Than, an adverb of comparison.

His, a possessive pronoun, or the possessive case of the personal pronoun *he;* if regarded in the former light, *his* agrees with *task* understood; if in the latter, it is governed by *task* understood.

Who, a relative pronoun, the subject of the verb *drives*.

Drives, a transitive verb, present time, having for its subject or nominative case the pronoun *who*.

Lazy, an adjective qualifying *horses*.

Horses, a common noun, in the plural number, the object to the verb *drives*.

Along, a preposition, made up of *a* and *long*.

A, the indefinite article from *an*, employed before a singular noun beginning with a consonant.

Sandy, an adjective qualifying *road*.

Road, a common noun, of the neuter gender, singular number, dependent on the preposition *along*.

If viewed etymologically, the sentence yields these results. Of Saxon or Teutonic origin are these words, namely, *the, of, a, is, worse, than, he, who, drives, lazy, horses, along, sandy road;* of Celtic origin is task (tasg, *a bond, a job*); and of Latin origin are *laboriously, prompting, urging, indolent. Schoolmaster* is a hybrid, being made up of the Greek σκολη (skol'-e), *leisure, school*, and the Latin magister, *a master*. The student should ascertain the signification of the words of Latin origin from the lists already given of Latin stems.

EXERCISE IN COMPOSITION.

Words with their proper Prepositions, to be formed into sentences.

	FOREIGN REPRESENTATIVES.
Eager in, for, after	Lat. acer, *sharp, vigorous.*
Embark in, for	em, en, French form of in, and bark, Fr. barque, *a boat.*
Embellished with	em and bellus, *beautiful*, Fr. belle.
Emerge from	Lat. emergo, *I dip up.*
Employ in, on, about	Fr. employer, Lat. plica, a fold.
Emulous of	Lat. æmulus, *a rival.*
Enamoured of	en (em, in), amor, *love.*
Encounter with	en (in, *against*) and contra, *against.*
Encouragement to	Fr. cœur, Lat. cor, *heart.*
Encroach on	connected with our *crook*, in Welsh *crog.*
Endeared to	en and dear.
Endeavour after	en and devoir, Fr. *duty.*
Endowed with	Lat. dos, dotis, *a gift, dower.*
Endued with	Lat. induo, *I put on* or *in.*
Engage in, with, for	Fr. engager, en and gage, *a pledge.*

CORRESPONDENCE IN FRENCH.—VII.

31.—LETTER ON PAYMENT OF ACCOUNTS FOR ANOTHER, ETC.

Lyons, Feb. 9th, 1881.

Mr. Armand, jun., Paris.

Sir,—In reply to your esteemed favour of the 5th inst., I beg to state that I have paid the accounts as desired, and debit you as follows :—

1st. According to the enclosed receipt of Ch. Aurigny of our town			fr. 328 25 c.
2nd. Made good Messrs. James Barker & Co., Amiens, in account current . . .			„ 1,311 40 „
3rd. Cash forwarded per diligence to Mr. Martin le Tourneur, Fécamp . .	fr. 195 85 c.		
Packing and Postage . .	„ 1 65 „		„ 197 50 „
value the 8th February.		Total	fr. 1,837 15 c.

I have most willingly undertaken the slight trouble which these payments have occasioned; you need not therefore make yourself at all uneasy on that account. I execute your commissions with pleasure, and shall be delighted if a lucrative commercial speculation should offer itself in our town. You may rest assured that your interest will always meet my most scrupulous care.

Referring you to our enclosed price-current, I beg you to observe that our business in lace is very good this winter, our imitation Valenciennes and Caen Blonde being particularly in demand. It must be admitted that the first-mentioned article is a wonderful imitation, and can be offered much cheaper than the real.

Awaiting further communications,

I have the honour to remain, Sir,

Yours very truly,

LEON TAVEL.

Lyon, le 9 Février 1881.

M. Armand fils, à Paris.

Monsieur,—En réponse à votre honorée du 5 courant, j'ai l'avantage de vous faire part que j'ai payé les différentes sommes que vous m'avez commises et que je vous en débite comme suit :—

1⁰ Selon le reçu ci-inclus de Ch. Aurigny de notre ville			fr. 328 25 c.
2⁰ Bonifié à MM. James Barker & C^ie^, d'Amiens, en compte courant . . .			„ 1,311 40 „
3⁰ Envoyé à M. Martin le Tournenr, Fécamp, par la diligence . .	fr. 195 85 c.		
Pour port et emballage .	„ 1 65 „		„ 197 50 „
le tout au 8 Février.		Total . . .	fr. 1,837 15 c.

Je me suis chargé volontiers du petit embarras que ces paiements m'ont donné, et vous ne devez pas vous en inquiéter. C'est avec plaisir que je prends soin de vos commissions et je serai charmé qu'une affaire lucrative sur notre place vienne s'offrir à vous. Vous pourrez être assuré que vos intérêts seront toujours l'objet de mes soins les plus scrupuleux.

En vous référant à notre prix courant ci-inclus, je vous fais observer que notre dentellerie va parfaitement bien cet hiver; ce sont principalement nos Valenciennes et nos Blondes de Caen contrefaites qui sont en grande vogue; mais il faut avouer qu'on sait à merveille imiter les articles de cette catégorie, et qu'on les livre à beaucoup meilleur marché que les originaux.

En attendant vos communications ultérieures,

J'ai l'honneur d'être, Monsieur,

Votre très-dévoué,

LÉON TAVEL.

32.—ACKNOWLEDGMENT OF BILL OF LADING, ETC.

The Hague, July 9th, 1881.

Messrs. Van Steen, Gniyten, & Co., Rotterdam.

Gentlemen,—We received, with your esteemed favour of the 16th inst., the bill of lading for—M & C. 18 bales of Tobacco shipped per *Clara*, but the bill of exchange of

Florins 1,280, on Asher & Co., Frankfort, mentioned in your letter as being enclosed, was wanting.

We hasten to inform you of the fact, so that, if it is not a slight inadvertence merely, you may take the necessary measures to protect yourselves from loss.

Having nothing further to add to-day, we beg leave to sign ourselves with respect,

Gentlemen, your humble servants,

J. TERENAER & SONS.

La Hague, le 9 Juillet 1881.

Messieurs Van Steen, Gniyten, & C^ie^, à Rotterdam.

Messieurs,—Nous reçûmes avec votre honorée du 16 courant le connaissement pour 18 balles de Tabac M & C par la *Clara*, chargées à notre adresse, mais la lettre de change dont vous parlez comme y étant incluse de

Florins 1,280, sur Asher & C^ie^, à Franckfort, ne s'y trouvait point.

Nous nous empressons par conséquent de vous en donner connaissance, afin que s'il n'y a qu'une petite erreur, vous fassiez les démarches nécessaires pour vous garder d'une perte.

Nous n'avons rien à ajouter aujourd'hui et sommes,

Vos humbles serviteurs,

J. TERENAER & FILS.

33.—LETTER ANNOUNCING REFUSAL OF ACCEPTANCE.

Manchester, July 6th, 1881.

Messrs. Walton Bros., Birmingham.

Gentlemen,—As you will have seen by our telegram of this morning, which we beg to confirm, Messrs. Dashwood & Co. have refused the payment of their acceptance for

£500, due to-day,

stating they had not the necessary funds in consequence of the non-arrival of some remittances they expected.

They promise, however, to honour your draft in a few days. We have had a protest made out, and shall keep it together with your bill, awaiting your instructions whether you wish to have it returned or not.

We are, Gentlemen, yours truly,

JAMES ANSTRUTHER & CO.

Manchester, le 6 Juillet 1881.

Messieurs Walton Frères, à Birmingham.

Messieurs,—Comme vouz l'aurez appris par notre dépêche télégraphique de ce matin, que nous vous confirmons, Messieurs Dashwood & C^ie^ ont refusé le paiement de leur acceptation de

£500, payable aujourd'hui,

disant qu'ils n'avaient pas les fonds nécessaires par suite de faute d'arrivée de quelques remises qu'ils attendaient.

Ils promettent cependant de payer votre traite sous quelques jours. Nous avons fait faire le protêt que nous garderons avec l'effet en attendant vos instructions, si nous devons vous le retourner ou non.

Recevez, Messieurs, nos salutations amicales,

JACQUES ANSTRUTHER & C^IE^.

34.—LETTER ABOUT DISHONOURED ACCEPTANCE.

Birmingham, July 7th, 1881.

Messrs. Dashwood & Co., Manchester.

Gentlemen,—We have just been informed, to our great sur-

prise, by our banker that you refused the payment of your acceptance for £500, due yesterday,
saying you had not the necessary funds to meet it.

As the bill was drawn at three months from the date of our invoice, we are really much astonished to hear of your using the above pretext, for you had plenty of time to provide the money.

We hear that you promise to pay in a few days, and therefore allow you till the end of this week; but if at that time the bill is not honoured, we shall be under the necessity of putting the matter into the hands of our solicitor.

We are, Gentlemen, yours truly,
J. & H. WALTON.

Birmingham, le 7 *Juillet* 1881.

Messieurs Dashwood & Cie, à Manchester.

Messieurs,—Nous venons d'apprendre à notre grande surprise par notre banquier, que vous avez refusé le paiement de votre acceptation de £500, payable hier,
en disant que vous n'aviez pas les fonds nécessaires pour y faire honneur.

L'effet étant tiré à trois mois de la date de notre facture, nous sommes vraiment très-étonnés d'apprendre que vous ayez donné ce prétexte, car vous avez eu tout le temps de vous procurer l'argent.

Comme l'on nous écrit que vous promettez de payer dans quelques jours, nous vous allouerons jusqu'à la fin de la semaine; mais si à cette époque la traite n'est pas payée nous serons dans la nécessité de mettre l'affaire entre les mains de notre avoué.

Nous vous présentons, Messieurs,
Nos salutations empressées,
J. & H. WALTON.

LESSONS IN ENGLISH LITERATURE.—VII.

THE ELIZABETHAN AGE—POETRY.

WHAT we said in our last lesson will have enabled the student to understand some of the influences which had been long at work, and which conduced to bring about the Elizabethan literature; but it must not, of course, be supposed that anything we have said or shall say is an exhaustive account of the subject. Our object in speaking on such subjects is not so much to impart positive instruction, as to suggest a line of thought and inquiry which seems to us of great importance to the useful study of literature. To assign causes for the greater phenomena of history—if, indeed, such a thing be possible at all—is quite beyond our scope. But the connection between literature and history is a thing which can generally be traced without much risk of error, and with great profit. To say why one age is through all Europe an age of life, energy, and power, and another age an age of lethargy and monotonous feebleness, we do not attempt. But to fail in observing that the literature of each of these periods partakes of the character of the period would be a serious omission. The sixteenth century was a century of unequalled energy and power in Europe. In the wide extent of its intellectual movements, the strength of men's convictions, the abundance of great men, the variety of fields in which mental energy made itself felt—in thought and in action, in religion, in politics, in science, in the most serious and permanent undertakings, and in more boyish adventure—this century probably stands quite unrivalled in the history of Europe, and certainly so in that of England. We need scarcely remind our readers that this was the era of the Reformation, of the Spanish wars and the defeat of the Armada, of the colonisation of America, no less than the age of Shakespeare and of Bacon.

The great achievements of the age were, however, among the latest fruits of the intellectual life of the nation. During the actual struggles of the Reformation literary power had been perverted and literature stunted by the all-pervading spirit of theological controversy. The Elizabethan literature does not really begin till the latter half of the reign of Elizabeth, and extends to the close of that of James I. When the queen began her reign Spenser was a mere child, and neither Shakespeare nor Bacon was born.

But when the literary harvest did begin it came with a richness never known in any age or country. The mere number of writers in this period, and the extent of their writings, would by itself distinguish it from all others. The poets who wrote during it are counted by hundreds. And the student who bears in mind the barrenness of the preceding age will appreciate the importance of this fact. But almost more extraordinary than the extent of the Elizabethan literature is its variety. The philosophy of Bacon, the poetry of Spenser, and the drama of Shakespeare are types of literary power as dissimilar to one another as can well be imagined. Nor ought we to fail to observe the universality with which the literary impulse was diffused throughout the people. This literature was not only national in the sense of expressing the most ardent patriotism in the most powerful forms, but in the sense, too, that all classes of the nation contributed to it. Sidney and Raleigh, the courtly cavaliers; Bacon, the diligent lawyer, son of a shrewd and successful statesman; Shakespeare, the tradesman's son from a small country town, represent extremely different classes of the social whole. In short, the student who gives most attention to the Elizabethan literature will most fully feel how it is marked by the same qualities that characterise the whole life of England in that day—unequalled extent and unequalled variety of energy and power.

There is one poem produced at quite the commencement of the reign of Elizabeth which must not be passed by, for while its intrinsic merit is considerable, its interest, as marking a transition period in literature, is even greater. Thomas Sackville, Lord Buckhurst, and afterwards Earl of Dorset, was both an eminent statesman and an eminent writer in more than one department of literature. We shall have occasion to speak of him hereafter as a dramatist. At present we have to do with him as the designer and in part the writer of a poem or series of poems of extraordinary popularity in their day, entitled, "The Mirror for Magistrates." Sackville's idea seems to have been to bring together for didactic purposes in a poetical form the history of the most illustrious men in the history of England whose career was unfortunate. He himself wrote only the "Induction," or introduction to the work, and the story of the Duke of Buckingham, first the associate and afterwards the victim of Richard III. The remainder of the work is by various hands, and, for the most part, of inferior merit. Richard Baldwyne, George Ferrers, Thomas Churchyard, Thomas Phaer, a Welsh physician and poet, and a less-known writer, John Higgins, were contributors to it. Sackville's own share of the work shows much vigour of imagination, a singular power of description, with great skill in versification; but his music is all in one key, his thoughts are entirely of the gloomy and the painful. We give a few specimens from his "Induction," upon the same principle which we adopt throughout these lessons—that is, to enable the student, by a chain of extracts, to follow the changes in our language and in the style of English versification. The poet, reflecting upon the tragic fate of great men, meets with the impersonation of Sorrow:—

"Musing on this worldly wealth in thought,
Which comes and goes, more faster than we see
The flickering flame that with the fire is wrought,
My busy mind presented unto me
Such fall of peers as in the realm had bee,
That oft I wisht some would their woes descryve,
To warn the rest whom fortune left a live.

"And strait forth stalking with redoubled pace,
For that I sawe the night drew on so fast,
In blacke all clad there fell before my face
A piteous wight, whom woe had all forewast;
Forth on her eyes the crystal tears outbrast,
And sighing sore, her hands she wrong and folde,
Tore all her hair, that ruth was to beholde.

"Her body small, forwithred, and forspent,
As is the stalk that sommer's drought opprest,
Her wealked face with woefull teares bee sprent,
Her colour pale, and, as it seemed her best,
In woe and plaint reposed was her rest;
And as the stone that drops of water wears,
So dented were her chekes with fall of teares.

"Her eyes swollen with flowing streams aflote,
Where, with her lookes throwne up full piteously,
Her forceless hands together oft she smote,
With dolefull shrikes, that echoed in the skye;
That, in my doome, was never man did see
A wight but halfe so woe-begone as she."

Sorrow becomes his guide, and leads him to the infernal regions, where he meets with Remorse, Dread, Revenge, Misery, Care, and other characters, each of whom is described with much power, and in lines which often remind us of some of Spenser's allegorical descriptions. The following striking verses are from the description of old age:—

"But who had seen him, sobbing, how he stoode,
Unto himself, and how he would bemone
His youth forepast, as though it wrought him good
To talk of youth, all were his youth foregone,
He would have mused, and mervaylde much, whereon
This wretched age should life desire so fayne,
And knowes full well lyfe doth but length his payne.

"Crookebackt he was, toothshaken, and blere eyde,
Went on three feet, and sometyme crept on four,
With old lame bones, that rattled by his syde,
His scalp all pild, and he with eld forlore;
His withred fist still knocking at Death's dore,
Fumbling and driveling as he draws his breath
For brief, the shape and messenger of Death."

At last the Duke of Buckingham appears upon the scene, and tells the story of his woes. The whole framework of the poem underwent much alteration, though it certainly received no improvement from its later authors. The stories of later introduction are by no means confined to English character, nor are the characters always brought upon the scene with anything like Sackville's skill and power.

Contemporary with Sackville was George Gascoigne, a poet of a class very characteristic of the times. He was a soldier, a courtier, and a poet—brilliant in all these capacities. The poem by which he is known to posterity is a vigorous satire, in blank verse, upon the manners and vices of his day, quaintly entitled "The Steel Glass."

But, as we have already said, the snpreme greatness of the Elizabethan literature belongs not to the beginning, but to the later period of the reign of the great queen; and this latter portion of her reign may, with respect to poetry, be again divided into two portions—the period of poetry other than dramatic, during which Spenser held the throne of literature; and the period of the drama, during which Shakespeare reigned supreme. Of course, we do not say there were not great plays written before Shakespeare, and beautiful poems written during the period of his greatness. But it is clearly true that, even putting aside the greatest names, Spenser and Shakespeare, poetry was earlier in its development than the drama. We are, therefore, following the natural order when we treat of Elizabethan poetry before the Elizabethan drama.

Among the Elizabethan poets Spenser holds by far the first place, and there can be little doubt that the popularity of his works, the finish which he gave to the English language, and the beanty and music of his versification, contributed much to promote the cultivation of poetry, and to form the style of contemporary poets. But it will be more convenient to treat of Spenser and his works in a separate lesson, and to devote what remains of the present to a very brief account of some of the other poets of his day.

Sir Philip Sidney, whom we shall have to notice hereafter as filling an important place in the history of prose writing in English, and as the generous and discriminating patron of literature, is entitled to a place among the poets of his time, by virtue of his collection of sonnets, which are smooth and graceful, but not distinguished by much force or originality.

Samuel Daniel was a poet of great reputation among his contemporaries, though his poems, with all their ease of versification and purity of style, are not very attractive reading in the present day. He wrote many shorter pieces, but his two largest and most important works are a narrative poem, "The History of the Civil Wars," on the contest between the houses of York and Lancaster; and a dialogue in verse, entitled "Musophilus," which is a sort of defence of literature.

William Warner was by profession an attorney. He was the author of a long poem, which he called "Albion's England." This work, like the "Mirror for Magistrates," the "History of the Civil Wars," and many other of the most popnlar poems of this period, was historical in snbject and narrative in form. It pnrports to be a poetical history of England, from the very earliest times to the writer's own day. From its singular terseness and vigour of style, its variety of incident, and the unusnal descriptive power which it displays, and perhaps to some extent also from a vein of coarseness quite in harmony with the prevalent taste of the day, Warner's work attained a remarkable popularity.

To somewhat the same class as these belong most of the works of another poet of the same period, Michael Drayton. But Drayton was a poet of greater force, and of far greater variety of power. His chief works are "The Barons' Wars," an historical poem on the civil wars of the days of Edward II.; "England's Heroical Epistles," also historical in subject; and his "Polyolbion." The latter singular work is a sort of itinerary in verse of the whole of England and Wales, in which he goes through every part of the country in turn, and gives his readers all the stories and legends which history or popular imagination has attached to each spot. This work is written in a singular and not very attractive metre, one which tends to weary the ear with the monotony of its cadences. It is in long Alexandrine lines of twelve syllables, rhyming in couplets. We give a very few lines, merely as a specimen of the metre:—

"And near to these our thicks, the wild and frightful herds,
Not hearing other noise but that of chattering birds,
Feed fairly on the lawns; both sorts of seasoned deer,
Here walk the stately red, the speckled fallow there;
The bucks and lusty stags amongst the rascals strewed,
As sometimes gallant spirits amongst the multitude."

To most modern readers the lighter poems of Drayton will be found more attractive than the "Polyolbion." In his "Nymphidia," or the "Court of Fairy," his graceful fancies remind the reader of Ben Jonson's lighter poems.

George Chapman was known as a dramatist, but his fame with posterity rests upon his great translation of Homer. This translation is written in what we now call ballad metre, that is to say, in alternate lines of eight and six syllables. But in Chapman's day, the two lines were written as one long line of fourteen syllables. In its rugged vigour this is probably still the best English translation of Homer.

Sir John Davies is a type of a class of whom we meet with many in the Elizabethan period—men who combined an active participation in public affairs, or professional business, with a keen devotion to literature. Davies was an eminent lawyer, filled for a long time the office of Attorney-General in Ireland, and was well known as a prudent statesman. In addition to a few shorter poems, he wrote a long argumentative poem on the immortality of the soul, under the title of "Nosce te ipsum." For its clearness and dignity of style, as well as for the skill of its arguments, this work has been much admired. Sir John Davies was also the author of another work on a singularly dissimilar subject, "Orchestra," a poem in honour of dancing.

Phineas and Giles Fletcher were brothers. They were jointly the authors of a curious and in some respects powerful poem, "The Purple Island." The Fletchers belong quite to the close of the Elizabethan period, and in the very title of this poem, as well as in its substance, we find plain evidence that the force and simplicity of the Elizabethan poetry were beginning to give place to the subtlety and qnaintness which belonged to the next generation. The Purple Island is the human body, and the poem is a full description of the physical and mental attributes of man.

Joshua Sylvester is a poet whose works are little read now, though they once enjoyed a very general popularity. His principal literary productions were translations of the works of the French poet, Du Bartas.

Among the minor poets of the age ought to be mentioned Drummond of Hawthornden, near Edinburgh. He is, perhaps, best known from his intimacy with Ben Jonson; but his sonnets would, had he lived in an age less crowded with poetical genius, have secured him a very distinguished reputation.

Dr. Donne, Dean of St. Paul's, and Joseph Hall, Bishop of Norwich, were the founders of English satire. Bishop Hall was a satirist of considerable power. Donne's satires are familiar to most readers in Pope's modernised version of them.

We have been able to do no more than give a very slight sketch of a few of the most prominent of the Elizabethan poets, other than the dramatists. To attempt more than this would be to turn our lessons into mere catalogues of names. We shall have occasion to show hereafter that many of those who are best known to us as dramatists were also, like Shakespeare himself, no mean poets in other departments as well. In our next lesson we shall give some account of Spenser and his works.

NATURAL HISTORY OF COMMERCE.

CHAPTER V. (*continued*).

THE UNITED KINGDOM: GREAT BRITAIN—RAW PRODUCE, MINERAL, VEGETABLE, ANIMAL (*continued*).

Animal and Vegetable Produce of Great Britain—Population—Agricultural Statistics.

I. *Animal Produce: Domestic Animals of Great Britain.*

Horses.—Hunting and racing are national sports. The English racer, improved with the best Arab blood, has become a type of the highest equine development. Yorkshire and Northamptonshire draught or dray horses, such as used by the London brewers, are peerless in size and strength. The Suffolk Punch for ploughing, and the old Lincolnshire cart-horse, have long been eminent. The twelve sable steeds used to draw the state car at the funeral of the Duke of Wellington were a part of the trade stud of a distiller. The powerful chargers for our cavalry; carriage horses, whose pawing arrests our admiration; and the eight royal creams, whose occasional labour is said to cost £1,000 an hour each, are all distinct breeds and specially broken in for their duty. The Welsh pony is small but notable; and at the extreme in point of size stands the shaggy Shetlander, peculiar to its island home.

Cattle.—Not only our horses, but our domestic cattle are among the finest in the world, although fewer than are needed for consumption. The Devonshire oxen, and the breeds of Gloucester, Hereford, and Sussex are as famous for muscular power as they are for fattening. Comely cows and finely-proportioned steers are the pride of English estates, and breeders compete for honour as well as for profit. The animals of the greatest bulk are those of Lincoln and Tweedside. The latter are of historical note, for during the long period of border warfare the lifting of cattle and the levying of black mail were not merely incidents, but frequent incentives, of quarrel. In our days, Scotch kine are transported to the rich southern pastures to fatten for market. Dairy produce must not be undervalued, for milk is consumed by young and old, and its secondary products, butter and cheese, enter more largely into the constituents of the food of every family than any substance except bread. The localities most favoured for dairy produce are referred to below.

Sheep.—Lincolnshire, Norfolk, Sussex, Wiltshire, and the Cheviots have given names to famous breeds of sheep, and, taking into account the fleece as well as the flesh, none are equal to ours. By skilful crossing, the maximum of meat and wool of the best quality has been combined in the same animal.

Swine.—Berkshire, Gloucestershire, and Sussex have given names to breeds of pigs. The fame of Wiltshire bacon, York hams, and Berwick pork suggests a widespread attention to these animals. Indeed, any British farm would hardly be complete without a well-filled sty or hog-pen. Turned into the woods in autumn, swine will feed greedily upon acorns, beech mast, chestnuts, and other dry indehiscent fruits, without browsing upon young trees and destroying them.

Poultry.—Amongst the minor produce of the farm, poultry stands highest, and the common domestic fowl first. Turkeys and geese, at certain seasons, are fattened and brought to market in enormous numbers, providing us with an important supply of food.

Wild Animals.—The wild animals of Great Britain do not differ from those of Europe, and require but a brief reference. The bear, wolf, boar, fox, and wild ox once dwelt in our forests, and the beaver built on our river-banks. All but the fox and the ox have long since been extirpated. Wild oxen, unique types of our domestic breeds, are preserved with exclusive care in the spacious parks of Chartley, in Derbyshire, and Chillingham, the seat of Earl Tankerville, in Northumberland. They are smaller than the common ox, cream-white in colour, with the exception of the ears, which are red, and the muzzle, which is black. Permitted to range at will through spacious parks, they retain many of the wild habits of their tribe. The fox has received the doubtful privilege of being preserved for the chase. On the borders of Cornwall a few stags are still found in their natural state, and more exist in the mountains and the wooded parts of Scotland, especially in the forest of Athol. The roebuck, which seeks the hills only, is also occasionally met with there. The fallow-deer of our parks are of foreign introduction, but have taken so well to the climate that the French imperial parks have been stocked from England. By a severe system of preserving (a relic of ancient forest laws), hares, partridges, pheasants, and in the north red grouse, continue abundant, despite the progress of agriculture and the extension of towns. Water-fowl frequent the fens, the most numerous being varieties of the wild duck, and sea-birds make the northern cliffs their home. The rivers of Britain contain fresh-water fish, the delight of anglers, but little regarded as a source of food, except the salmon. The Welland and the Witham are so alive at times with the tiny stickleback, that farmers use them by the bushel for manure.

II. *Vegetable Produce: Food Substances for Man and Animals.*

Of the substances grown for the food of man, corn stands first; and of the different kinds, wheat is so important that it nearly reaches in value all others. Reading, Guildford, and Uxbridge are the local markets for the finest white wheats, produced in the fertile fields forming the basin of the Thames, and London for the like wheat from the south-eastern counties. The soil between the estuaries of the Wash and the Thames is equally renowned for the growth of red wheat, a variety of inferior value but greater yield. Wheat does not ripen further north than the line of lochs running from Loch Linnhe to the Moray and Dornoch firths. Next to corn, green vegetables form the chief supply of food for all classes of people, the great towns being girdled with productive market-gardens.

Food crops for animals form an essential part of the industry of the husbandman, and consist of both grasses and roots. The grass, the oats, and hay of England are matchless. A few weeks' feed in the alluvial marshes of the Thames restores imported foreign cattle from the effects of the roughest voyage, covers them with flesh, and fits them for the shambles. The root crops are either fed off upon the open field or are stored for winter food.

Fruits.—Of fruit-trees the species are not many, but the varieties are numerous. At the head of these is the apple, cultivated as a wholesome article of food, as a dessert fruit, and for cider. This fruit abounds in every part of the kingdom, but the Armorican region of the west and south-west of England is the cider district.

The pear is only next in value to the apple, flourishing under similar conditions of climate and soil, and furnishing a beverage called perry, chiefly made in Worcestershire.

Our orchards and gardens are enriched still further with drupes, or fruits of the almond tribe, as the plum, the apricot, and the cherry. The produce of the garden also includes gooseberries, currants, strawberries, and other small fruits, culinary vegetables, and sweet herbs. Some of these were brought from Holland in the reign of Henry VII. The cherry is said to have been brought from the East. The indigenous fruits are very few, limited, probably, to the crab apple, the sloe, the bramble, the gooseberry, and the raspberry.

Timber.—England has always been famed for her forests, which neither the enormous demand for ship and house-building, nor the exigencies of improved farming, have yet caused to disappear. Most of the exogens valued for their timber are found in England. The largest forests are Crown property, and still grow oak for the navy. Such are the New Forest, covering 400 square miles; the Forest of Dean, in Gloucestershire, of 144 square miles, and others of smaller area. Many parts of historical note have long been disafforested, or thrown open to common use. Dartmoor and Charnwood, for example, are forests only in name. Science has lent the aid of iron as a partial substitute for wood, and we annually supplement our native stores by 4,000,000 loads of timber, 36 cwt. to the load, from British possessions and foreign parts.

The mountains and islands of Scotland are singularly treeless and bare. There are, however, a few extensive growths of fir, particularly in Aberdeen. The landed proprietors have of late years beautified their estates with larches, carrying out the behest of the laird of Dumbiedikes, "Jock, when ye hae naething else to do, ye may be aye sticking in a tree; it will be growing, Jock, when ye are sleeping."

The chief varieties of British timber trees are the beech, the chestnut, the elm, the oak, and the lime. In the south, the ash, the poplar, and the birch are specially numerous, and the Scotch fir reaches to the northernmost parts of the islands.

Great Britain contrasts with Ireland in the occupations of its inhabitants, a larger per-centage being engaged in mining, manufactures, and commerce than in the varied pursuits of agriculture. Of the three divisions of Great Britain, only Wales shows a larger per-centage of its population employed in agriculture than in other forms of industry; yet the wealthiest and the densest parts are the mineral counties. To the end of the eighteenth century, the people of England and Scotland were more engaged in agriculture than in mining and manufacture; but the development of their mineral wealth has since been so great as to transpose the respective industries, and the tendency is at the present time still more rapidly in the same direction. Agriculture advances absolutely, but relatively it retrogrades.

The subjoined tables will help to summarise and elucidate the details of the foregoing chapters.

POPULATION OF THE UNITED KINGDOM, 1871.

Great Britain.		*Ireland.*	*Total.*
England,	21,495,491	5,411,416	31,483,700
Scotland,	3,360,018		
Wales,	1,216,775		

AVERAGE TO THE SQUARE MILE.

		Great Britain.	*Ireland.*
England	419	= 293	166
Scotland	110		
Wales	165		

DISTRIBUTION OF POPULATION ACCORDING TO OCCUPATIONS.

	Mining, Manufactures, Commerce.	*Agriculture.*
England	17 per cent.	7·7 per cent.
Scotland	18 „	8·8 „
Wales	10 „	11·4 „

POPULATION ACCORDING TO COUNTIES.

DENSEST POPULATION. *Manufacturing or Mining Counties.*		LEAST POPULATION. *Moorlands or Agricultural Counties.*	
ENGLAND.			
Middlesex	8,974 to sq. mile.	Westmoreland	83 to sq. mile.
Lancashire	1,494 „	Cumberland	145 „
Stafford	750 „	North Riding of Yorkshire	138 „
West Riding of Yorkshire	670 „		
Durham	677 „		
Cheshire	509 „		
WALES.			
Glamorgan	465 to sq. mile.	Merioneth.	77 to sq. mile.
Flint	288 „		
Anglesea	169 „		

Of the cultivated land in England, 40 per cent. is arable, and 60 per cent. meadows, pastures and marshes. In Wales 30 per cent. is under tillage and 70 per cent. is in pasture.

DISTRICTS OF ARABLE HUSBANDRY.

ENGLAND.—Kent, Essex, Suffolk, Norfolk, Hampshire, Berkshire, Bedford, Surrey, Sussex, Hertford, parts of Yorkshire and Lincolnshire, Durham, and Northumberland.

SCOTLAND.—The Lothians, Berwick, Dumfries, Ayr, Renfrew, Lanark, Fife, Carse of Gowrie, parts of Aberdeen, Elgin, and Nairn.

DISTRICTS OF DAIRY HUSBANDRY.

ENGLAND.—Cheshire, Shropshire, Gloucester, Wiltshire, Buckingham, Essex, York, Derby, Cambridge, Dorset, and Devon.

PASTORAL AND CATTLE-REARING DISTRICTS.

Lincoln, Somerset, Leicester, Northampton, parts of Durham and of the North and East Ridings of Yorkshire, and the Downs.

PER-CENTAGE OF INHABITANTS ENGAGED IN AGRICULTURE.

Lincolnshire, 16%; other districts, as above, 10% to 14%; Middlesex, 1%.

LESSONS IN GREEK.—XXXII.

THE AUGMENTS.

THE AUGMENT AND THE REDUPLICATION.

THE augment is specifically the token of past time. Consequently, it forms a part of the historical tenses—namely, the imperfect, the pluperfect, and the aorist; but it is retained in no other mood than the indicative. The perfect, though a principal tense, takes a reduplication, and to this reduplicated form an augment is prefixed to form the pluperfect.

The augment, considered as distinct from the reduplication, appears in two forms. Of these, one is called the *Syllabic;* the other the *Temporal.*

THE SYLLABIC AUGMENT.

The syllabic augment is an ε, which in verbs whose root begins with a consonant is prefixed to the stem of the imperfect and the aorist, and to the reduplication in the pluperfect. Thereby is the word augmented (hence the name) by one syllable in the imperfect and the aorist, and by two syllables (including the reduplication) in the pluperfect—*e.g.*, λυω, imperfect ε-λυον, aorist ε-λυσα, pluperfect ελελυκειν.

When the root begins with ρ, the ρ is doubled before receiving the augment, as ῥιπτω (*I throw*), imperfect ἐῤῥιπτον, aorist ἐῤῥιψα.

In the three verbs βουλομαι (*I will*), δυναμαι (*I am able*), and μελλω (*I intend*), the augment sometimes, and especially in the later writers, is η instead of ε; as, imperfect ηβουλομην as well as εβουλομην, aorist ηβουληθην as well as εβουληθην, imperfect ηδυναμην as well as εδυναμην, aorist ηδυνηθην as well as εδυνηθην (instead of εδυνασθην), imperfect ημελλον as well as εμελλον: the aorist is very seldom ημελλησα.

THE TEMPORAL AUGMENT.

The temporal augment is prefixed to verbs whose root begins with a vowel, and consists in the lengthening of that vowel. The lengthening is made by the conversion of a short vowel into a long vowel; thus—

α becomes η, as ἄγω (*I lead*), imp. ηγον, perf. ηχα, plup. ηχειν.
ε „ η, „ ελπιζω (*I hope*), imp. ηλπιζον, perf. ηλπικα, plup. ηλπικειν.
ῐ „ ῑ, „ ἱκετευω (*I entreat*), imp. ῑκετευον, perf. ῑκετευκα, plup. ῑκετευκειν.
ŏ „ ω, „ ὁμιλεω (*I accompany*), imp. ὡμιλεον, perf. ὡμιληκα, plup. ὡμιληκειν.
ῠ „ ῡ, „ ὑβριζω (*I insult*), imp. ῡβριζον, perf. ῡβρικα, plup. ῡβρικειν.
αι „ ῃ, „ αἱρεω (*I take*), imp. ᾑρεον, -ουν, perf. ᾑρηκα, plup. ᾑρηκειν.
αυ „ ηυ, „ αυλεω (*I play on the flute*), imp. ηυλεον, -ουν, perf. ηυληκα, plup. ηυληκειν.
οι „ ῳ, „ οικτιζω (*I pity*), imp. ῳκτιζον, perf. ῳκτικα, plup. ῳκτικειν.

In αἱρεω, ᾑρουν, the α is lengthened into η, and the ι is subscript; thus, ῃ. In αυλεω, ηυλουν, the α is simply lengthened into the η. In οικτιζω, ῳκτιζον, the ο is lengthened into ω, and the ι is subscript; thus, ῳ.

The augment does not appear in the verbs which begin with η, ι, ῡ, ω, ου, and ει, inasmuch as the initial syllables are already long; as ἡτταομαι (*I submit*, I am worse, inferior), perf. ἡττημαι, plup. ἡττημην; ἰποω (*I press upon*), aor. ιπωσα; ὑπνοω (*I put to sleep*), aor. ὑπνωσα; ωφελεω (*I benefit*), imp. ωφελουν; ουταζω (*I wound*), imp. ουταζον; εικω (*I yield*), imp. εικον, aor. ειξα. Εικαζω (*I liken, guess*) forms an exception, which, though but seldom, changes the ε into η and underwrites the ι, thus giving rise to these two forms, εικαζον, ῃκαζον; εικασα, ῃκασα; εικασμαι, ῃκασμαι.

Those verbs are also commonly without the augment whose root begins with ευ—*e.g.*, ευχομαι (*I pray*), ευχομην, less often ηυχομην, but the pluperfect is ηυγμαι, the ε being augmented into η. Εὑρισκω (*I find*) in good prose rejects the augment.

Verbs which begin with ᾰ and a following vowel have in the augmented form ᾱ instead of η, as αἰω (a poetic word), *I feel* or *apprehend*, imp. ᾱἰον. In those which begin with ᾱ, αυ, οι, and a following vowel, there is no change for the augment, as ἀηδιζομαι, *I am displeased*, imp. ἀηδιζομην; αυαινω, *I dry up*, imp. αυαινον; οιακιζω, *I steer*, imp. οιακιζον; also ανᾰλισκω, *I destroy*, though no vowel follows the ᾰ, has ανᾱλωσα, ανᾱλωκα, and also ανηλωσα and ανηλωκα. However, the poetic αειδω (in prose ᾳδω), *I sing*, and αἰσσω (Attic ᾳσσω), *I rush*, take the augment, as ηειδον (in prose ηδον), ηἶξα (Attic ηξα). Οιομαι, *I think*, imp. ῳομην, does not belong to this class, because the ο following the οι is not a part of the root.

There is no augmental change, also, in some verbs beginning with οι and a following consonant, as οικουρεω, *I govern a house*, aorist οικουρησα; οινιζω, *I desire wine*, imp. οινιζον; οινοω, *I indulge in wine*, perf. mid. or pass. οινωμενος and also ῳνωμενος; οιστραω, *I madden*, aor. οιστρησα.

The following verbs beginning with ε have for their augment ει instead of η:—

Εαω, *I permit*, imp. ειων, aor. ειασα.

Εθιζω, *I accustom*, aor. ειθισα, perf. ειωθα, *I am accustomed*; εισα (from the stem εδ), *I establish*, is poetic; in prose there are only εισαμενος and εσαμενος, *grounding, instituting*.

Ἑλισσω, *I wind, roll*, perf. mid. or pass. εἰλιγμαι.

Ἑλκω, *I draw, drag*, aor. εἱλκυσα (stem, ἑλκυ), εἱλον (stem, ἑλ), *I took*, commonly called the aorist of αἱρεω, *I choose, take*.

Ἑπομαι, *I follow*, imp. εἱπομην.

Εργαζομαι, *I labour*, perf. ειργασμαι.

Ἑρπω (ἑρπυζω), *I creep*, aor. 2 εἱρπον.

Ἑστιαω, *I entertain a guest*, perf. εἱστιᾱκα.

Εχω, *I have*, aor. 2 ειχον.

The ensuing verbs take the syllabic augment instead of the temporal; namely—

Αγνυμι, *I break*, aor. εαξα; perf. 2 εᾱγα, *I am broken*.

Ἁλισκομαι, *I am being caught*, perf. ἑᾱλωκα, also ἡλωκα, *I am caught*.

Ἁνδανω, *I please*, imp. ἑανδανον, perf. ἑᾱδα, aor. 2 ἑᾰδον.

Ωθεω, *I push*, imp. εωθουν; sometimes without augment, as διωθουντο.

Ωνεομαι, *I purchase*, imp. εωνουμην, also ωνουμην.

The verb ἑορταζω, *I celebrate a festival*, takes the augment in the second syllable, as imp. ἑωρταζον. This happens, also, in

Εικω, *I resemble*, perf. 2 εοικα, *I am like*; εοικε, *it is likely*; plup. εῳκειν.

Ελπομαι, *I hope*, perf. 2 εολπα, plup. εωλπειν } poetic.
Εργω, *I do*, perf. 2 εοργα, plup. εωργειν }

The following three verbs have both the syllabic and the temporal augment; the aspirate of the root passes to the augment ε:—

Ὁραω, *I behold*, imp. ἑωρων, perf. ἑωρακα, ἑωραμαι.

Ανοιγω, *I open*, imp. ανεῳγον, aor. ανεῳξα (infin. ανοιξαι).

Αλισκομαι, *I am being caught*, aor. ἑαλων (infin. ἁλωναι), also ἡλων.

THE REDUPLICATION.

The reduplication is used only when the root begins with a single consonant, or with a mute and a liquid, excepting verbs beginning with ρ, βλ, γλ, γν, which take the simple augment.

	Perfect.	*Pluperfect.*
Λυω, *I loose*,	λελυκα,	ελελυκειν.
Θυω, *I sacrifice*,	τεθυκα,	ετεθυκειν.
Φυτευω, *I plant*,	πεφυτευκα,	επεφυτευκειν.
Χορευω, *I dance*,	κεχορευκα,	εκεχορευκειν.
Γραφω, *I write*,	γεγραφα,	εγεγραφειν.
Κλινω, *I bend*,	κεκλικα,	εκεκλικειν.
Κρινω, *I judge*,	κεκρικα,	εκεκρικειν.
Πνεω, *I breathe*,	πεπνευκα,	επεπνευκειν.
Θλαω, *I break*,	τεθλακα,	ετεθλακειν.
Ῥιπτω, *I throw*,	ἐρριφα,	ἐρριφειν.
Βλακευω, *I am lazy*,	εβλακευκα,	εβλακευκειν.
Γλυφω, *I grave*,	εγλυφα,	εγλυφειν.
Γνωριζω, *I make known*,	εγνωρικα,	εγνωρικειν.

Yet βλαπτω, *I injure*, takes the reduplicative; as—

βλαπτω, βλαψω, βεβλαφα, βεβλαμμαι.

Besides the verbs that begin with ρ, βλ, γλ, γν, those verbs also take the simple augment whose root begins with a double consonant, or with two single consonants (provided they are not a mute and a liquid), and those which begin with three consonants; as—

	Perfect.	*Pluperfect.*
Ζηλοω, *I am eager for*,	εζηλωκα,	εζηλωκειν.
Ξενοω, *I receive as a guest*,	εξενωκα,	εξενωκειν.
Ψαλλω, *I sing to the lyre*,	εψαλκα,	εψαλκειν.
Σπειρω, *I sow*,	εσπαρκα,	εσπαρκειν
Κτιζω, *I found*,	εκτικα,	εκτικειν.
Πτυσσω, *I fold*,	επτυχα,	επτυχειν.
Στρατηγεω, *I am a general*,	εστρατηγηκα,	εστρατηγηκειν.

The two verbs μιμνησκω (root μνα), *I remind*, and κταομαι, *I acquire*, though their root begins with two consonants which are not a mute and a liquid, yet take the reduplication; as μιμνησκω, μεμνημαι, ε-με-μνημην; κε-κτημαι, ε-κε-κτημην.

Five verbs beginning with a liquid do not repeat that sound, but take as augment ει, namely—

	Perfect.	*Pluperfect.*
Λαμβανω, *I take*,	ειληφα,	ειληφειν.
Λαγχανω, *I get by lot*,	ειληχα,	ειληχειν.
Λεγω, συλλεγω, *I collect*,	συνειλοχα,	συνειλοχειν.
Ῥεω, *I say*,	ειρηκα,	ειρηκειν.
Μειρομαι, *I receive as my share*.	Εἱμαρται, *it is resolved*.	

Διαλεγομαι, *I discourse*, has for its perfect διειλεγμαι, though the simple λεγω, in the sense of *I say, speak*, has instead the regular reduplication, λελεγμαι.

THE ATTIC REDUPLICATION.

Several verbs beginning with α or ε or ο repeat in the perfect and the pluperfect, before the temporal vowel, the two first letters of the stem. This augmentation is called the Attic reduplication. The pluperfect very seldom takes a new augment, as διωρωρυκτο, from ορυσσω (*I dig*), fut. ορυξω, perf. ορ-ωρυχα, perf. pass. or mid. ορ-ωρυγμαι, plup. ορ- and ωρ-ωρυγμην. In ηκ-ηκοειν the pluperfect is regular.

The temporal augment, as well as the reduplication, remains in all the moods as well as in the participle.

The Attic reduplication affects verbs of two classes:—

1. Verbs whose stem-syllable is short by nature, *e.g.*—

Αροω, *I plough*,	αρ-ηροκα, αρ-ηρομαι, αρ-ηροκειν, αρ-ηρομην.
Ελεγχω, *I convince*,	ελ-ηλεγχα, ελ-ηλεγμαι, ελ-ηλεγχειν, ελ-ηλεγμην.
Ελαω (ελαυνω), *I drive*,	ελ-ηλακα, ελ-ηλαμαι, ελ-ηλακειν, ελ-ηλαμην.
Ορυττω, *I dig*,	ορ-ωρυχα, ορ-ωρυγμαι, ορ-ωρυχειν, ορ-ωρυγμην.

2. Verbs which in the second syllable of the stem have a vowel long by nature, which after prefixing the augment they shorten; except ερειδω, *I support*, stem ερ-ηρεικα, ερ-ηρεισμαι.

Αλειφω, *I anoint*,	αλ-ηλιφα, αλ-ηλιμμαι, αλ-ηλιφειν, αλ-ηλιμμην.
Αγειρω, *I collect*,	αγ-ηγερκα, αγ-ηγερμαι, αγ-ηγερκειν, αγ-ηγερμην.
Ακουω, *I hear*,	ακ-ηκοα, ηκουσμαι, ηκ-ηκοειν, ηκουσμην.
Εγειρω, *I awake, arouse*,	εγ-ηγερκα, εγ-ηγερμαι, εγ-ηγερκειν, εγ-ηγερμην.

The verb αγω, *I lead*, forms also the second aorist active and middle with this reduplication, only that the vowel of the reduplication takes the temporal augment, and retains it in the indicative, and the vowel of the stem remains pure; as in the following—

Αγω, aor. 2 act. ηγ-αγον, inf. αγαγειν; aor. 2 mid. ηγ-αγομην, inf. αγαγεσθαι.

AUGMENT AND REDUPLICATION IN COMPOUND VERBS.

Verbs compounded of a preposition and a verb take the augment between the verb and the preposition. In the change, prepositions ending in a vowel (except περι and προ) have the vowel elided; but προ generally mingles by crasis with the ε of the augment, forming πρου: εκ before the syllabic augment becomes εξ, and the ν in εν and συν is either dropped or assimilates itself to the initial consonant of the verb; for example:—

Present.	*Imperfect.*	*Perfect.*	*Pluperfect.*
Απο-βαλλω, *I throw away.*	απ-εβαλλον,	απο-βεβληκα,	απ-εβεβληκειν.
Προ-βαλλω, *I throw before,*	προ-εβαλλον, προυβαλλον,	προ-βεβληκα,	προ-εβεβληκειν. προυβεβληκειν.
Εκ-βαλλω, *I throw out.*	εξ-εβαλλον,	εκ-βεβληκα,	εξ-εβεβληκειν.
Συλ-λεγω, *I collect,*	συν-ελεγον,	συν-ειλοχα,	συν-ειλοχειν.
Εγ-γιγνομαι, *I arise in.*	εν-εγιγνομην,	εγ-γεγονα,	εν-εγεγονειν.
Εμ-βαλλω, *I throw in.*	εν-εβαλλον,	εμ-βεβληκα,	εν-εβεβληκειν.

In αποβαλλω, the ο of the preposition is dropped before the vowel of εβαλλον, to prevent the hiatus occasioned by two vowels coming immediately together; but as in βεβληκα the reason ceases, so the ο is resumed, and you have αποβεβληκα; yet again απ-εβεβληκειν. In συλλεγω the λ of the verb has changed the ν of the preposition into its own sound, namely, λ; but when the preposition is not immediately subjected to the form of the λ, it resumes its own ν, as in συνελεγον.

Verbs which are made up of δυς, *hardly, with difficulty,* take the augment of the reduplication (1) in front, or at the beginning, when the root of the simple verb begins with a consonant or with η or ω; and (2) in the middle, when the root of the simple verb begins with any other vowel except η and ω; *e.g.*—

Present.	*Imperfect.*	*Perfect.*	*Pluperfect.*
Δυς-τυχεω, *I am unfortunate.*	ε-δυς-τυχουν,	δε-δυς-τυχηκα,	ε-δε-δυς-τυχηκειν.

These two laws are observed by compounds of ευ, *well,* only that such compounds avoid the augment at the beginning; also ευεργετεω, *I do well to, I benefit,* commonly avoids the augment in the middle; *e.g.*—

	Imperfect.	
Ευ-τυχεω, *I am fortunate,*	ηυ-τυχεον, commonly ευ-τυχεον.	
Ευ-εργετεω, *I serve,*	ευ-ηργετεον, commonly ευ εργετεον,	perf. ευ-ηργετηκα, but ευ-εργετηκα.

Verbs derived from compound nouns or adjectives take the augment at the beginning; *e.g.*—

	Imperfect.	*Perfect.*
Μυθολογεω, *I narrate,* (from μυθολογος),	ε-μυθολογουν,	μεμυθολογηκα.
Οικοδομεω, *I build,* (from οικοδομος),	ῳκοδομουν,	ῳκοδομηκα.

Some verbs compounded with prepositions take the augment in both places, that is, in the root and in the preposition; *e.g.*—

Present.	*Imperfect.*	*Perfect.*	*Aorist.*
Ανορθοω, *I set upright,*	ηνωρθουν,	ηνωρθωκα,	ηνωρθωσα.
Ανεχομαι, *I support.*	ηνειχομην,	ηνεσχημαι,	ηνεσχομην.

The analogy of these verbs is followed by two other verbs which are not formed with the aid of prepositions, but by derivation from other compounds; *e.g.*—

Διαιταω (from διαιτα, *subsistence*), *I feed,* imp. εδιῃταον and διῃταον, aor. εδιῃτησα and διῃτησα, perf. δεδιῃτηκα; mid. διαιταομαι, *I live,* διῃταομην.

Διακονεω (from διακονος, *a servant,* our *deacon*), *I serve,* imp. εδιηκονεον and διηκονεον, perf. δεδιηκονηκα.

As exceptions, some verbs compounded with prepositions take the augment before the preposition. These are verbs in which the preposition and the verb have so coalesced as to present the signification of a simple verb; *e.g.*—

Αμφιγνοεω (νοεω, *I think*), *I am in doubt,*	impf.	ημφιγνοεον.
Αμφιεννυμι, *I put on, clothe,*	aor.	ημφιεσα, pf. m. or p. ημφιεσμαι.
Αφιημι, *I dismiss, send forth,*	imp.	αφιεον and ηφιεον or ηφιειν.
Καθεζομαι, *I sit myself, I sit down,*	,,	εκαθεζομην and καθεζομην.
Καθημαι, *I sit,*	,,	εκαθημην and καθημην.

An apparent exception is offered by those verbs which are formed not by a combination of a simple verb with a preposition, but from an already compounded word; *e.g.*—

	Imperfect.
Εναντιοομαι, *I oppose* (from εναντιος),	ηναντιοομην,
Προφητευω, *I prophesy* (from προφητης),	επροφητευον,

where εναντιος is made up of εν, *in,* and αντι, *against;* and προφητης is made up of προ, *before,* and φημι, *I say.*

Exercise 94.—Greek-English.

N.B.—Tell the part and give the English of each of these forms:—

1. Ηνωρθουν. 2. Επαρῳνουν. 3. Ηνωχλησα. 4. Ηνωρθωκα. 5. Εδιηκονεον. 6. Διῃταομην. 7. Ηνειχομην. 8. Εμυθολογουν. 9. ῳκοδομηκα. 10. Εῤῥιπτον. 11. Ηγον. 12. Ηλπικα. 13. Ἱκετευκα. 14. Ὡμιληκα. 15. ῳκτικα. 16. Ευχομην. 17. Αναλωσα. 18. Ειπομην. 19. Εκτικειν. 20. Ειληφειν. 21. Ορωρυγμαι. 22. Απεβαλλον. 23. Συνεσκευαζον. 24. Δυσηρεστουν. 25. Ευεργετηκα. 26. Μεμυθολογηκα.

The student should not only give the English and assign the part (mood, tense, etc.), but explain the formation of each word, giving the derivation, the manner in which the several parts are produced, and the rule or remark which the formation exemplifies, as set forth in what precedes.

KEY TO EXERCISES IN LESSONS IN GREEK.—XXXI.

Exercise 90.—Greek-English.

1. The enemy are making an expedition against our city. 2. We will consult respecting the safety of the citizens. 3. The father told me that he would go. 4. The Greeks made an expedition against the Persians. 5. Let us rest, my friends. 6. Consult well before action. 7. All wish to taste honour. 8. The father will go when he has rested. 9. The gates will have been shut by night. 10. If such a man attends to the constitution, it will have been well cared for (*consulted about*).

Exercise 91.—English-Greek.

1. Πεπαιδευσομαι. 2. Πεπαιδευσεται. 3. Πεπαιδευσομεθα. 4. Πεφυτευσονται. 5. Πεφονευσεται. 6. Ὁ στρατηγος επι την πολιν πορευσεται. 7. Ὁ στρατηγος επι την πολιν επορευσεν. 8. Ὁ στρατηγος επι την πολιν πορευσηται. 9. Ὁ στρατηγος επι την πολιν πορευσαιτο. 10. Βεβουλευσομεθα περι της πατριδος σωτηριας. 11. Βουλευσεται περι της σης σωτηριας. 12. Περι της των πολιτων σωτηριας εβουλευσατο. 13. Επαυσαντο. 14. Πεπαυσονται. 15. Παυσεται. 16. Ὡ δυο ανθρωπω επαυσασθην. 17. Παυσομεθα, ω φιλοι. 18. Οἱ φιλοι πορευσονται. 19. Οἱ φιλοι πορευσονται. 20. Οἱ φιλοι επορευσαντο.

Exercise 92.—Greek-English.

1. Hector was slain by Achilles. 2. The two brothers were educated by the same teacher. 3. Many democracies were destroyed by the usurpers. 4. Great fear possesses the citizens lest the treaty should have been broken by the enemy. 5. Would that all youths were well educated. 6. Death to thee (*be thou slain*), thou villain. 7. The soldiers are said to have marched into the enemy's land. 8. The enemy, having broken the treaty, are coming to war against us (lit., *are bringing war against*). 9. The robber shall be slain.

Exercise 93.—English-Greek.

1. Φονευθησονται. 2. Εφονευθησαν. 3. Εφονευθη. 4. Δυο στρατιωτα εφονευθητην. 5. Πολλοι ανθρωποι φονευθησονται. 6. Παιδευθησομαι. 7. Παιδευθησεται. 8. Παιδευθησομεθα. 9. Παιδευθησεσθον. 10. Ευ επαιδευθην. 11. Ἡ πολιτεια κατελυθη. 12. Ἡ πολιτεια καταλυθησεται. 13. Αἱ συνθηκαι κατελυθησαν. 14. Αἱ συνθηκαι καταλυθησονται. 15. Των συνθηκων λυθεισων οἱ πολιται εφονευθησαν. 16. Οἱ λῃσται εφονευθησαν. 17. Οἱ λῃσται φονευθηναι λεγονται. 18. Ἡ δημοκρατια καταλυθησεται.

LESSONS IN GEOLOGY.—XV.

UPPER SILURIAN.

The upper Silurian may be divided into three groups :—

Ludlow group	2,500 feet.
Wenlock group	2,300 „
Upper Llandovery or May Hill group	4,000 „

The *May Hill Sandstone* is developed in the Malvern range, and in its lithological character so resembles the Caradoc group that at first the two were confounded. Professor Sedgwick first pointed out the mistake; he considered these rocks to be the proper base of the upper Silurians. They rest unconformably on the beds below them, and are perfectly distinct from the lower Silurians. In the Malvern hills they exhibit a thickness of some 600 feet, and are composed of calcareous sandstones, which are nodular at the top.

From the general and abundant distribution of the brachiopod, the *Pentamerus lævis* (Fig. 39), these beds are sometimes called Pentamerus beds. With this fossil another is usually associated—the *Pentamerus oblongus* (Fig. 42); but this latter is by some geologists considered only to be the young *Pentamerus lævis.* As they are wanting in the groups both above and below, they are very characteristic of these beds; and as is generally the case when a fossil has in one place a deep sea range, its representatives are very widely distributed. The corresponding Silurian rocks both in America and Russia produce these Pentameri. In Fig. 40 is represented a broken fossil of the *Pentamerus lævis,* and in Fig. 41 the internal cast of the same is shown. Besides these, about sixty specimens of fossils have been found in these beds. About one-half of them extend into other beds of the upper Silurian, and some few are found in the lower. Immediately resting upon the May Hill sandstone is a pale fine-grained slate, which sometimes runs so fissile as to be shaley. Near Tarannon, in Montgomeryshire, the bed reaches the thickness of 1,000 feet, hence it is called the *Tarannon shales.* It contains but few fossils, and they bear a great resemblance to those of the next surrounding rocks, the

Wenlock Formation.—This group admits of a division, the upper and lower Wenlocks. The upper comprises the *Wenlock limestone;* the lower comprises the Wenlock shale, and the Woolhope limestone.

The *Woolhope Limestone* is massive and nodular, interstratified with grey shales, and underlying it are fine slabs or flagstones. Of this bed the mountain ranges of North and South Wales are generally formed, and wherever it is found on the surface the aspect is barren and bleak.

The *Wenlock Shale,* which succeeds in the upward order the Woolhope grit, is the most prominent member of the Wenlock formation. It is a thick mass of fine argillaceous deposit, and is worked for flagstones and slates. It contains trilobites and a great number of graptolites, together with corals, crinoids, and several other species, which are also found in

The Upper Wenlock.—This bed is a limestone, by no means uniform, but sometimes concretionary, sometimes thin and flaggy, and often interstratified with shales. It is exhibited in Shropshire, running some twenty miles from north-east to south-west. The soft shales above and below it have succumbed to the eroding action of the rain, and have been gradually worn away, leaving the limestone in a ridge prominently above the surface; and about a mile distant the same thing has occurred with the Aymestry limestone, so that these two limestone ridges run parallel to each other. This limestone, as in Lesson VIII. we stated was the case with all limestones, was probably built up by organic causes. It is full of fossils, many of them corals, of which there are numerous species; crinoids with their long stems, and cups and arms. The trilobites have several remarkable representatives, as *Calymene Blumenbachii* and *Phacops caudatus,* noted for its large size and flattened form. Some of the most prominent of these fossils are here figured :—Fig. 43, *Cyathophyllum;* Fig. 44, *Heliolites;* Fig. 45, *Catenipora;* Fig. 46, *Cyathocrinus;* Fig. 47, *Calymene Blumenbachii;* Fig. 48, *Phacops caudatus.*

This limestone, before its geological position was fixed, was generally known as the Dudley limestone, and the Calymene as the Dudley trilobite.

We have now reached the topmost of the Silurian formation,

The Ludlow Group, which also has its upper and lower divisions. The lower Ludlow consists of a limestone which lies upon certain shales. The limestone is well marked, and from the town near which it is exhibited it is called the *Aymestry Limestone;* the shales beneath have received the name of lower Ludlow shales. They are a dark-grey argillaceous deposit, containing fossils of a higher order than we have found hitherto. In 1859 this bed produced a fish of the genus *Pteraspis,* which Professor Huxley allies with the sturgeon. This is the first indication of piscine life on our globe, and it is a damaging fossil to the theory of progression; for instead of being of a very inferior development, as the supporters of that theory would have expected, it is in reality a good way up the scale. Of course it may be said that we do not know the whole contents of the lower Silurian beds, and that remains of the lower orders of fish may yet be brought to light. And so they may; yet it is hardly likely that among the numerous organic remains which have been unrocked, we should not have hit upon some ichthyolite had any been there. As yet, facts are against the supposition that the higher orders of life are mere developments from those which belong to inferior types. Here, when fish first appear, we have a highly-developed genus, indicating a separate creation.

The lower Ludlow contains many large-chambered shells, such as the *Phragmoceras ventricosum*, and a shell of the same kind but straight, the *Orthoceras Ludense* (Fig. 49). These two last fossils are peculiar, and therefore characteristic of the lower Ludlow shales.

The *Aymestry Limestone* is somewhat argillaceous and semi-crystalline; it is celebrated by the enormous quantity of the *Pentamerus Knightii* (Fig. 50), a brachiopod, each chamber of which is divided by a septum, or wall of division, into five cells, hence its name. *Lingula Lewisii*, *Rhynchonella Wilsoni*, and *Atrypa reticularis* are three other abundant and noted fossils, which are drawn in Figs. 51, 52, and 53.

The *Upper Ludlow Series* consists of grey argillaceous sandstones containing calcareous nodules, which sometimes become shaley, and in the upper parts of the series show the red tint so characteristic of the overlying Devonians. The most interesting feature they exhibit is a *bone-bed*. Here we have indications that we are approaching the great fish era, when the piscine life reached its maximum. We shall find in the Devonian period the waters were alive with fish of every form and character—wonderful creations! In this, the uppermost strata of the Silurians, we find premonitory symptoms of the coming profusion of fish life. Near the town of Ludlow, Sir R. Murchison observed a brown layer, which can be traced forty-five miles. It varies from one inch to a foot thick, and is absolutely composed of fish remains. Many of the bones, spines, and scales of these palæozoic fish are well preserved; but the great mass of the fossils bear evidence of the action of the water, being more or less rounded. We may suppose that the remains of the fish were swept by the marine currents, and deposited in some place where the water was undisturbed. This is no far-stretched supposition. The reader will remember we cited an instance where, in dredging, an area found, which was evidently the cemetery of the fish, remains now in process of deposition off the coast of Yorkshire.

The *Downton Sandstone*, which was classed with the old red sandstone by Sir R. Murchison under the name of "Tilestones," is the last member of the Silurian group. Its fossils have a Silurian likeness; hence the reason of its present classification.

We shall now give a list of the most common of the Silurian fossils. Those which did not outlive the period in which they are named are printed in italics.

For the localities where the various formations occur, the student is referred to any of the perfect geological maps based upon an accurate geological survey of this kingdom. Any attempt at defining the exact position of the formations would only be a useless expenditure of our limited space; and for a complete list of British fossils, Professor Morris's catalogue will be found invaluable. If the name of a strata be enclosed in brackets immediately after a fossil, it should be understood that that fossil is particularly characteristic of that strata.

LOWER SILURIAN FOSSILS.

Plants.—Fucoids, Chondrites, Palæochorda.
Corals.—Chætetes, Favosites, Halysites, Heliobites, Nebulipora.
Zoophyta.—Petraia subduplicata; Stenopora fibrosa; Nidulites Strephodes, Pyritonema.
Hydrozoa.—Graptolitus; *Didymograpsus*: *Diplograpsus.*
Bryozoa.—Oldhamia (Cambrians), Retepora.
Brachiopoda.—Atrypa; Discina Lingula, Pentamerus, Rhynconella, Strophomena, *Trematis*, Orthis, Orthisina.
Conchifera.—Ambonychia Arca, Conocardium, Cypricardia Modiola, Nucula, Mytilus.
Gasteropoda.—Capulus, Euomphalus, *Holopea*, *Maclurea*, Turbo Trochus, Turritella, Murchisonia Pleurotomaria.
Pteropoda.—Conularia, Bellerophon Theca, *Pterotheca.*
Cephalopoda.—Actinoceras, Lituites, Orthoceras, Phragmoceras.
Echinodermata.—*Agelacrinites Caryocystites*, Echinospherites Rhodocrinus.
Annelida.—Arenicola, Lumbricaria, Nereites, Serpulites, Tentaculites.
Crustacea.—Acidaspis, *Amphion*, Ampyx, *Asaphus*, Calymene, Homalonotus, *Ogygia*, Phacops, Trinucleus, Agnostus, Illænus, Remopleurides.

UPPER SILURIAN FOSSILS.

Plants.—Chondrites antiquus.
Zoophyta.—Acervularia, Alveolites, Arachnophyllum, *Cænites*, Cystiphyllum, *Palæocyclus Thecia*, Petraia bina, Heliobites.
Bryozoa.—Festenella, Cellepora, Discopora.
Brachiopoda.—*Obolus*, Spirifer, Athysis, Chonetes, Pentamerus oblongus (Upper Llandovery), P. Knightii (Aymestry limestone), Leptæna, Strophomena, Orthis Atrypa, Orbicula, Lingula Rhynconella.
Conchifera.—Avicula Pterinea, *Cardiola*, *Grammysia*, Leptodomus, Clidophorus Modiola, Mytilus, Nucula.
Gasteropoda.—*Holopella*, Natica, Newta, Pleurotomaria, Euomphalus, Turbo, Murchisonia Turritella.
Pteropoda.—Bellerophon, Cornularia.
Cephalopoda.—Actinoceras, Cyrtoceras, Lituites, Orthoceras, Phragmoceras.
Echinodermata.—Actinocrinus, *Apiocystites*, Cyathocrinus, *Eucalyptocrinus*, Taxocrinus.
Annelida.—*Cornulites*, Serpulites, Tentaculites, Spirorbis.
Crustacea.—Acidaspis, Amphyx, Calymene, Encrinurus, Eurypterus, Lichas.
Fish.—Onchus, *Plectrodus.*

READINGS IN LATIN.—VII.

THE ELEGIAC POETS.

SEVERAL of the Roman poets wrote in what is called the Elegiac metre, consisting of alternate hexameters and pentameters, but there are some few—notably Ovid, Tibullus, and Propertius—whose achievements in this direction stand out far beyond those of any other poets who attempted the same metre. Of these Ovid is undoubtedly worthy of mention first, not only on account of the exceeding melodious beauty and clear simplicity of his verse, but also for the surprising quantity of his writings. He is by far the most voluminous of the Roman poets, and yet he never seems to have exhausted his poetic vein, all his poetry being singularly equal throughout. He lived in the early years of the Roman empire, a period peculiarly prolific in great poets, of whom he may fairly be reckoned as famous as any; and though chiefly known as a writer of elegiac verse, yet he did not confine himself to that metre, the fifteen books of "Metamorphoses," in which he clothed in a poetic dress many of the singular legends of the Greek mythology, being a notable exception. After living some years at Rome in familiar intercourse with the chief literary men of the day, and in the enjoyment of the patronage of the emperor, he was suddenly banished, for some reason that has never been divulged, to Tomi, a wild, uncivilised place on the shores of the Adriatic. His lament on leaving the city where he had lived so long and gained so great a name is one of his most beautiful productions, and we give a portion of it below among our present extracts. Fortunately for posterity, his dreary banishment did not stop his literary career, and many of his most beautiful poems were given to the world from his place of exile, where he died in the year A.D. 18. The works of Ovid are always considered the very best model for elegiac verse-writing, every one of the laws which govern that rhythm being studiously obeyed, with a remarkable absence of any appearance of constraint. The grammatical constructions are remarkably simple and straightforward, and for the most part there is very little difficulty either in apprehending the meaning or appreciating the beauty of his poems. The great German historian Niebuhr remarks of Ovid: "No one can have had a greater talent or a greater facility for writing poetry than Ovid had. In this respect he may rank among the greatest poets. This is the kind of poetry in which every one feels at home, and as if the sentiments could not be expressed in any other way. Horace is much inferior to Ovid in this respect; there are only a few among his lyric poems of which we can say that they were composed with ease and facility."

Of the subject of our first extract we have already spoken; it is the account of his leaving Rome:—

OVID.—"TRISTIA," I. III. 1—34.

Cum subit illius tristissima noctis imago,
    Quæ mihi supremum tempus in urbe fuit;
Cum repeto noctem, qua tot mihi cara reliqui,
    Labitur ex oculis nunc quoque gutta meis.
Jam prope lux aderat, qua me discedere Cæsar
    Finibus extremæ jusserat Ausoniæ.
Nec mens, nec spatium fuerat satis apta paranti
    Torpuerant longa pectora nostra mora.

Non mihi servorum, comitis non cura legendi,
  Non aptæ profugo vestis opisve fuit.
Non aliter stupui, quam qui Jovis ignibus ictus
  Vivit, et est vitæ nescius ipse suæ.
Ut tamen hanc animo nubem dolor ipse removit,
  Et tandem sensus convaluere mei;
Alloquor extremum mœstos abiturus amicos,
  Qui modo de multis unus et alter erant.
Uxor amans flentem flens acrius ipsa tenebat,
  Imbre per indignas usque cadente genas.
Nata procul Libycis aberat diversa sub oris;
  Nec poterat fati certior esse mei.
Quocunque aspiceres, luctus gemitusque sonabant;
  Formaque non taciti funeris intus erat.
Femina, virque, meo pueri quoque funere mœrent;
  Inque domo lacrymas angulus omnis habet.
Si licet exemplis in parvo grandibus uti;
  Hæc facies Trojæ, cum caperetur, erat.
Jamque quiescebant voces hominumque canumque,
  Lunaque nocturnos alta regebat equos:
Hanc ego suspiciens, et ab hac Capitolia cernens,
  Quæ nostro frustra juncta fuere Lari;
Numina vicinis habitantia sedibus, inquam,
  Jamque oculis nunquam templa videnda meis;
Dîque relinquendi, quos Urbs habet alta Quirini;
  Este salutati tempus in omne mihi.

NOTES.

1. Subit, sc. in mentem, *comes into my mind.*
4. Nunc quoque, *even now*, after all these years of exile.
6. Finibus extremæ Ausoniæ, for finibus extremis Ausoniæ, *the furthest limits of Italy.* Ausonia, a name given to Italy, from an ancient tribe, the Ausones, who were said to have inhabited it.
9. Servorum. Supply *legendorum* from *legendi.*
10. Vestis and opis are genitives after cura in the previous line, and must have legenda supplied in the construction.
11. Non aliter — quam, *as much as.* Jovis ignibus, *the thunder-bolt* —supposed in the Roman mythology to be Jove's special weapon.
12. Vivit, etc. Compare Tennyson's "Princess," vi. 2, 3:—

"As in some mystic middle state I lay,
Seeing I saw not, hearing not I heard."

15. Extremum, neut. used adverbially, *for the last time.*
22. Non taciti, *i.e.*, attended with loud lamentation; intus, *within the house.*
29. Ab hac, *looking from her on to the Capitol.*
30. Frustra, *to no purpose*, because it could do nothing to assist him. Probably an allusion to M. Manlius Capitolinus, the defender of the Capitol, whom the people refrained from putting to death while he was in sight of the scene of his bravery.
32. Jam — nunquam, *never more.*
33. Quirini. Romulus, the founder of Rome, was worshipped under this title.

The next extract is taken from an elegy embodying the complaints of an ill-used walnut-tree:—

OVID.—"NUX, ELEGIA," 1—20.

Nux ego juncta viæ, cum sim sine crimine vitæ,
  A populo saxis prætereunte petor.
Obruere ista solet manifestos pœna nocentes,
  Publica cum lentam non capit ira moram.
Nil ego peccavi; nisi si peccare videtur,
  Annua cultori poma referre suo.
At prius arboribus, tum, cum meliora fuere
  Tempora, certamen fertilitatis erat.
Cum domini memores sertis ornare solebant
  Agricolas, fructu proveniente, deos.
Sæpe tuas igitur, Liber, miratus es uvas;
  Mirata est oleas sæpe Minerva suas.
Pomaque læsissent matrem; ni subdita ramo
  Longa laboranti furca tulisset opem.
At postquam platanis, sterilem præbentibus umbram,
  Uberior quavis arbore venit honos;
Nos quoque frugiferæ (si nux modo ponor in illis)
  Cœpimus in patulas luxuriare comas.
Nunc neque continuos nascuntur poma per annos;
  Uvaque læsa domum, læsaque bacca venit.

NOTES.

1. Juncta viæ, *hard by the way-side.* Cum sim, *although I am.*
2. Petor, *am pelted*; cf. "Me Galatæa petit malo." (Virg., "Ecl.")
3. Manifestos, *caught in actual crime*, "red-handed," *in flagrante delicto.*
4. Non capit, *does not admit of.*
7. In old days, when times were better, the trees used to vie with each other in productiveness.
9. Memores, *with due attention.*
10. Agricolas, used as an adjective. So we find victor exercitus—domina hasta, etc.
11. Liber, a name of Bacchus, god of wine; tuas, *sacred to thee.*
12. Suas. When there was a contest between Neptune and Minerva which should give the best gift to mankind, Neptune struck the earth with his spear, and the horse appeared; Minerva in a similar way produced the olive.
13. Læsissent, *i.e.* by weighing down and breaking the bough.
16. Quavis arbore, *i.e.* honore cujusvis arboris. This abbreviated form of comparison (brachylogy of comparison) is not uncommon. Thus we find *κόμαι χαρίτεσσιν ὁμοίαι, hair like the graces*, for *hair like that of the graces*; and an English poet has—

"They for their young Adonis might mistake
The soft luxuriance of thy golden hair"—

i.e. for the hair of their young Adonis.
17. In illis, *i.e.* among the fruit-bearing trees. The general sense of this passage is, as trees have come to be cultivated more for their foliage than their fruit, so the walnut-tree, following the fashion, grows wide-spreading leaves.

The "Heroides" are a series of imaginary epistles from the heroines of the ancient Greek mythology. The following is the commencement of the address of the nymph Œnone to the shepherd Paris, who had deserted her for the superior charms of Helen. Our readers will probably recollect that the same subject is beautifully treated by Tennyson in his poem of "Œnone."

OVID.—"ŒNONE PARIDI," 1—22.

Perlegis? An conjux prohibet nova? Perlege: non est
  Ista Mycenæa litera facta manu.
Pegasis Œnone, Phrygiis celeberrima sylvis,
  Læsa queror de te, si sinis ipse, meo.
Quis deus opposuit nostris sua numina votis?
  Ne tua permaneam, quod mihi crimen obest?
Leniter, ex merito quidquid patiare, ferendum est;
  Quæ venit indignæ pœna, dolenda venit.
Nondum tantus eras, cum te contenta marito
  Edita de magno flumine Nympha fui.
Qui nunc Priamides (adsit reverentia vero!),
  Servus eras; servo nubere Nympha tuli.
Sæpe greges inter requievimus arbore tecti,
  Mistaque cum foliis præbuit herba torum.
Sæpe super stramen fœnoque jacentibus alto
  Defensa est humili cana pruina casa.
Quis tibi monstrabat saltus venatibus aptos,
  Et tegeret catulos qua fera rupe suos?
Retia sæpe comes, maculis distincta, tetendi;
  Sæpe citos egi per juga longa canes.
Incisæ servant a te mea nomina fagi;
  Et legor *Œnone* falce notata tua.

NOTES.

1. Perlegis? *i.e.* this epistle which I am sending you.
2. Mycenæa, *by Helen's hand.* Helen was the wife of Menelaus, king of Mycenæ.
3. Pegasis, *a fountain nymph*; from the Greek πηγή, *a fountain.* Phrygia is used for Asia Minor generally, in which Troy, Helen's native place, was situated.
4. Te — meo, *you who are mine, if you will only allow it.*
6. Ne tua, *from continuing to be called your wife.*
9. Tantus, *so great as you are now*, chosen to be the arbiter of the beauty of goddesses.
11. Nunc, *who now turns out to be a son of Priam.*
16. Defensa, *kept off.* This word is found in two senses—(1) to defend, (2) to ward off.
19. Maculis distincta, *marked*, i.e. *dotted, with knots.*
22. Legor Œnone, *my name, Œnone, is read, carved by your knife.*

In our next readings we propose to give further specimens of the Latin elegiac poets, noticing especially Tibullus and Propertius.

TRANSLATION OF EXTRACT II. IN LAST READING.

CICERO.—"IN CATILINAM," I. 1.

How much further, Catiline, are you going to insult our forbearance? How long will this mad folly of yours continue to escape our vengeance? What limit shall bound the reckless course of your unbridled audacity? The Palatine guarded by night, sentries posted in the city, the people in a scare, all good citizens banded together, this our senate house most strongly defended, even the very looks and glances of those around us—have all these things failed to impress you? Can you help feeling that your plots are discovered, or seeing that your conspiracy is already checked and stifled by the fact that every one here knows all about it? Do you think there is a man among us who knows not what you did last night, or the night before, where you were, whom you summoned to your councils, or what plans you adopted? O the depravity of our age! The senate is cognisant of this—the consul sees it—and yet this man lives. Did I say lives? Why, he comes into the senate, he takes part in our political discussions, and all the time his eye is noting each one of us, and marking him down for assassination; while we—brave men that we are—are supposed to be doing our duty by the state if only we avoid his frenzy and murderous attacks. In justice, Catiline, the consul's order should long ago have doomed you to death and the destruction you have all the while been plotting against us. Did not Publius Scipio, the chief pontiff, a man of the highest position, put to death in his private capacity Ti. Gracchus, who was only weakening the constitution in a moderate degree; and shall we, the consuls, put up with Catiline, who is eager to desolate the whole earth with sword and fire? I say nothing of the deeds of the remote past, such as C. Servilius Ahala slaying with his own hand Sp. Mælius, who was aiming at a revolution. There was once, but it is gone, such a feeling of honour in our state that the brave citizens would punish a traitor among their fellows more severely than their bitterest foe. We have a decree of the senate passed against you, Catiline, in stringent and severe terms. The senatorial order does not withhold from the state the benefit of its talent and authority; it is ourselves—I say it openly—ourselves, the consuls, who are wanting in our duty.

RECREATIVE NATURAL HISTORY.

SOME LAND, SEA, AND FRESH-WATER SHELLS, WORMS, AND TUBE-DWELLERS (*continued*).

At the conclusion of our last paper we were engaged in examining certain upturned hills of fine sand, left partially dry by the departed tide. If we provide ourselves with a spade, and dig deep enough, we shall find a specimen of the common "*lug*" worm of the coast fishermen. This creature resembles in a marked degree the large *lob* worms found in our rich cultivated lands and kitchen gardens. Unlike some of the annelids we have before described, these creatures need no defensive armour, either of hardened shell or cemented sand-grains. Dwelling in a hole or burrow of its own excavation, both the *lug* (represented at Fig. 1) and *lob* depend for immunity from danger mainly to their extraordinary power of retrograde movement, assisted by the peculiar mechanical arrangement of their external surfaces, aided by the increase and diminution of circumference and length, brought about by the sudden and forcible imprisonment of the natural fluids contained within and acted on by the system of muscular arrangement with which the body is surrounded and fortified. Progression, or the act of crawling, is mainly dependent on this alternate, or forward and back injection of the juices. Wound a sea-worm with any sharp instrument in such a way that there may be an escape of this vital and movement-giving fluid, and paralysis immediately follows. Marine worms are less hardy than some we shall have to notice, as fishermen and naturalists well know. Although not provided with legs, most members of the worm family manage to travel with tolerable celerity even on the surface of the earth. When in their underground burrows, or tubes, they are capable of performing extremely rapid movements.

Most of our readers will have observed the manner in which the large lob or garden worms protrude their heads and the greater portion of their bodies from their earth tubes on warm, moist evenings. To capture them, it is necessary to act with considerable adroitness and rapidity. The worm once seized must be instantly plucked forth, or the myriads of rough, tooth-like asperities with which the creature's covering tissues are provided are elevated by muscular contraction, thus rendering any attempt at extraction perfectly futile. So powerful, too, is the resistance set up, that the worm may be completely severed before it relaxes its hold on the interior of its dwelling. By this mode of action it endeavours to guard itself against the attacks of surface enemies, but these are not alone to be dreaded. That accomplished sapper and miner, the mole, with his pointed snout and exquisitely formed digging-feet, and half shovel, half rake-shaped hands, drives his galleries beneath the tiny passages of the worms, who, feeling a vibration and disturbance going on below, dart rapidly upwards, quit their burrows, and crawl panic-stricken away, they know not whither.

Here, then, we have a link by which we can trace out another instance of the marvellous and perfect provision made by Creative Wisdom for the support of living things.

Let us see how the long-beaked, nocturnal worm-feeding birds (of which the snipe and woodcock of this country, and the apteryx of Tasmania are familiar examples) proceed when in search of food. They are far too wise to grasp the half-sheltered worm, and try vainly to draw it forth. Instinct teaches a better way of proceeding. There is not, perhaps, in the whole world a more skilful worm-catcher than the common snipe. Running actively along the soft, oozy ground, where moisture and decomposing vegetation afford nutriment for its prey, the long, slender-toed bird peers keenly downward with its full round eye, and on detecting a worm-hole, down is thrust the long, probe-like beak, which is again and again opened as far as the capacity of the tube will allow, thus causing a movement amongst the minute fibres of the plant roots and particles of earth, and bringing about a state of panic and alarm amongst the worms just as great as when our little fur-clad miner was at his labours below; and now the snipe reaps his harvest, and gleans from the ranks of the fugitives worm-food enough for a hearty meal.

Those of our readers who are desirous of witnessing the manner in which the beaks of certain birds are opened, after the manner of reversed action forceps, for disturbing purposes, may do so by placing a piece of loose turf with a few ants' eggs in it before a common starling, who, although unlike the members of the family *Scolopax* in most particulars, resembles them in the dexterity with which it forces impediments asunder by spreading open its mandibles.

We have already remarked how easily the sea-worms are deprived of vital power by the infliction of a trifling wound. We shall see that there are worm mud-dwellers, equally delicate in appearance, who possess constitutions infinitely stronger than their marine cousins. Let us visit the shores of some of our large tidal rivers above salt-water influences, and as we wander on amongst the willows and tufted reeds we shall see, where some tiny rill discharges itself into the main stream, a large patch of red-looking matter, as though some extravagant painter had been heedlessly casting away his stock of vermilion. Break off that old dry willow stump, and throw it well out to the scene of the artist's recklessness, and, as though touched with an enchanter's wand, the red is gone, and nought but mud remains. The red blotch was formed by a legion of tiny red worms (*Naïs littoralis*); and so obstinately tough and tenacious of life are these extraordinary pigmies, that they appear perfectly and supremely indifferent to the decapitating process so long as it is not repeated frequently enough to become tedious. It has been found from experiment that the *naïs* is very little, if at all, the worse for having its little head cut off seven distinct times, as an excellent and perfectly satisfactory new one sprouted out in good time. But after the appearance of the seventh new head matters must be allowed to rest as they are, or the *naïs* dies literally from the expenditure of too much vital force in the formation of heads for itself. Not only is the *naïs* prolific in this respect, but a feat, which has bidden defiance to the efforts of the most zealous and industrious of the human race to perform, is by it achieved perfectly.

We often hear particularly active friends exclaim, "It is impossible for any living creature to be in three or four places at the same time." Do not believe a word of it. M. Bonnet, a French naturalist, deliberately cut one of our little *naïs* friends into twenty-six tiny fragments. Each fragment formed a head for itself, and shortly became a perfect worm, thus calling into separate life twenty-six organisms from one original stock.

Research has shown that these tiny creatures, insignificant as they at the first glance appear, possess a most perfect and admirable arrangement for blood connection, as shown in Fig. 2, which represents a magnified view of the blood tubes and lines of connection in the *Naïs filiformis*.

Fig. 3 shows the interior, or head portion, of a common earth-worm after division. The wounded surface rapidly draws together; its central portion forms a ventral orifice, and all the functions of the creature go on as before. Figs. 4 and 5 represent the eggs of earth-worms; Fig. 4 shows the valvular mouth of the egg open for the worm to pass through; Fig. 5 shows it closed, with two young worms in the same egg.

As we proceed, we shall find amongst another class of burrower even greater capabilities of being subjected to subdivision. From the consideration of the inhabitants of the soil and the sand, let us take a glance at some of the strange organisms we find unerringly following out the laws of increase, assimilation, and reproduction in the tissues of other living organisms. The origin of some of these is extremely obscure, and we are compelled to content ourselves with more speculation concerning it. A familiar example of the mystery which hangs over and surrounds parasitic life is to be found in the *frendeet* worm of Abyssinia, and the guinea-worm of India. It is popularly believed, and not without much show of reason, that the minute ova, germ, or whatever else it may be, is taken into the human system with the drinking water. That this notion is likely to be correct is shown by the fact that those who make use of water taken from the ponds produced during the rainy season are especially liable to its attacks, whilst we have found that the inhabitants of native villages, near which clear rapid rivers flow, are comparatively free from its attacks.

Sir Samuel Baker, in speaking of this curious pest, says:—"There was one complaint that I was obliged to leave entirely in the hands of the Arabs. This was called *frendeet;* it was almost the certain effect of drinking the water that, in the rainy season, is accumulated in pools upon the surface of the rich table-lands, especially between the Atbara and Katariff." Frendeet commences with a swelling of one of the limbs, generally accompanied with intense pain. This is caused by a worm several feet in length, but no thicker than a packthread. The Arab cure is to plaster the limb with cow dung, which is their common application for almost all complaints. They then proceed to make what they term *doors,* through which the worm will be able to escape; but should it not be able to find one exit, they make a great number, by the pleasant and simple operation of pricking the skin in many places with a red-hot lance. In about a week after these means of escape are provided one of the wounds will inflame, and assume the character of a small boil, from which the head of the worm will issue. This is then seized and fastened, either to a small reed or piece of wood, which is daily and most gently wound round, until, in the course of about a week, the entire worm will be extracted, unless broken during the operation, in which case severe inflammation will ensue."


Fig. 2.


Fig. 4.


Fig. 5.


Fig. 3.


Fig. 6.


Fig. 1.

The manner of drawing forth the guinea-worm of India differs but little from that above described, except that the punctures with the heated spear are omitted. What can be more strangely inscrutable than the laws which influence the existence and development of this justly dreaded creature, lurking hidden in some microscopic form in countless myriads amongst the lakes and rain deposits of vast tracts of wilderness, until some chance brings a human victim to furnish an abiding place for the creature to develop in! How the species is propagated who shall say? Probably the frendeet worm is but, after all, an immature organism, and capable of further metamorphosis, as we find in the case of the *helminthæ*, or intestinal worms—those strange, anomalous beings, who appear to bid defiance to all acknowledged natural laws. In some we find a total absence of the digestive organs, all nutritive matter penetrating their tissues by endosmosis, just as it would enter the pores of a condensed form of sponge.

The reproduction of the race is brought about in a most extraordinary manner. Research has shown that fresh members of the family may be called into existence by a system of spontaneous breaking up into lengths, the casting forth of offshoots or buds, and the deposition of eggs. It may be that one creature combines within itself the united functions of both male and female, or perchance there may be found the two sexes distinct. It is then that the egg deposition takes place, but at this stage we find that a series of transformations have to be carried out and passed through which appear almost incredible in their strangeness. Here the axiom that like begets like entirely fails us. The egg gives birth to a creature differing entirely from the parent, and although, so to speak, in the transition or larva stage itself, this creature is found capable, without the process of fecundation being passed through, of producing a brood or broods of other immature creatures still in the larva stage, which may in time become developed into the form of the original parent organism.

Of this law we find a familiar example in the vesicle or bladder formed in the tissues of the pig when suffering from the disease popularly known as "measles." The name applied to this peculiar form of parasite is *Cysticercus cellulosa*, but it has been unfortunately proved that it is merely the larva or immature young of the tapeworm (or *tænia*), which comes rapidly to a matured form in the intestines of any human being who has unfortunately and unwittingly swallowed meat in which the vesicle had its abiding place.

Fig. 6 shows a portion of one of these creatures, together with two separated joints.

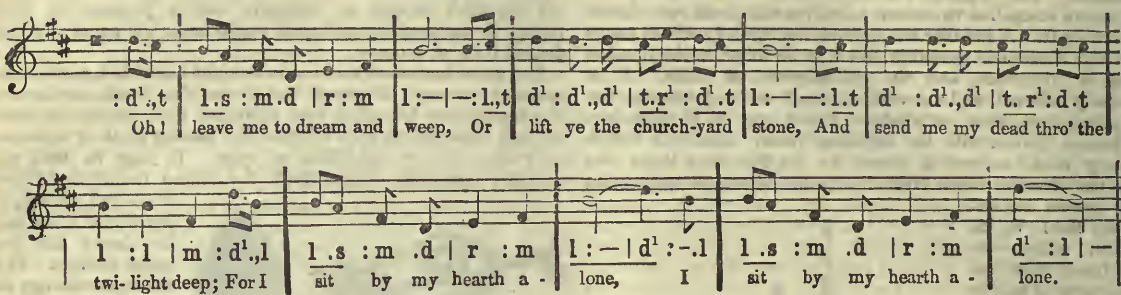
Thus we see that by no system of reasoning can we arrive at any just conclusion as to what description of perfect being amongst the family of *helminthæ*, and some other parasitical worms, may be in the end brought to light by the metamorphoses through which the immature brood or larvæ pass. Therefore it behoves us to note carefully such results as we may absolutely witness, and to take nothing for granted without actual demonstration.

A consideration of the habits of certain winged insects which deposit their ova in living animals we must reserve for a future paper.

LESSONS IN MUSIC.—XXVI.

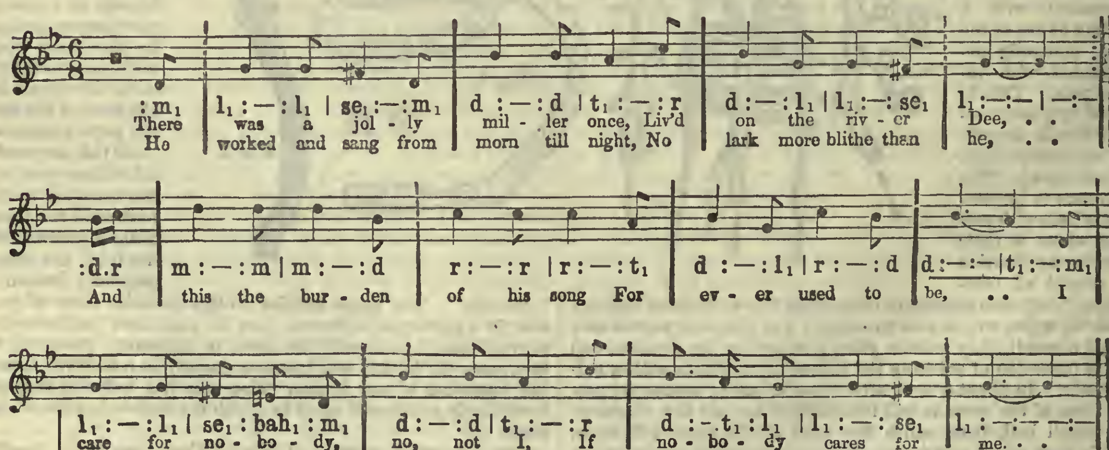
Exercise 48.—THREE EXAMPLES OF MENTAL EFFECT IN MINOR TUNES.

Example 1. Key D. Lah Mode.



Example 2. Key F. Lah Mode.

Example 3. Key B Flat. Lah Mode.



The musical facts which are here ascribed simply to the *common scale* used in a peculiar manner, and admitting occasional variations, are usually supposed to be founded on an entirely new scale, and that of a very remarkable structure. This *new* scale is described as having its "semitones" between its second and third, and fifth and sixth notes. (If you reckon from LAH₁ to LAH, in the common mode, you will find the little steps thus placed.) But the scale, it is said, only retains this form in *descending*, for in *ascending* the sixth and seventh are sharpened (making our *occasional* BAH and SE) so as to place the "semitones" between the second and third, and seventh and eighth. This is, in fact, two scales; and some teachers of the pianoforte have gone so far, Dr. Mainzer tells us, with this "illogical system," as to make their pupils play with the right hand ascending the scale—BAH and SE, at the same time that the left hand descending produced the sounds FAH and SOH! He justly remarks that "the simultaneous unison of notes so opposite, producing an effect so discordant, is more calculated to destroy than awaken the musical sentiments of the pupil." Let us examine facts and authorities on this subject.

First, then, it appears that *the common scale, even without any new note* (SE or BAH), but simply allowing LAH to predominate

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and to be heard at the opening and at the close of a tune, *is quite sufficient to produce a true "minor" tune;* and that *many fine melodies, manifestly minor, are formed on this model*, using the ordinary notes of the common scale (from LAH$_1$ to LAH) both ascending and descending, and not requiring the aid of any accidental note. No one can doubt that the examples given are minor tunes, nor hesitate to allow that they are formed on the common scale, and are simply distinguished by their making LAH, the proper mournful note, predominate. Accordingly we find Dr. Crotch describing his "ancient diatonic minor key" (which corresponds with our common scale when you reckon from LAH to LAH^1) as "the scale of the ancient Greek music, and found in the oldest national tunes, in psalms and cathedral music;" Dr. Bryce speaking of this as the "proper" formula of minor tunes, in which are written "multitudes of exquisite melodies, especially among the ancient national music of different countries;" and Dr. Mainzer maintaining that this is the only true and the only *agreeable* arrangement of notes for such tunes. By fact, then, and by competent authority, the COMMON SCALE with LAH predominating is declared sufficient to produce a true minor tune. But still, it may be argued, are not BAH and SE, the "sharp sixth and seventh" (reckoning from LAH, as though it were the key-note), *always used* in tunes of this kind (instead of FAH and SOH) *when the music ascends?* Are they not, therefore, *essential* at least to *every* minor passage in which the music *ascends* from its sixth or seventh note? Must we not necessarily suppose a distinct scale in which these essential notes may find a place? We deny the proposition, and the conclusion falls, for—

Secondly, it appears that *the new notes* BAH and SE (the "sharp sixth and seventh") *are not essential even in ascending passages*, and that *the use of them is entirely arbitrary*. Nothing can prove this more clearly than the great discrepancy and disagreement among the best authorities on this subject. If there had been any fixed usage, long established by the requirement of good ears, and the example of the best composers, such opposite statements of facts could not have existed. In reference to BAH (the "sharp sixth") we find Dr. Callcott describing this note as "accidental," but rendered necessary for the sake of avoiding what he calls "the harsh chromatic interval," FAH SE, "from F natural to G sharp;" while M. Galin and M. Jeu de Berneval refer to this very interval as a "constitutive interval of the minor mode," full of "melancholy," "replete with anguish and tears," and speak indignantly of those who would "cancel" the very interval which is most "characteristic" of the "minor mode." Is it not evident from this, that the use of BAH is arbitrary—by some approved, by others disapproved? In reference to SE, Dr. Callcott declares that it is an "essential" part of the "minor scale" in *ascending*, but not to be used in *descending*. M. Galin and M. Jeu speak of SE as "invariable" and essential both in ascending and in descending, and M. Jeu gives examples of its use in descending. Schneider, in his "Elements of Harmony," maintains the same opinion. Marpurg declares that "this custom (of using BAH and SE) by no means changes the essential nature of the tonality (key or mode reckoning from LAH to LAH^1), and the two sharps which are prefixed to the sixth and seventh degree are *purely accidental*." Dr. Crotch says distinctly of both BAH and SE, "*these alterations are only occasional*." Sir John Goss says, "The sixth and seventh (FAH and SOH) are generally made *accidentally* major in ascending." Dr. Bryce ascribes the introduction of these notes to modern musicians, who prefer harmony to melody. Dr. Mainzer says that there are a very large number of compositions "in which the leading note (SE) does not appear at all in the minor keys, and this is the case with many composers of the fifteenth, sixteenth, and seventeenth centuries." Dr. Mainzer thus concludes:—"Let any one sing the above scales one after the other" (four varieties of the so-called "minor scale"), "and assuredly he will not be long in discovering which of the four is the most agreeable and natural, and most in the character of the minor tonality (key). It is evident that the scales with leading notes (SE), instead of being pleasing, are disagreeable to the ear, and impracticable to the voice. The *absence* of the leading note (SE), on the contrary, often gives to the melody *something majestic and solemn*. The Gregorian chant, so remarkable for melodious beauties, affords many proofs of this, and also the popular melodies of different countries, especially those of Ireland and Scotland, so much admired by the greatest musicians." Surely here is example and testimony enough to prove these notes—whether good or bad—at least non-essential and arbitrary.

One question yet remains. Should not the scale on which minor tunes are framed be still treated as a distinct one, and something more than the common scale used in a peculiar manner? To which we answer—Yes, *if it is distinct;* but, if otherwise, why multiply difficulties and conceal the truth? But *it clearly is not, in any particular, distinct.* First, in reference to the "character" or musical effect of the notes—the most important particular of all—the notes of the so-called minor scale correspond precisely with those of the common one (reckoning from LAH to LAH^1). Not a single note of the common scale changes its character when used in a minor tune. LAH is still the *sorrowful*, TE the *piercing*, FAH the *awe-inspiring* note, etc., as before. Next, in reference to the exact intervals between the notes—they are precisely the same as those of the common scale (from LAH to LAH^1), with only this peculiarity, that the *graver* (flatter) *position* of the "variable note" RAY is *ordinarily used* in tunes of this character, whereas it is only *occasionally used* in other tunes. Premising that from DOH to DOH^1 is commonly called by musicians a major key (beginning with a major or greater third, DOH ME), and that a minor key beginning on a note in the position of our LAH would be called its *relative minor*, let us quote the following testimonies to the last point. General Thompson says, "The change to the relative (or, as it would *more properly be called, the synonymous*) minor reduces itself to avoiding the acute second of the old key (r′) and using only the grave (r‘)." Dr. Crotch says, "Some authors make it" (the first note of the principal minor key) "the same as the note LAH of the relative major key—viz., A in the key of C, a minor tone" (smaller tone—of eight degrees) "above G (SOH). In that case all the *natural* notes excepting D (RAY) correspond with those of the major key of C." Turning to his illustrative plates, we find the scale of minor tunes requiring the smaller tone (eight degrees) between DOH RAY, and the larger tone (nine degrees) between RAY ME, while other tunes usually require a larger tone between DOH RAY and a smaller one between RAY ME. In fact, the variable note assumes its *grave* position. But it sometimes does the same in the common scale. Is this, then, a peculiarity sufficient to establish a new scale? Moreover, is it not natural to suppose that the *common scale*, which is found to be essentially the *musical scale of all nations*, must hold a peculiar accordance with the ear and sympathies of the human race? and is it not proper, therefore, to consider this as *the one scale*, and everything else that cannot establish a distinct and independent character as but a modification or a peculiar use of it? It is certain that great detriment must be done to the mind of our pupils, and great hindrance given to their progress, if we first cause them to study and practise *our theory*, of a new and self-contradictory minor scale, and then leave them to discover that, in *music itself*, instead of the artificial difficulties they have so laboriously mastered, there is only to be found *the common scale, so used as to produce a peculiar effect and the merely occasional, non-essential, introduction of a new note!*

Sometimes in the course of a tune the music takes the "minor" character, introducing the new note SE, and returns again to the ordinary use of the common scale. Occasionally, too, the music passes into the minor of the SOH KEY, making a new note, a tonule below ME, which (to distinguish it from SE of the original key) we call RE; and not unfrequently it enters the "minor" of the FAH KEY, originating another note, a tonule below RAY (r‘), which we call DE. The modulator at the side will illustrate these changes.

	s	d^1	f
		t	m
ta—	f		
	m	l	r
		se	
	r	s	d
			t_1—*fe_1*
	d	f	
	t_1	m	l_1
			—*re_1*
	l_1	r	s_1
de			
	s_1	d	f_1

Another "transition" into what is called the "minor of the same tonic" (DOH becoming LAH) is more proper to "tempered" musical instruments than to the unaided voice. You may treat it as transition into the key of ME flat, or, retaining the syllables of the original key, the new notes may be treated as chromatic. Thus you will have the oddly-sounding notes MA, LA, and TA.

*

CIVIL SERVICE PAPERS.—VI.

THE COMPETITIVE EXAMINATIONS (*continued*).

SCHEME I. (*continued.*)

SPECIMEN GEOGRAPHY PAPER.

On the accompanying map of Ireland, show the position of the principal lakes and mountain ranges; place Tullamore, Youghal, Elphin, Newtown Butler, Cahir, Trim; trace the principal lines of raliway connecting Dublin with the south of the island, and mark the position of the principal towns through which they pass.

In what counties and on what lines of railway are the following towns:—Athy, Andover, Peterborough, Hawick, Yeovil, Diss, Thurles, Dunkeld, Swindon, Athlone? Give approximately the distance of any of them from either London or Dublin.

What countries are watered by the following rivers:—The Rhone, Rio de la Plata, San Francisco, Garonne, Amoor, Goomtee? Mention the sea into which each flows.

Where are the following places, and for what are any of them remarkable:—Culloden, Curaçao, Atlanta, Geelong, Surat, Ehrenbreitstein, Damascus, Namur, Malaga, Chicago?

Where are Catalonia, Bessarabia; St. Michael's Island, Ischia; the mountains Wetterhorn and the Brocken; the rivers Fraser and Cauvery; the Gulf of Obi; Algoa Bay?

Draw a map of the west coast of England and Wales, from Carlisle to the Land's End, as large as your paper will admit, marking the counties, headlands, river mouths, and seaport towns.

Write a geographical description of Prussia.

FRENCH: TRANSLATION.

Plus la ruine de Marie Thérèse paraissait inévitable, plus elle eut de courage; elle était sortie de Vienne, et elle s'était jetée entre les bras des Hongrois, si sévèrement traités par son père et par ses aïeux. Ayant assemblé les quatres ordres de l'état à Presburg, elle y parut tenant entre ses bras son fils ainé presque encore au berceau; et leur parlant en Latin, langue dans laquelle elle s'exprimait bien, elle leur dit à peu près ces paroles: Abandonnée de mes amis, persécutée par mes ennemis, je n'ai de ressource que dans votre fidélité, dans votre courage, et dans ma constance; je mets au vos mains la fille et le fils de vos rois qui attendent de vous leur salut. Tous les députés attendris et animés tirèrent leurs sabres en s'écriant: Mourons pour notre roi Marie Thérèse! Ils donnent toujours le titre de roi à leur reine. Jamais princesse en effet n'avait mieux mérité ce titre. Ils versaient des larmes en faisant serment de la défendre: elle seule retint. Mais quand elle fut retirée avec ses filles d'honneur, elle laissa couler en abondance les pleurs que sa fermeté avait retenu.—*Voltaire.*

State the rules which govern the respective genders of the following words: *loi, liberté, revendication, droit, espèce, science, huître, marée, idéal, œuvre.*

Give the feminine forms of the following adjectives and nouns, and explain the irregularities, when any: *net, inquiet, grec, sec, long, roux, voleur, majeur, perturbateur, menteur, aigu, dû, tiers, malin.*

State the rules of formation of the plural of compound nouns, taking as instances the following: *chou-fleur, arrière-garde, gentilhomme, mademoiselle, timbre-poste, porte-feuille, moulin-à-vent, abat-jour, Hôtel-Dieu.*

"*Ces Josués de la politique.*" When are proper nouns to take the mark of the plural?

Write an Essay in French on ONE *of the following subjects:*

La guerre dans les temps modernes.

La guerre civile en France comparée aux guerres civiles chez les peuple anciens.

"On ne peut pas mépriser les autres sans se mépriser soi-même."

"Le travail utile est une des conditions de la liberté et du bonheur."

(Exercises of about equal length and difficulty are given in Latin and the other languages.)

MATHEMATICS, PURE AND MIXED.

Prove that the line, $y = mx + \frac{a}{m}$, is a tangent to the parabola $y^2 = 4ax$, and find the value of c, when the line, $y = mx + c$, is a normal to the same parabola.

Prove that the equation to an ellipse, referred to its centre and axes, is

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1.$$

If chords of this ellipse touch the circle, $x^2 + y^2 = c^2$, prove that the locus of their middle point is

$$(a^2y^2 + b^2x^2)^2 = c^2 (a^4y^2 + b^4x^2).$$

Show that a rational algebraic equation of an odd degree always has one real root, and that an equation of an even degree with its last term negative always has two real roots.

What is the nature of the roots of the equation,

$$(x^2 + a^2)(x^2 + b^2)(x^2 + c^2) + d^2 = 0?$$

Prove that a point, moving from rest with a constant acceleration f, will describe in the time t a space $\frac{1}{2} f t^2$, and that, if s be this space, the velocity of the point at the time t will be $\sqrt{2fs}$.

If the point have initially a velocity u in the direction of the acceleration, explain why it is erroneous to assert that its velocity, after passing over a space s, is $u + \sqrt{2fs}$; and investigate the true expression.

Find the range of a projectile on an inclined plane passing through the point of projection and perpendicular to the vertical plane of projection.

Show that when the range is the greatest possible for a given velocity of projection, the direction of projection bisects the angle between the plane and the vertical.

Explain the principle of the transmission of fluid pressure, and describe the actions of a hydraulic press, and of a safety valve.

NATURAL SCIENCE.

Give an account of the action of water under various circumstances in producing strata.

Describe the other agencies that work with water in producing strata. (1) What is meant by conformity and unconformity of strata? (2) Show by diagrams and description what bearing these conditions of strata have in both theoretical and practical geology.

Explain what is meant by the words (1) marl, (2) slate, (3) grit, (4) loam, (5) schist, and (6) arkose.

Describe galena, and state under what conditions and where it is found, and how it is utilised.

Mention the minerals that have the hexagonal system of crystallisation; figure and describe their chief modifications.

Describe the circumstances under which different lignites and coals have respectively been formed; and state the main differences between lignite and coal as to composition, characters, properties, and modes of occurrence.

Explain how electric currents may be measured by reference to a standard involving no arbitrary units other than those of time, space, and mass.

Define electro-motive force. What is the unit of measurement of electro-motive force? Describe fully how to compare the electro-motive force of a Grove's cell with that of a Daniell's; and point out the most probable causes of error in making the comparison.

ARITHMETIC.

Supposing the quick-time or step in marching to be 2 paces per second, and the length of each pace to be 28 inches: find the time in which a regiment will march 35 miles.

A merchant sells tea to a tradesman at a profit of 60 per cent.; but the tradesman becoming bankrupt pays only 2s. 6d. in the pound. How much per cent. does the merchant gain or lose by the sale?

Find the length of the side of a square which is equal in area to the rectangle the sides of which are 513 yds. 1 ft. 11 in. and 1628 yards 11 in.

Find exactly the cube root of $127728\frac{9}{125}\frac{7}{}$.

How many yards of carpet $2{\cdot}1\dot{6}$ wide will cover a room $25{\cdot}\dot{3}$ feet broad and $28{\cdot}\dot{8}$ feet long?

If a metric system of area were adopted, so that 2 acres 2 roods 6 perches would be represented by 5·12, express the unit of measurement in square yards and decimal parts of a square yard.

POLITICAL ECONOMY.

Show that it is impossible that there can be a general over-production of valuable objects.

Is there any fundamental principle which indicates a true distinction between the imposition of local and imperial taxation?

Is the contest between capital and labour permanent and fundamental? If not, give reasons for your answer.

What are the evidences of a progressive state of wealth? What are those of industrial decline?

Has morality a price in social economy?

Is there the same economical defence for a technical education, *i.e.*, a training at the public expense in special branches of knowledge, that there is for a primary education, *i.e.*, a general culture of the people at the public expense?

Under what circumstances is emigration a benefit, (1) to the country from which the emigrant departs, (2) to the country in which he settles, (3) to the emigrant himself?

What are the best taxes in a colony, where the population is scanty? What in a densely peopled country?

What is the effect of poor law relief on wages? What is that of endowments in aid of education on the salaries of teachers?

Define precisely what it is which gives value to objects, and point out the causes which vary the value of the same object, under differing circumstances.

Expound the mischief induced by a tax on raw materials. What are the circumstances under which it is peculiarly pernicious?

"The population of England and Wales could not during the fourteenth century have exceeded two millions." What must be the grounds on which any historian could affirm such a limit?

MORAL SCIENCE AND JURISPRUDENCE.

Sketch the history of opinion in ancient and modern times respecting the existence of a moral sense.

Give at length the Greek theory of moral education.

Explain the division of duties into duties of perfect obligation and duties of imperfect obligation.

State the views of Plato and Aristotle respecting the relation of Justice to Virtue.

What are the postulates of international law?

Compare the Roman and the English law regarding husband and wife.

What is Blackstone's account of the origin of private property? What objections may be made to it?

Discuss briefly the leading provisions of Roman and English law regarding servitudes and easements.

(The examinations under Scheme II. are much less difficult, as may be seen by referring to the subjects included.)

LESSONS IN FRENCH.—LXII.

§ 52.—Regular Verbs.—Continued.

THIRD CONJUGATION,—ENDING IN *OIR*.

MODEL VERB.

RECEVOIR, *TO RECEIVE* (*continued*).

Conditional Mood.

SIMPLE TENSES. PRESENT.		COMPOUND TENSES. PAST.		
Je recevrais,	*I should receive.*	J'aurais reçu,	*I should*	
Tu recevrais,	*thou wouldst receive.*	Tu aurais reçu,	*thou wouldst*	
Il recevrait,	*he would receive.*	Il aurait reçu,	*he would*	
On recevrait,	*one would receive.*	On aurait reçu,	*one would*	*have received.*
Nous recevrions,	*we should receive.*	Nous aurions reçu,	*we should*	
Vous recevriez,	*you would receive.*	Vous auriez reçu,	*you would*	
Ils recevraient,	*they would receive.*	Ils auraient reçu,	*they would*	

Imperative Mood.

Reçois,	*receive* (*thou*).	Recevons,	*let us receive.*
Qu'il reçoive,	*let him receive.*	Recevez,	*receive* (*ye* or *you*).
Qu'on reçoive,	*let one receive.*	Qu'ils reçoivent,	*let them receive.*

Subjunctive Mood.

SIMPLE TENSES. PRESENT.			COMPOUND TENSES. PAST.		
Que je reçoive,	*that I may*		Que j'aie reçu,	*that I may*	
Que tu reçoives,	*that thou mayest*		Que tu aies reçu,	*that thou mayest*	
Qu'il reçoive,	*that he may*		Qu'il ait reçu,	*that he may*	
Qu'on reçoive,	*that one may*	*receive.*	Qu'on ait reçu,	*that one may*	*have received.*
Que nous recevions,	*that we may*		Que nous ayons reçu,	*that we may*	
Que vous receviez,	*that you may*		Que vous ayez reçu,	*that you may*	
Qu'ils reçoivent,	*that they may*		Qu'ils aient reçu,	*that they may*	

IMPERFECT.			PLUPERFECT.		
Que je reçusse,	*that I might*		Que j'eusse reçu,	*that I might*	
Que tu reçusses,	*that thou mightest*		Que tu eusses reçu,	*that thou mightest*	
Qu'il reçût,	*that he might*		Qu'il eût reçu,	*that he might*	
Qu'on reçût,	*that one might*	*receive.*	Qu'on eût reçu,	*that one might*	*have received.*
Que nous reçussions,	*that we might*		Que nous eussions reçu,	*that we might*	
Que vous reçussiez,	*that you might*		Que vous eussiez reçu,	*that you might*	
Qu'ils reçussent,	*that they might*		Qu'ils eussent reçu,	*that they might*	

§ 53.—Remarks.

(1.) In the verbs of this conjugation ending with **cevoir**, a cedilla is put under the *c* (ç) when it comes before *o* or *u*, in order to indicate that *c* must be pronounced like *s* before these vowels:—

Je reçois,	*I receive.*	J'aperçus,	*I perceived.*

(2.) There are only seven regular verbs in this conjugation. They are:—

Apercevoir,	*to perceive.*	Percevoir,	*to collect duties, taxes.*
Concevoir,	*to conceive.*	Recevoir,	*to receive.*
Décevoir,	*to deceive.*	Redevoir,	*to be still owing.*
Devoir,	*to owe.*		

§ 54.—Regular Verbs.—Continued.

FOURTH CONJUGATION,—ENDING IN *RE*.

MODEL VERB.

VENDRE, *TO SELL*.

Infinitive Mood.

PRESENT.		PAST.	
Vendre,	*to sell.*	Avoir vendu,	*to have sold.*

Participles.

PRESENT.		COMPOUND.	
Vendant,	*selling.*	Ayant vendu,	*having sold.*

PAST.

Vendu, *sold.*

Indicative Mood.

SIMPLE TENSES. PRESENT.		COMPOUND TENSES. PAST DEFINITE.	
Je vends,	*I sell.*	J'ai vendu,	*I have sold.*
Tu vends,	*thou sellest.*	Tu as vendu,	*thou hast sold.*
Il vend,	*he sells.*	Il a vendu,	*he has sold.*
On vend,	*one sells.*	On a vendu,	*one has sold.*
Nous vendons,	*we sell.*	Nous avons vendu,	*we have sold.*
Vous vendez,	*you sell.*	Vous avez vendu,	*you have sold.*
Ils vendent,	*they sell.*	Ils ont vendu,	*they have sold.*

IMPERFECT.		PLUPERFECT.	
Je vendais,	*I was selling* or *used to sell.*	J'avais vendu,	*I had sold* or *been selling.*
Tu vendais,	*thou wast selling.*	Tu avais vendu,	*thou hadst sold.*
Il vendait,	*he was selling.*	Il avait vendu,	*he had sold.*
On vendait,	*one was selling.*	On avait vendu,	*one had sold.*
Nous vendions,	*we were selling.*	Nous avions vendu,	*we had sold.*
Vous vendiez,	*you were selling.*	Vous aviez vendu,	*you had sold.*
Ils vendaient,	*they were selling.*	Ils avaient vendu,	*they had sold.*

PAST DEFINITE.		PAST ANTERIOR.	
Je vendis,	*I sold* or *did sell.*	J'eus vendu,	*I had sold.*
Tu vendis,	*thou soldest.*	Tu eus vendu,	*thou hadst sold.*
Il vendit,	*he sold.*	Il eut vendu,	*he had sold.*
On vendit,	*one sold.*	On eut vendu,	*one had sold.*
Nous vendîmes,	*we sold.*	Nous eûmes vendu,	*we had sold.*
Vous vendîtes,	*you sold.*	Vous eûtes vendu,	*you had sold.*
Ils vendirent,	*they sold.*	Ils eurent vendu,	*they had sold.*

FUTURE.		FUTURE ANTERIOR.	
Je vendrai,	*I shall sell.*	J'aurai vendu,	*I shall have sold.*
Tu vendras,	*thou wilt sell.*	Tu auras vendu,	*thou wilt have sold.*
Il vendra,	*he will sell.*	Il aura vendu,	*he will have sold.*
On vendra,	*one will sell.*	On aura vendu,	*one will have sold.*
Nous vendrons,	*we shall sell.*	Nous aurons vendu,	*we shall have sold.*
Vous vendrez,	*you will sell.*	Vous aurez vendu,	*you will have sold.*
Ils vendront,	*they will sell.*	Ils auront vendu,	*they will have sold.*

Conditional Mood.

SIMPLE TENSES. PRESENT.		COMPOUND TENSES. PAST.		
Je vendrais,	*I should sell.*	J'aurais vendu,	*I should*	
Tu vendrais,	*thou wouldst sell.*	Tu aurais vendu,	*thou wouldst*	
Il vendrait,	*he would sell.*	Il aurait vendu,	*he would*	
On vendrait,	*one would sell.*	On aurait vendu,	*one would*	*have sold.*
Nous vendrions,	*we should sell.*	Nous aurions vendu,	*we should*	
Vous vendriez,	*you would sell.*	Vous auriez vendu,	*you would*	
Ils vendraient,	*they would sell.*	Ils auraient vendu,	*they would*	

Imperative Mood.

Vends,	*sell* (*thou*).	Vendons,	*let us sell.*
Qu'il vende,	*let him sell.*	Vendez,	*sell* (*ye* or *you*).
Qu'on vende,	*let one sell.*	Qu'ils vendent,	*let them sell.*

SUBJUNCTIVE MOOD.

SIMPLE TENSES.		COMPOUND TENSES.	
PRESENT.		PAST.	
Que je vende,	*that I may sell.*	Que j'aie vendu,	*that I may*
Que tu vendes,	*that thou mayest sell.*	Que tu aies vendu,	*that thou mayest*
Qu'il vende,	*that he may sell.*	Qu'il ait vendu,	*that he may*
Qu'on vende,	*that one may sell.*	Qu'on ait vendu,	*that one may*
Que nous vendions,	*that we may sell.*	Que nous ayons vendu,	*that we may*
Que vous vendiez,	*that you may sell.*	Que vous ayez vendu,	*that you may*
Qu'ils vendent,	*that they may sell.*	Qu'ils aient vendu,	*that they may*

have sold.

IMPERFECT.		PLUPERFECT.	
Que je vendisse,	*that I might sell.*	Que j'eusse vendu,	*that I might*
Que tu veudisses,	*that thou mightest sell.*	Que tu eusses vendu,	*that thou mightest*
Qu'il vendît,	*that he might sell.*	Qu'il eût vendu,	*that he might*
Qu'on vendît,	*that one might sell.*	Qu'on eût vendu,	*that one might*
Que nous vendissions,	*that we might sell.*	Que nous eussions vendu,	*that we might*
Que vous vendissiez,	*that you might sell.*	Que vous eussiez vendu,	*that you might*
Qu'ils vendissent,	*that they might sell.*	Qu'ils eussent vendu,	*that they might*

have sold.

§ 55.—CONJUGATION OF A PASSIVE VERB.

ÊTRE AIMÉ, *TO BE LOVED.*

INFINITIVE MOOD.

PRESENT.		PAST.	
Être aimé,	*to be loved.*	Avoir été aimé,	*to have been loved.*

PARTICIPLES.

PRESENT.		COMPOUND.	
Étant aimé,	*being loved.*	Ayant été aimé,	*having been loved.*

INDICATIVE MOOD.

PRESENT.

Je suis aimé, *m.* aimée, *f.*	*I am loved.*
Tu es aimé *or* aimée,	*thou art loved.*
Il est aimé,	*he ie loved.*
Elle est aimée,	*she is loved.*
Ou est aimé,	*one is loved.*
Nous sommes aimés *or* aimées,	*we are loved.*
Vous êtes aimés *or* aimées,	*you are loved.*
Ils sont aimés, *m.*	*they are loved.*
Elles sont aimées, *f.*	*they are loved.*

IMPERFECT.

J'étais aimé, *m.* aimée, *f.*	*I was loved, was being loved*
Tu étais aimé *or* aimée,	*thou wast loved, wast being loved*
Il était aimé,	*he was loved, wae being loved*
Elle était aimée,	*she wae loved, wae being loved*
On était aimé,	*one was loved, was being loved*
Nous étions aimés *or* aimées,	*we were loved, were being loved*
Vous étiez aimés *or* aimées,	*you were loved, were being loved*
Ils étaient aimés, *m.*	*they were loved, were being loved*
Elles étaient aimées, *f.*	*they were loved, were being loved*

or used to be loved.

PAST DEFINITE.

Je fus aimé, *m.* aimée, *f.*	*I was loved.*
Tu fus aimé *or* aimée,	*thou wast loved.*
Il fut aimé,	*he was loved.*
Elle fut aimée,	*she was loved.*
On fut aimé,	*one was loved.*
Nous fûmes aimés *or* aimées,	*we were loved.*
Vous fûtes aimés *or* aimées,	*you were loved.*
Ils furent aimés, *m.*	*they were loved.*
Elles fureut aimées, *f.*	*they were loved.*

PAST INDEFINITE.

J'ai été aimé, *m.* aimée, *f.*	*I have been loved.*
Tu as été aimé *or* aimée,	*thou hast been loved.*
Il a été aimé,	*he has been loved.*
Elle a été aimée,	*she has been loved.*
On a été aimé,	*one has been loved.*
Nous avons été aimés *or* aimées,	*we have been loved.*
Vous avez été aimés *or* aimées,	*you have been loved.*
Ils ont été aimés, *m.*	*they have been loved.*
Elles ont été aimées, *f.*	*they have been loved.*

PLUPERFECT.

J'avais été aimé, *m.* aimée, *f.*	*I had been loved.*
Tu avais été aimé *or* aimée,	*thou hadst been loved.*
Il avait été aimé,	*he had been loved.*
Elle avait été aimée,	*she had been loved.*
On avait été aimé,	*one had been loved.*
Nous avions été aimés *or* aimées,	*we had been loved.*
Vous aviez été aimés *or* aimées,	*you had been loved.*
Ils avaient été aimés, *m.*	*they had been loved.*
Elles avaient été aimées, *f.*	*they had been loved.*

PAST ANTERIOR.

J'eus été aimé, *m.* aimée, *f.*	*I had been loved.*
Tu eus été aimé *or* aimée,	*thou hadst been loved.*
Il eut été aimé,	*he had been loved.*
Elle eut été aimée,	*she had been loved.*
On eut été aimé,	*one had been loved.*
Nous eûmes été aimés *or* aimées,	*we had been loved.*
Vous eûtes été aimés *or* aimées,	*you had been loved.*
Ils eurent été aimés, *m.*	*they had been loved.*
Elles eurent été aimées, *f.*	*they had been loved.*

FUTURE.

Je serai aimé, *m.* aimée, *f.*	*I shall be loved.*
Tu seras aimé *or* aimée,	*thou wilt be loved.*
Il sera aimé,	*he will be loved.*
Elle sera aimée,	*she will be loved.*
On sera aimé,	*one will be loved.*
Nous serons aimés *or* aimées,	*we ehall be loved.*
Vous serez aimés *or* aimées,	*you will be loved.*
Ils seront aimés, *m.*	*they will be loved.*
Elles serout aimées, *f.*	*they will be loved.*

FUTURE ANTERIOR.

J'aurai été aimé, *m.* aimée, *f.*	*I ehall have been loved.*
Tu auras été aimé *or* aimée,	*thou wilt have been loved.*
Il aura été aimé,	*he will have been loved.*
Elle aura été aimée,	*she will have been loved.*
On aura été aimé,	*one will have been loved.*
Nous aurons été aimés *or* aimées,	*we ehall have been loved.*
Vous aurez été aimés *or* aimées,	*you will have been loved.*
Ils auront été aimés, *m.*	*they will have been loved.*
Elles auront été aimées, *f.*	*they will have been loved.*

CONDITIONAL MOOD.

PRESENT.

Je serais aimé, *m.* aimée, *f.*	*I should be loved.*
Tu serais aimé *or* aimée,	*thou wouldst be loved.*
Il serait aimé,	*he would be loved.*
Elle serait aimée,	*she would be loved.*
On serait aimé,	*one would be loved.*
Nous serions aimées *or* aimées,	*we should be loved.*
Vous seriez aimés *or* aimées,	*you would be loved.*
Ils seraient aimés, *m.*	*they would be loved.*
Elles seraient aimées, *f.*	*they would be loved.*

PAST.

J'aurais été aimé, *m.* aimée, *f.*	*I should have been loved.*
Tu aurais été aimé *or* aimée,	*thou wouldst have been loved.*
Il aurait été aimé,	*he would have been loved.*
Elle aurait été aimée,	*she would have been loved.*
On aurait été aimé,	*one would have been loved.*
Nous aurions été aimés *or* aimées,	*we should have been loved.*
Vous auriez été aimés *or* aimées,	*you would have been loved.*
Ils auraient été aimés, *m.*	*they would have been loved.*
Elles auraient été aimées, *f.*	*they would have been loved.*

IMPERATIVE MOOD.

Sois aimé, *m.* aimée, *f.*	*be (thou) loved.*
Qu'il soit aimé,	*let him be loved.*
Qu'elle soit aimée,	*let her be loved.*
Qu'on soit aimé,	*let one be loved.*
Soyons aimés *or* aimées,	*let us be loved.*
Soyez aimés *or* aimées,	*be (ye or you) loved.*
Qu'ils soient aimés, *m.*	*let them be loved.*
Qu'elles soient aimées, *f.*	*let them be loved.*

SUBJUNCTIVE MOOD.

PRESENT.

Que je sois aimé, *m.* aimée, *f.*	*that I may be loved.*
Que tu sois aimé *or* aimée,	*that thou mayest be loved.*
Qu'il soit aimé,	*that he may be loved.*
Qu'elle soit aimée,	*that she may be loved.*
Qu'on soit aimé,	*that one may be loved.*
Que nous soyons aimés *or* aimées,	*that we may be loved.*
Que vous soyez aimés *or* aimées,	*that you may be loved.*
Qu'ils soient aimés, *m.*	*that they may be loved.*
Qu'elles soient aimées, *f.*	*that they may be loved.*

IMPERFECT.

Que je fusse aimé, *m.* aimée, *f.*	*that I might be loved.*
Que tu fusses aimé *or* aimée,	*that thou mightest be loved.*
Qu'il fût aimé,	*that he might be loved.*
Qu'elle fût aimée,	*that she might be loved.*
Qu'on fût aimé,	*that one might be loved.*
Que nous fussions aimés *or* aimées,	*that we might be loved.*
Que vous fussiez aimés *or* aimées,	*that you might be loved.*
Qu'ils fussent aimés, *m.*	*that they might be loved.*
Qu'elles fussent aimées, *f.*	*that they might be loved.*

PAST.

Que j'aie été aimé, *m.* aimée, *f.*	*that I may have been loved.*
Que tu aies été aimé *or* aimée,	*that thou mayest have been loved.*
Qu'il ait été aimé,	*that he may have been loved.*
Qu'elle ait été aimée,	*that she may have been loved.*
Qu'on ait été aimé,	*that one may have been loved.*
Que nous ayons été aimés *or* aimées,	*that we may have been loved.*
Que vous ayez été aimés *or* aimées,	*that you may have been loved.*
Qu'ils aient été aimés, *m.*	*that they may have been loved.*
Qu'elles aient été aimées, *f.*	*that they may have been loved.*

PLUPERFECT.

Que j'eusse été aimé, *m.* aimée, *f.*	*that I might have been loved.*
Que tu eusses été aimé or aimée,	*that thou mightest have been loved.*
Qu'il eût été aimé,	*that he might have been loved.*
Qu'elle eût été aimée,	*that she might have been loved.*
Qu'on eût été aimé,	*that one might have been loved.*
Que nous eussions été aimés *or* aimées,	*that we might have been loved.*
Que vous eussiez été aimés *or* aimées,	*that you might have been loved.*
Qu'ils eussent été aimés, *m.*	*that they might have been loved.*
Qu'elles eussent été aimées, *f.*	*that they might have been loved.*

LESSONS IN BOTANY.—XLI.

SECTION CXXI.—MOSSES (*concluded*).

THE Liverworts, of which we have next to give some account, come lower in the scale of organisation; they are much varied in size, appearance, and structure, and some of them are of exceeding beauty. They muster under their banner some genera which closely resemble true mosses, others which are nearer the structure of lichens, and again others which link them with the *Algæ*. *Jungermanniæ*, *Marchantiæ*, *Targioniæ*, and a few other less noticeable genera, are all of this tribe; but they differ so widely from each other, that we shall scarcely from their appearance be led to place them in the same order. The similarity of their organs of fructification shows, however, that they must all be considered as belonging to the order *Hepaticæ*, and we proceed to give a brief notice of a few of the most interesting genera.

The *Jungermanniæ*, or scale-mosses, so named from Louis Jungermann, a German botanist, are of a very peculiar and exquisitely delicate structure. The whole substance of the plant is loosely cellular, so much so that, although most of the species are exceedingly minute, the beautiful reticulation of the leaves may often be detected by the naked eye. The herbage consists of a variously dilated frond, often naked, but more frequently covered with small leaf-like appendages. These are often divided, but never truly nerved, and might more properly be considered as dilatations of the frond.

The scale-mosses may be considered as divided into two classes: the foliaceous, or those which have the appearance of possessing separate leaves; and the frondose, or those which consist of lobed fronds or thalli.

The former of these divisions is composed of minute plants, which by an unaccustomed eye might be taken for true mosses, amongst which, in many instances, they are found growing. These are widely spread over the ground on banks and trunks of trees, or other positions in shady woods; some are found on moist Alpine moors, frequenting the beds of torrents, or growing in boggy places, along the edges of springs or rivulets; whilst we find some species spread out on clay and exposed heaths, exhibiting their pretty purple or bronze foliage where nothing else will grow.

The second or frondose division of this tribe is chiefly confined to semi-aquatic positions. They are larger, their leafy parts, or fronds, are thicker, broader, and of a different texture from the foliaceous kinds, and some of them are slimy to the touch; but there are one or two of this division—namely, the forked and the downy scale-mosses—which grow on stones, trunks of trees, and on shady limestone rocks.

The fruit of this genus is a theca or capsule, which rises from a tubular leaf or cluster of leaves called the *perichætium*, and is usually borne on a seta or fruit-stalk. The theca lies involved in this protecting sheath until it is mature enough to make its appearance in the world; the perichætium then opens at the top, and the little theca—unlike the modest little mosses which never lift their young heads to the light without the covering of their calyptra or veil—suddenly starts up, leaving that organ attached to the point at which it originally grew, and displays itself unveiled to the eye which may be sharp enough to detect its diminutive beauties. This theca is four-valved, in shape much like those of mosses, but it has no lid, and no central column round which the spores assemble; instead of this, it is furnished with some very curious spiral filaments with which the spores are associated (Fig. 288). It is in the possession of these spring-like organs alone that the different families which are classed under the general name of *Hepaticæ* resemble each other; but these are common to the *Jungermanniæ*, the *Marchantiæ*, and all the rest of the genera which the order comprises. These organs consist of double spiral threads, somewhat like the tracheæ or spiral air-vessels in plants, only more elastic. They are contained in the same case with the spores, and curled up among them, and when the capsule is mature, spring up with a sudden jerk like a Jack-in-a-box, and scatter the spores which are around them in all directions. So sensitive are these *elaters*, that even breathing on them will set them in motion after the spores have escaped. The scale-mosses chiefly differ from true mosses in the permanent attachment of the calyptra of which we spoke above, and in having no lid or *operculum*, and no columella. The tubular form of the sheath and the presence of the spiral filaments, just described, constitute the other distinguishing features of the order. Besides the normal fructification, the *Jungermanniæ* possess a second kind of reproductive organ, by means of which the species are often propagated; these are called *gemmæ*, and consist of minute roundish or oblong bodies, variously situated, sometimes in the axil of the leaf, at others on its margin, and clustered together in the form of little bells.

The colour of the scale-mosses varies through all the shades of green into brown, yellowish, dusky purple, and bronze. The theca is usually black, or deep purple, or dark brown, although occasionally it is nearly transparent.

The seta or fruit-stalk is in most cases semi-transparent, and as delicately reticulated as the other parts of the plant. Our example, the pear-shaped scale-moss (*Jungermannia turbinata*, Fig. 289), shows this very beautifully. This species is one which is frequent in moist shady spots in limestone districts, and we have selected it as illustrative of the highly cellular structure of plants of this tribe. *Jungermannia pusilla* (Fig. 290), the dwarf scale-moss, is given for the purpose of exhibiting the beautiful form of its folded sheath or perichætium. The plant is of a tender green, the capsule brown, and the edges of the bell-shaped sheath of a delicate pink. This is given, as are all the other scale-mosses of which we present drawings, as they appear when magnified to about six times their natural size.

Sowerby says, in speaking of mosses, that which may with equal truth be said of the tribes which at present engage our attention:—"It is chiefly in the economy of Nature that we must look for the utility of these little plants, that she has fashioned with so much care, and for the reproduction and dissemination of which she has invented so beautiful and complicated an apparatus as that described above, though they are destined for the most part to flourish where no human eye beholds that beauty, no intelligence, save her own, can calculate the necessity and advantage of their existence. Their ministry is pursued in concert with other families lower in the scale of vegetable being; the smaller species assisting in the production of soil upon newly-formed lands, clothing with verdure the most barren spots, and gradually fitting them for the support of the higher order of plants; while the larger are occupied in no small degree in the production of land itself, especially the aquatic kinds, which fix themselves upon the surface of lakes and stagnant waters, already interlaced with the slender stems of the *Charæ*, *Confervæ*, and plants of similar habit, gradually converting the liquid plain into a partially solid one, on which eventually grasses, rushes, etc., are capable of growing; thus are formed morasses, which, by a further progress of vegetation, become at length fertile meadows. While thus slowly operating to increase the extent of the habitable world, their influence directly and indirectly affects in various ways—but more frequently, perhaps, unseen and unsuspected—the welfare and interest of those who are too apt to despise their apparent insignificance, and too proud to stoop to the examination of their surpassing beauty." Of the species which render their feeble aid in thus converting water into land, are some of the little frondose scale-mosses, and also some of the other tribes of the *Hepaticæ*. The broad - leaved scale-moss (*Jungermannia epiphylla*, Fig. 291), which is depicted of the natural size, is one of these. It is frequent on moist heaths, and in damp woods and thickets, especially by the sides of wells and rivulets. The slippery scale-moss (*Jungermannia pinguis*) is another of this description.

We next come to the family *Marchantiæ*, named from Nicholas Marchant, a noted botanist. It is a pretty and singular tribe, its English name, liverwort, being derived from a fancied resemblance to the human liver; this resemblance was supposed to indicate some special virtue in the plant, as connected with that organ, and in olden time it was considered as a specific for jaundice and other such disorders. The *Marchantiæ* grow on earth or the bark of trees in damp places, spreading over the ground in the form of a green incrustation, from the lower surface of which root-fibres are developed. This crust or thallus is entirely composed of cellular tissue, the cells of the outer layer being closer in texture than the rest, and forming a thick leathery cuticle, in which are large stomata. The fruit consists of a head of spore-cases, radiating from a central disc called the *shield*, like the spokes of a wheel. The head is mounted on a long stalk springing from a bell-shaped sheath, which starts from the surface of the frond or thallus, usually at the margin. The spore-cases or thecæ open by irregular fissures, either four or eight in number. Besides this normal fruit, gemmæ, or detached buds, of quite a different structure, are found on these plants. These are small leafy bodies which spontaneously separate from the parent plant, and when mature are washed out by the rain, and carried abundantly to new localities, where they spring up and grow very rapidly. The form of the thalli or fronds of the *Marchantiæ* is thus quaintly described by the good old herbalist Gerard:—"Liverwort is a kinde of mosse which spreadeth itself abroad upon the ground, having many uneven or crumpled leaves lying over one another, as the scales of fishes do; greene above, browne underneath." These fronds are variously lobed, their colour is a living green, and when broadly spread over a damp bank or the wall of a fountain or reservoir of water, they form a beautiful object. The Germans have the same name for the tribe as ourselves, and call it *Leberkraut*. The conical liverwort (Fig. 292) is common. It is of a yellowish - green, tinged with brown; the peduncle, or fruit-stalk, is white, touched with pink, and fleshy. It springs from a concave disc, usually situated in the marginal clefts of the fronds. The sporules are large, of a dark olive hue. The fronds, when bruised, send forth a peculiar fragrance like bergamot.

288. SPIRAL FILAMENTS OR ELATERS OF HEPATICÆ. 289. THE PEAR-SHAPED SCALE-MOSS. 290. THE DWARF SCALE-MOSS. 291. THE BROAD-LEAVED SCALE-MOSS. 292. CONICAL LIVERWORT. 293. STAR-HEADED LIVERWORT (MARCHANTIA POLYMORPHA).

The other example given in our illustration (Fig. 293) is of the star-headed liverwort (*Marchantia polymorpha*), a species even more common than the conical. Of the other genera which the order *Hepaticæ* comprises we shall say but little, as they are few and, in comparison, insignificant.

Targionia hypophylla at first sight resembles a *Marchantia*, but differs in its fructification, which is globose and nearly buried in the margin of the frond; and this, with *Anthoceros punctatus*, *Sphærocarpus terrestris*, and a few species of the little genus called *Riccia* (on which, as they are for the most part little known and not of much general interest, we shall not enter particularly), complete the number of the genera contained in this order.

ELECTRICITY.—VI.

ELECTRIFIED PITH BALLS—DANCING FIGURES—ELECTRIC BELLS—EFFECTS OF A POINT—ELECTRIC AURA—ELECTRIC FLYER—LICHTENBERG'S FIGURES—CHEMICAL EFFECTS—ELECTROPHORUS.

There are many interesting experiments, besides those already explained, which illustrate more fully the principles of electrical attraction and repulsion; and to some of these we must now direct our attention. Balls made out of the pith of the elder are well adapted for many of these experiments, on account of their extreme lightness. If we place a number of these balls on a metal tray, and cover them with a glass shade, fitted at the top with a cap through which a brass wire passes (Fig. 21), we shall find that, when the wire is connected with the prime conductor and the machine is set in action, the balls will dance up and down very rapidly. The rod is made to slip tightly through the cap at the top of the shade, so that the ball may be adjusted to any required height, according to the power of the machine.

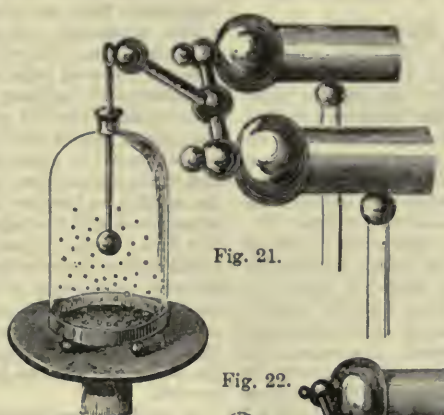


Fig. 21.

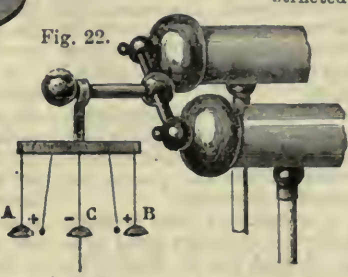


Fig. 22.

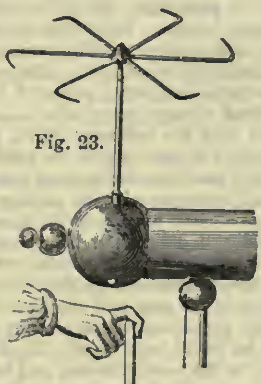


Fig. 23.


Fig. 24.

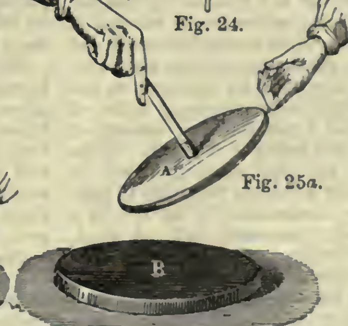


Fig. 25a.


Fig. 25b.

The explanation of this experiment is simple. The brass ball, being connected with the conductor, becomes highly charged, and therefore attracts the light particles of pith. As soon, however, as they touch it, and share its electricity, they are repelled, and fly off violently, so that they would roll quite away were they not confined by the shade. On again touching the tray, each parts with its share of the electricity, and rises as before for a fresh supply. This is by far the best mode of trying the experiment; there is, however, a much simpler plan, which consists in inverting over the balls a common tumbler, previously rendered thoroughly dry and warm. A chain from the conductor is then laid on the bottom of the glass. The electricity thus collected on the exterior surface sets free a corresponding amount on the interior, and the balls rise and convey this away by the tray to the ground. In this case a charge soon accumulates in the glass, and must be discharged, or the balls will cease to rise.

If a pointed wire be inserted in the conductor, and a tumbler be then held so that different portions of its interior are exposed to the action of the point, it will become charged, and on placing it over the balls, they will dance as before. Here, too, the glass becomes charged in a similar way to that in which a Leyden jar does, and when the action nearly ceases it may be renewed by touching the exterior with the hand, thus removing the free electricity there, and setting free a further amount within.

Let a disc of metal, or thin wood carefully coated with tinfoil, and having a diameter of five or six inches, be suspended from the conductor, so as to be about one and a-half or two inches above a similar but rather larger plate supported under it. On this lower plate place some small figures of men dancing, cut out of pith or cardboard; as soon as the machine is worked they will rise, and then dance up and down rapidly, thus carrying away the electricity from the upper plate. The figures should be cut so that their feet are rather heavier; the upper part should also be somewhat pointed, as otherwise they have a tendency to dance with the head downwards. Sometimes two brass wires, with the ends turned over so as to avoid the effects of the rough ends, are substituted for the two plates, and thus we have the electrical rope-dancer. This experiment is, however, more difficult to manage properly.

On the same principle we have the electric swing, in which a figure supported by a silk thread is made to swing backwards and forwards between two brass balls, one of which is connected with the conductor and the other with the ground. The electric seesaw is merely another modification of the same apparatus. The beam in it must be very carefully balanced, and should turn freely.

Fig. 22 represents the electric bells. The middle one, C, is suspended by a thread of silk, and from it a small piece of chain leads to the ground. The other two bells are suspended by pieces of chain from the metal bar. Between them are small metal balls hung by silk threads; buttons will answer well for these. As soon as the machine is worked, the bells A and B become positively charged, and attract the clappers; these take a portion of their electricity, and, being then repelled, convey it to the middle bell, by which they are attracted, and thus to the ground. In this way they are kept in a state of oscillation as long as the machine is worked. Bells constructed on this principle are sometimes fitted to wires arranged for showing the electricity of the atmosphere, and at once ring and call the attention when the air is more than usually charged with the electric fluid.

Procure two pieces of board two or three feet long, and, having coated them with tinfoil, suspend one by means of silk threads; then connect it with the machine, placing the other a few inches under it, and connect it with the ground. If now bran or a number of small pieces of paper be scattered on the lower one, they will collect and arrange themselves in a column, rolling about after the manner of columns of sand in a desert when a whirlwind is raging. Many other experiments, showing the manner in which lightning strikes different objects, may also be tried with these boards.

If a basin of water be placed on an insulating stand, and charged with electricity, an imitation swan placed on it will at once be attracted by and follow the finger or any conducting body held to it. A small boat may also be placed on the water, but if a pointed wire be fixed to it, it will be repelled instead of being attracted. A point held to it will also produce the same effect.

We will now speak of the mechanical and other effects produced by a point, some of which have been already referred to by way of caution in making the machine. When a pointed wire is fixed in or near the conductor, the induction at the point is so much increased, on account of the large surface which it faces, that the electricity cannot be confined, but is dissipated and lost. A needle held at the distance of a few feet from the conductor will seriously impair the power of a machine, and particles of dust act in the same way, though, of course, in a much smaller degree. If the hand be held near a point fixed in the conductor a distinct breeze will be felt, and if the face be held there a sensation as of cobwebs will be experienced, just as is felt when a person stands on an insulating stool. In the dark such a point becomes beautifully luminous. Not only can the breeze, or *aura*, as it is called, be felt by the hand, but its effects may be seen on objects held near the point. If a lighted candle be held to it the flame will be perceptibly blown over to one side, just as if a faint stream of air from a blowpipe was passing through it. Wheels fitted with floats after the plan of paddle-wheels have also been turned by it; it is requisite, however, that they should be very light and well balanced, or else the current will be too weak to set them in motion. Instead of the candle being held to a point, it may be placed on the conductor, and a pointed wire brought near it; the flame will then be repelled just as if a negative stream were issuing from the point.

Another way in which the mechanical effects produced by a point are shown is by means of the electric flyer, which is shown in Fig. 23. A number of pieces of wire radiating like the spokes of a wheel are fixed to a centre cap, and the whole is then carefully balanced so that it may turn freely on a vertical point placed in the conductor. The ends of all the wires are pointed and turned in one direction, and when the conductor is charged the electricity is given off by these, and thus causes the flyer to turn round rapidly, in the same way as the water issuing from the arms in Barker's mill causes it to rotate.

The experiment is, however, sometimes explained in a different manner. The electricity given off by the points renders the air aronnd them strongly positive, and it therefore repels the points which are similarly charged, and thus sets the flyer in motion. If it be placed under the receiver of an air-pump, and the air exhausted, no motion will be produced. A simpler mode of constructing the flyer is to flatten a piece of copper wire in the middle, and make in the flattened part a small depression for the point to fit into. The ends of the wire are then pointed and bent round, as shown in Fig. 24.

The electric orrery is merely a modification of this experiment. A second flyer being placed on a point projecting upwards from the first, small globes made of cork or some other light material are then placed on them to represent the sun and planets, and the reaction of the points sets the whole in motion.

If these experiments be tried in a darkened room a faintly luminous ring will be seen, caused by the electricity given off in the form of the brush discharge. A good way of showing the flyer, and at the same time illustrating the principle of the Leyden jar, is to use the two together. The knob of the jar is made to unscrew, and the end of the rod pointed so that the flyer may be placed upon it. As soon as the jar is charged it should be placed on a sheet of glass or an insulating stand, and the knob unscrewed. Only the excess of positive electricity will be given off, and the flyer may then be balanced on the point. If now the knuckle be held to its exterior, a series of small sparks will be given off, while a corresponding amount of electricity will be dispersed from the points of the flyer. If the knuckle be withdrawn, the flyer will soon cease to move. It may be mentioned here that it is by no means necessary to have a cover to a Leyden jar. Many electricians fix the rod to a plate at the bottom, or to a thin framework made of wood, covered with tinfoil, and placed within the jar, and this mode seems to be in many respects preferable to the older plan.

Instead of placing the flyer on the conductor, the latter may be altogether removed, and the flyer balanced on a pointed wire and held near the edge of the silk flap; the electricity will then be attracted by the points, and will set it in motion.

If a small metal pail, with an opening in the bottom of such a size that the water can only just drip from it, be suspended from the conductor, the particles of the liquid being similarly electrified will repel one another, and the water will flow in a fine stream instead of in a series of drops. Similarly, the water will drop much more rapidly from a wet sponge if it be hung from the conductor. In both cases, the issuing water will at times appear faintly luminous in the dark, owing to its being charged with electricity.

Let a piece of camphor be laid on the conductor, and then lighted, it will radiate in all directions as soon as the machine is set in action.

There is one experiment we must now refer to which hardly comes under this class of effects. Having charged a Leyden jar, take it up by the knob, and trace with the knob a series of lines and figures on a cake of resin or vulcanite. Then, having placed the jar on an insulating stand in order to avoid receiving a shock, take it up by the knob and trace a second set of lines on the same surface with the outside. The latter will, of course, be negatively electrified, and the former positively. Now take a mixture of red lead and flowers of sulphnr, and sift it evenly on to the resin; the ingredients will at once separate themselves to a considerable extent, the sulphur settling in a series of tree-like forms along the positive track, while the red lead gathers in a series of stars or spots along the negative.

The devices thus formed vary, of course, very greatly, and elegant patterns may at times be obtained. They are known as Lichtenberg's figures.

The chemical effects of electricity are very great and very important; they are, however, most easily seen by means of voltaic electricity, and must, therefore, be chiefly referred to under that head. We will, however, give one or two illustrations here. If pieces of paper coloured with litmus and turmeric, and moistened with sulphate of soda, be placed on a plate, and a wire leading from the prime conductor be connected with one end, and a second wire connected with the gas or water-pipes be laid upon the other, we shall find on working the machine that the turmeric paper will be stained brown at the place where the earth wire touches it, showing that the sulphate has been decomposed and the alkaline constituent of it set free against this wire. If the litmus paper be employed a red stain will be found against the wire leading from the conductor, showing that the acid constituent of the salt has been liberated there. We see thus that the acid and alkali appears at the positive and negative poles respectively. The reason of connecting the wire to the gas or water pipes is to ensure a good connection with the earth, and thus to let the electricity escape as rapidly as possible.

If sparks be made to pass over a piece of paper soaked with iodide of potassium, the iodine will be liberated, and will stain the paper brown. This effect is, however, sometimes attributed to the nitric acid—which is formed in the air by the passage of the electricity, causing the nitrogen and oxygen to unite—and not to the decomposing power of the electricity. After a thunder-storm a very perceptible amount of nitric acid is thus formed, and the influence which lightning has in clearing the air may, in a great degree, be attributed to this cause.

Water has been decomposed into its constituent gases—oxygen and hydrogen—by the passage of a large number of shocks through a small portion of it; the experiment is, however, complicated and difficult, and the mode of performing it need not be fully described. With this we conclude our glance at the main results produced by the electric spark.

There is one easy and simple method of obtaining electricity in small quantities, which has not yet been referred to, but will often be found very useful. It is by means of the apparatus known as the electrophorus, and represented in Fig. 25*a*, *b*. A tray, B, about ten or twelve inches in diameter, with an edge about half an inch high all ronnd it, is made of tin or zinc. Any tin-smith can easily manufacture this. A mixture, composed of about equal parts of shellac, Venice turpentine, and common resin, melted together, is then poured in so as to fill the tray up to the level of the edge.

A cover, A, about an inch or an inch and a-half less in diameter, is made of metal, or wood coated with tinfoil, and an insulating handle fixed so that it may be lifted by means of it. The edges of this plate should be carefully smoothed.

To use this apparatus, the resinous cake is excited, by being well rubbed with a piece of warm dry flannel or cloth, or, better still, by being struck several times with a piece of catskin. The metal plate is now placed upon it, and at first acquires a faint charge of negative electricity by touching the excited resin in places. If, however, it be now touched by the finger while resting on the resin, and then raised, a bright spark will be given from it to any conducting substance held near. Now replace the plate, touch with the finger and again remove, a second spark will be given off; and in this way we may continue until any number of sparks have been drawn, the original charge not being dissipated or weakened in any appreciable degree.

The *rationale* of the process is simple: the resin is not a perfectly smooth surface, and therefore only touches the cover in a few places, and, being an insulator, does not communicate its charge to it. It acts, however, by induction, driving the negative part of the electricity of the plate to its upper surface, and attracting the positive portion to the lower. When the finger touches the plate, the negative escapes to the ground through the body, and thus the whole plate is positively electrified, and yields a spark as soon as its charge is set free by its removal from the resinous surface. It will thus be seen that the charge in the resin merely acts by induction on the natural electricity in the plate, and therefore is not dissipated. As this apparatus remains in working order a long time, if carefully shielded from dust, and is ready for use at a moment's notice, it is sometimes found a very great convenience.

The main drawback to its use is the necessity of touching the plate every time it is laid upon the form B. This is sometimes obviated by fixing a brass ball on a short wire fixed to the plate, so that it may touch a similar ball attached to the tin case of the resinous cake, and this plan acts well. A better one has, however, been devised, by which a narrow strip of tinfoil is placed right across the surface of the resin, and made to communicate with the tin sides of the case. Some portion of the upper plate is sure then to touch this strip, and thus allow the negative electricity to escape to the ground.

Another modification, which is said to answer even better than this, consists in boring three or four holes through the resin down to the metal plate, and fixing in these pieces of wire with their ends just even with the surface of the resin.

One or more of these is almost certain to touch the plate each time it is placed on the resin, and thus a spark can be obtained when the plate is raised, without the trouble of touching it each time with the finger. In this way, with a plate about eighteen inches in diameter, sparks about two inches in length can readily be obtained, and by means of them a good-sized jar may easily be charged.

A somewhat simpler piece of apparatus, acting on the same principle, is sometimes employed. A piece of window-glass is carefully coated with tinfoil on one side, up to within about two inches of the edge. This is laid with the coated side downwards, and the upper surface is excited by being rubbed with a piece of silk coated with amalgam. The plate is now raised by the corners, and laid with the uncoated side downwards upon some badly conducting substance, such as the dry cover of a book. The tinfoil is then touched with the finger, and on raising the pane a spark may be obtained from it; this may be repeated, as with the electrophorus, until a sufficient charge has been obtained. Both these instruments are of great service in the laboratory, as in processes of analysis it is frequently necessary to pass a spark through a mixture of gases contained in a closed tube, and for such purposes a machine would be in the way, and involve a large amount of trouble. Condensers, acting in a similar way by induction, are employed for detecting the presence of small quantities of electricity. These will be described in the next lesson.

LESSONS IN LATIN.—XLIV.

IRREGULAR VERBS (*continued*).

III.—FERO, FERRE, TULI, LATUM, *to bear.*

PRESENT ACTIVE.	PRESENT PASSIVE.
INDIC.: Fero, *fers, fert;*	Feror, *ferris, fertur.*
Ferimus, *fertis,* ferunt.	Ferimur, Ferimini, feruntur.
INFINITIVE: *Ferre.*	*Ferri.*
IMPERATIVE: *Sing. Fer, ferto,* *Ferto.*	*Sing. Ferre, fertor,* *fertor.*
Plur. Ferte, fertote, ferunto.	*Plur.* Feriminor, Feruntor.
IMPERFECT SUBJUNCTIVE.	IMPERFECT SUBJUNCTIVE.
Ferrem, ferres, ferret.	*Ferrer, ferrēris (e), ferretur.*
Ferremus, ferretis, ferrent.	*Ferremur, Ferremĭni, ferrentur.*

The other parts are regularly formed from fero, tuli, and latum; as *Subj. Pres.*, feram, -as, -at, etc.; ferar, -aris, -atur, etc.; *Ind. Imp.*, ferebam and ferebar; *Fut.*, feram, -es, -et, etc., ferar, -ēris, -ētur, etc.; *Subj. Perf.*, tulerim, -is, -it, etc.; *Plup. Ind.*, tuleram, etc.; *Plup. Subj.*, tulissem, etc.; *Inf. Fut.*, laturum esse; *Part. Pres.*, ferens; *Part. Fut.*, laturus, -a, -um; *Part. Pass.*, latus; *Part. Pass.*, in -dus, ferendus; *Gerund*, ferundum.

So also the compounds, as offero, obtuli, oblatum, *to bring before.* From the stem of the perfect tuli, arose tollo, tollere, sus-tuli, sub-latum, *to raise, take away.*

VOCABULARY.

Affero, afferre attuli, allatum, *to bring to.*
Aufero (*ab* and *fero*), auferre, *abs*-tuli, ablatum, *to take away, to withdraw.*
Bellum infero alicui, *to make war on.*
Commŏdum, -i, n., *advantage, convenience.*
Confero, conferre, contuli, collatum, *to bring together, contribute, compare.*
Decedere, *to depart, die.*
Defero, deferre, detuli, delatum, *to bring down, present, accuse.*
Doctor, -ōris, m., *a teacher.*
Effero, efferre, extuli, elatum, *to bring out, to carry out for interment, to bury.*
Funditus, *from the foundation, thoroughly.*
Gigas, gigantis, m., *a giant.*
Hoc est (with genitive), *this is the sign or character of.*
Infero, inferre, intuli, illatum, *to bring in.*
Præfero, præferre, prætuli, prælatum, *to bring before, prefer.*
Qui (quo), *whereof, whereby.*
Refero, referre, retuli, relatum, *to bring back, report, refer.*

The compounds of fero are a good study in relation to the forms which prepositions take in combination, and the modifications of meaning which they occasion.

EXERCISE 167.—LATIN-ENGLISH.

1. Ferte misĕro atque inŏpi auxilium. 2. Confer nostram longissimam ætatem cum æternitate, et brevissima videbitur. 3. Quid quæque nox aut dies ferat, incertum est. 4. Incumbe in eam curam et cogitationem, quæ tibi summam dignitatem et gloriam affĕrat. 5. Ferre laborem consuetudo docet. 6. Pecuniam præferre amicitiæ sordidum est. 7. Ut quisque maxime ad suum commodum refert quæcunque agit, ita minime est vir bonus. 8. Bonum civem reipublicæ dignitatem suis omnibus commodis præferre oportet. 9. Hoc doctoris intelligentis est videre quo ferat natura sua quemque. 10. Aristides in tantâ paupertate decessit ut qui efferretur, vix reliquerit. 11. Poetæ ferunt gigantes bellum diis intulisse. 12. Socrates eundem vultum domum referebat quem domo extulerat. 13. Quod auri, quod argenti, quod ornamentorum in urbibus Siciliæ fuit id Verres abstulit. 14. Multi etiam naturæ vitium meditatione atque exercitatione sustulerunt. 15. Pietate adversus Deum sublatâ, fides etiam et societas humani genĕris tollitur. 16. Qui Deum esse negant, nonne omnem religionem funditus sustulerunt. 17. Caritate benevolentiâque sublatâ, omnis est e vitâ sublata jucunditas.

EXERCISE 168.—ENGLISH-LATIN.

1. Compare thy folly with thy father's wisdom. 2. I have compared my sin with God's love. 3. I will compare small things with great. 4. I have borne a mass of evil. 5. A mass of evil has been borne by me. 6. The giants are said to have raised mountains. 7. I know not what the day may bear (*bring*). 8. Bear the labour patiently (*with an equal mind*). 9. Do not refer all things to thy own advantage. 10. The enemy has taken away what gold and silver I had. 11. Love being taken away, all the pleasure of home is taken away. 12. Canst thou take away the fault of nature by meditation? 13. Do not take away the faith and intercourse of life.

IV.—VOLO, VELLE, VOLUI, *to be willing, to wish.*
NŌLO, NOLLE, NOLUI, *to be unwilling, refuse.*
MĀLO, MALLE, MALUI, *to be more willing, prefer.*

Nolo is made up of non and volo; as, non-volo, nolo; and malo is made up of magis and volo; as, magis-volo, mavolo. Consequently, the first vowel of nōlo and mālo is long, while that of vŏlo is short.

	INDICATIVE.			SUBJUNCTIVE.		
			Present.			
Sing.	Volo.	Nolo.	Malo.	Velim.	Nolim.	Malim.
	Vis.	Non-vis.	Mavis.	Velis.	Nolis.	Malis.
	Vult.	Non-vult.	Mavult.	Velit.	Nolit.	Malit.
Plu.	Volŭmus.	Nolŭmus.	Malŭmus.	Velimus.	Nolimus.	Malimus.
	Vultis.	Non-vultis.	Mavultis.	Velitis.	Nolitis.	Malitis.
	Volunt.	Nolunt.	Malunt.	Velint.	Nolint.	Malint.
			Imperfect.			
	Volebam.	Nolebam.	Malebam.	Vellem.	Nollem.	Mallem.
	Volebas.	Nolebas.	Malebas.	Velles.	Nolles.	Malles.
	etc.	etc.	etc.	etc.	etc.	etc.
			Future.			
	Volam.	Nolam.	Malam.			
	Voles.	Noles.	Males.			
	etc.	etc.	etc.			

IMPERATIVE (of volo and malo none).
Sing.—2, Nōli, nolito; 3, nolito. *Plur.*—2, Nolite, nolitōte; 3, nolunto.

PARTICIPLE.
Volens, -tis. Nolens, -tis. (Of malo none.)

The forms that are made from the perfect are regular, thus: volui, voluerim, voluero, volueram, voluisse, voluissem. The other parts are wanting.

VOCABULARY.

Acer, acris, acre, *sharp, energetic*	Faber, -ri, *a workman.*	Sectari (with acc.), *to follow, strive after.*
Adstringere, *to bind.*	Faber lignarius, *a carpenter.*	Serius, -a, -um, *earnest, serious.*
Defatigare, *to weary, be weary.*	Nobilitare, *to make known or celebrated.*	Velim nolim, *whether I will or not, will-I, nill-I.*
Ejusmodi, *such like, of that kind.*	Publicare, *to make public.*	

EXERCISE 169.—LATIN-ENGLISH.

1. Qui virtutem suam publicari vult, non virtuti laborat sed gloriæ. 2. Nonne poetæ post mortem nobilitari volunt? 3. Ego non eădem volo senex quæ volui adolescens. 4. Si vis amari, ama. 5. Bono mentis fruendum est, si beati esse volumus. 6. Docilis est qui attente vult audire. 7. Omnia benefacta in luce se collocari volunt. 8. Si acres ac diligentes esse vultis, magna sæpe intelligetis ex parvis. 9. Nolumus in conservandis bonis viris defatigari. 10. Homines nolunt eundem pluribus rebus excellere. 11. Si quid per jocum dixi, nolito in serium convertere. 12. Libero sum judicio, nulla ejusmodi adstrictus necessitate ut mihi, velim nolim, sit certa tuenda sententia. 13. Socrates noluit ex carcere edūci quum facile posset. 14. Ego me Phidiam esse mallem quam vel optimum fabrum lignarium. 15. Væ vobis qui divitias quam virtutem sectari mavultis.

EXERCISE 170.—ENGLISH-LATIN.

1. They wish to be wise. 2. They prefer to have wisdom rather than riches. 3. Do not wish to excel in luxury. 4. I wish to excel in virtue. 5. Dost thou wish to take a walk with me? 6. I would rather read this book. 7. They refused to go from their homes. 8. He will refuse to hear what thou wishest to say. 9. If any one shall wish to become wise, let him read the best books. 10. Men are unwilling for the same person to have learning, riches, and power. 11. I would rather have learning than riches. 12. I prefer to be wise than to be rich. 13. Few prefer wisdom to power.

V.—EO, IRE, IVI, ĬTUM, *to go.*

	INDICATIVE.	SUBJUNCTIVE.
Pres.	Eo, īs, ĭt; īmus, ītis, eunt.	Eam, eas, eat; eamus, eatis, eant.
Imp.	Ibam, ibas, ibat, etc.	Irem, ires, iret, etc.
1. *Fut.*	Ibo, ibis, ibit, etc.	Iturus, -a, -um, sim, etc.
Perf.	Ivi, ivisti, ivit, etc.	Iverim, ivcrĭs, iverit, etc.
Plupf.	Iveram, iveras, iverat, etc.	Ivissem, ivisses, ivisset, etc.
2. *Fut.*	Ivero, iveris, ivcrit, etc.	

	IMPERATIVE.	SUPINE.	PARTICIPLE.	GERUND.
Sin.	2. I, īto, 3 īto.	Itum.	*Pres.* Nom. Iens.	N. Eundum.
Plu.	2. Ite, itōte.	Itu.	Gen. Euntis.	G. Eundi.
	3. Eunto.		*Fut.* Iturus.	D. Eundo, etc.

In the same way the compounds, as, exeo, *I go out;* abeo, *I go from;* re-d-eo, *I go back;* so also ven-ĕo, ven-ii, ven-ītum, ven-ēre, *to be sold* (imperative, participle, and gerund wanting); ambīre, *to go round, surround, canvass,* is an exception, as it strictly follows the fourth conjugation, thus: ambio, ambiam, ambiebam, ambirem, ambiens: ambīvi, ambĭtum, ambitus (the substantive has the *i* short, ambĭtus, -ūs), ambiendum.

The compounds in the perfect throw out the *v*, and when *s* follows, *vi;* as, abii, for abivi; abisti, for abivisti; so abiit, abierim, abisse, abissem; venii, venieram, veniero, etc.

Of the simple verb, the passive is used only in the third person singular; as, ītur, literally, *it is gone,* that is, *one goes, they go;* ibatur, *they were going;* itum est, *they went.* By the passive infinitive, iri, in union with the supine, is formed the infinitive future passive, as amatum iri. But the compounds with a transitive force, like other transitives, have a complete passive: for example, præterire, *to go by;* prætereor, *I am gone by;* prætereor, præteriris, præterĭtur, præterīmur, præterimini, prætereuntur, præteribar, and so forth. Ambior (ambiuntur, ambiebar) in the passive also follows the model of the fourth conjugation.

VOCABULARY.

Adire, *to go to.*	Emŏri, 3, *to die.*	Obviam (ob and via), *in the way of, against.*
Aliquando, *some time.*	Fœde, *foully, shamefully.*	Perire, *to perish.*
Angustiæ, -arum, f., *a narrow pass.*	Intempestive, *unseasonably, out of time.*	Præaltus, -a, -um, *very high.*
Casa, -æ, f., *a cottage, hut.*	Interire, *to go between, perish.*	Prisci, *the ancients.*
Circumire, *to go round.*	Ire cubitum, *to go to bed.*	Priscus, -a, -um, *old.*
Cubĭtus, -ūs, *a bed.*	Ire ob, *to go to meet.*	Sero, *late, too late.*
Excessus, -ūs, m., *a going out, beyond* (E. R. *excess*).	Obire, *to die.*	Transire, *to pass over.*
		Turpitudo, -īnis, f., *baseness.*

EXERCISE 171.—LATIN-ENGLISH.

1. Qui ad nos intempestive adeunt, molesti sæpe sunt. 2. Pleraque ante oculos posita, transīmus. 3. Abeunt hirundīnes hibernis mensibus. 4. Corpus mortale aliquo tempore interīre necesse est. 5. Pereunt aliquando innocentes; quis neget? nocentes tamen sæpius pereunt. 6. Omnes homines summâ ope niti decet ne vitam silentio transeant. 7. Quis dubitet quin ex casâ vir magnus exire possit? 8. Potius sero quam nunquam, obviam eundum est audaciæ temeritatique. 9. Omnes cives militibus, qui e bello domum redibant, læti obviam ibant. 10. Si ita naturâ paratum esset, ut ea dormientes agerent quæ somniarent, alligandi omnes essent, qui cubitum irent. 11. Angustias Themistocles quærebat ne multitudine hostium circumiretur. 12. Romulus ad deos transisse creditus est. 13. Augustus obiit septuagesimo et sexto ætatis anno. 14. Muros turresque urbis præaltum mare ambiebat.

EXERCISE 172.—ENGLISH-LATIN.

1. They came to me unseasonably. 2. I will not go to my uncle unseasonably. 3. I have passed over the book placed before my eyes. 4. Good men die, but do not perish. 5. Good men will never perish. 6. Who doubts that great men may come forth from cottages? 7. Take care not to pass thy life in silence. 8. You must go against (*oppose*) baseness. 9. They have gone to the town. 10. When they return (*will have returned*), they will come to your house. 11. Romulus is said to have gone to the gods. 12. Dost thou think that Romulus went to the gods? 13. The children will go to meet their parents. 14. The general takes care not to be surrounded.

VI.—QUEO, QUĪRE, QUĪVI, QUĬTUM, *to be able.*
NEQUEO, NEQUĪRE, NEQUĪVI, NEQUĬTUM, *to be unable.*

Nequeo is merely queo and ne or non. These two verbs follow eo, ire, ivi, ĭtum. Many parts of these verbs appear but seldom, and not at all in good prose; these parts are omitted in the following table:—

	INDICATIVE.		SUBJUNCTIVE.	
Pres.	Queo.	Nequeo.	Queam.	Nequeam.
		Nequis.	Queas.	Nequeas.
		Nequĭt.	Queat.	Nequeat.
		Nequīmus.	Queamus.	Nequeamus.
		Nequītis.	Queatis.	Nequeatis.
	Queunt.	Nequeunt.	Queant.	Nequeant.
Imp.		Nequībam.		Nequirem.
Perf.	Quīvi.	Nequīvi.	Quīverim.	Nequīverim.
Plupf.	Quīvĕram.	Nequīvĕram.	Quivissem.	Nequivissem.
2. *Fut.*	Quīvero.	Nequīvĕro.		

	INFINITIVE.	PARTICIPLE.
Perf.	Quivisse, nequivisse.	Nequiens.

The other parts are wanting, or rarely occur.

VII.—FIO, FIERI, FACTUS SUM, *to be made, to become.*

This verb stands as the passive of facio, *I make.*

	INDICATIVE.	SUBJUNCTIVE.	INFINITIVE.
Pres.	Fio, fis, fit, fiunt.	Fiam, fias, fiat. Fiamus, fiatis, fiant.	*Pres.* Fieri. *Perf.* Factum esse.
Imp.	Fiebam, etc.	Fierem, etc.	*Fut.* Factum iri, or Futurum esse, or fore.
1. *Fut.*	Fiam, etc.		
Perf.	Factus sum, etc.		
Plupf.	Factus eram, etc.		
2. *Fut.*	Factus ero, etc.		

PARTICIPLE.

Perf.	Factus, -a, -um.
Fut. Pass.	Faciendus, -a, -um.
Fut. Act.	Futurus, -a, -um.

The other parts are wanting, or only of infrequent occurrence.

The compounds of facio formed from verbs, retain facio in the active voice, and in the passive follow fio: for example, calefacio, calefacĕre, calefeci, calefactum, *to make warm;* calefio, calefieri, calefactus sum, *to be made* or *become warm.* The compounds with prepositions, however, have in the active ficio, ficere, feci, fectum; and in the passive ficior, fici, fectus sum; as, perficio, perficĕre, perfeci, perfectum; in the passive, perficior, perfĭci, perfectus sum. Only a few compounds with prepositions, together with the regular forms, have, in the passive, forms from fio: for example, confit for conficitur, confieri; defit, defiat.

VOCABULARY.

Abesse, *to be absent.*	Definītus esse fataliter, *to be fore-ordained by fate.*	Generare, 1, *to beget, generate.*
Adversus, -a, -um, *turned towards, opposite.*	Elŏqui, 3, *to speak out, utter.*	Interdum, *sometimes.*
Civilĭter, *like a citizen, politely, elegantly.*	Exulcerare, *to make sore,* or *ulcerous.*	Niti, *to strive.*
Cogitato, *with thought, advisedly.*	Fataliter, *according to fate.*	Redire, *to return.*
Crebro, *frequently.*		Retinere, 2, *to hold back, retain.*
		Rho, *the Greek letter* r.

Exercise 173.—Latin-English.

1. Intueri solem adversum nequimus. 2. Decori vis ea est ut ab honesto non queat separari. 3. Risus interdum ita repente erumpit ut eum cupientes tenere nequeamus. 4. Dic utrum queas an nequeas mecum ire. 5. Quum hostes exercitum nostrum fundere nequirent, in castra munita se receperunt. 6. Quum dux precibus retinere militem nequiret, vim adhibendam censuit. 7. Sæpe imperiti medici ea quæ sanare nequeunt, exulcerant. 8. Quum Demosthenes rho dicere nequiret, exercitatione fecit ut planissime diceret. 9. Ex inimico cogita posse fieri amicum. 10. Nemo fit casu bonus.

Exercise 174.—English-Latin.

1. Men cannot look at the sun turned towards them (*adversus sol*). 2. The virtues are so (*ita*) bound together (*inter se*), that (*ut*) they cannot be separated. 3. Often we cannot restrain laughter, however (*quamvis* with sub.) we wish it (*would*). 4. Say whether you can or cannot go with us. 5. There are many diseases which cannot be healed. 6. Can Demosthenes pronounce *r*? 7. By exercise, I hope to be able to pronounce *r*. 8. If thou wishest to become learned, learn diligently. 9. An enemy is often made out of a friend. 10. Men do not become good or bad by chance. 11. If all things took place (*were done*) by chance, foresight would be useless. 12. Dost thou think that any one through sluggishness becomes immortal? 13. By old age, men become wiser. 14. Some philosophers were uncertain whether all things (*omnia ne*) took place by fate. 15. I am convinced that nothing takes place by fate.

We have now gone through what are generally called "The Irregular Verbs," and find them to be in number seven, namely, 1. Possum; 2. Edo; 3. Fero; 4. Volo; 5. Eo; 6. Queo; 7. Fio. If we add the compounds of volo (nolo, malo) and of queo (nequeo), we make the number ten.

KEY TO EXERCISES IN LESSONS IN LATIN.—XLIII.

Exercise 163.—Latin-English.

1. Proceed, O boys, and zealously apply yourselves to that pursuit in which you are engaged, that you may be able to be both an honour to yourselves, a benefit to your friends, and an advantage to the republic. 2. No one is so fierce that he cannot become gentle. 3. Meditate on this daily, that you may be able to die with a composed mind. 4. Some persons think that God does not exist, because he neither appears nor is perceived; just as if we were able to see our own mind. 5. When we behold the universe, can we doubt that some creator and governor presides over it? 6. Nothing is so difficult that it cannot be found out by inquiry. 7. We must so direct our thoughts as if some one were able (*and some one is able*) to behold our inmost heart. 8. We ought to be fully persuaded, that even though we may be able to conceal it from God and mankind, yet no unjust thing should be done by us. 9. Can you doubt that God governs the universe? we cannot. 10. Why cannot you walk with us? 11. Alcibiades could not endure that Athens should be subject to the Lacedæmonians.

Exercise 164.—English-Latin.

1. Scelus Deum possumus non celare. 2. Non potestis dubitare quin universus mundus ab animo gubernetur. 3. Potestne mundus ex nihilo esse? ex nihilo nihil fieri potest. 4. Quid ex confusis molibus fieri potest? 5. Potestne ordo ex casu fieri? 6. Bonos puniri non poterant pati. 7. Domum revertam quam potero maxima celeritate. 8. Domum revertent quam maximâ poterint celeritate. 9. Ante comprehensus sum quam loqui potui. 10. Pulchrior esse mundus non potest. 11. Possuntne illæ mulieres pulchriores esse? 12. Librum tibi dabo, si potero. 13. Frangere dolorem non poterat, sed poterit occultare. 14. Amicitia nisi in bonis esse non potest. 15. Si venire potuissem, omnia tibi dixissem. 16. Nisi venire potuissent, nihil scivissemus.

Exercise 165.—Latin-English.

1. It is necessary for us to eat, that we may live; not to live, that we may eat. 2. Eat and drink moderately. 3. Some young men assembled yesterday to enjoy a pic-nic. 4. This herb is bitter to eat. 5. Grief lacerates, corrodes, and completely wears down the mind. 6. Corn-worms begin to eat up the corn. 7. Quicksilver corrodes and breaks through vessels. 8. Our forefathers could not prevent age from corroding monuments. 9. What mass was ever so firm that the waves could not wear it away? 10. Woe to you who consume all your substance in luxury! 11. The fables relate that Saturn was accustomed to devour his children; for age consumes the spaces of time.

Exercise 166.—English-Latin.

1. Saturnus liberos ex se natos haud comedit. 2. Putasne Saturnum liberos ex se natos comedisse? 3. Undæ saxa exedunt. 4. Vivis ut edas. 5. Esse debes ut vivas. 6. Modice edunt. 7. Rus ibimus ut de symbolis edamus. 8. Hic panis acerbus est esu. 9. Curculiones frumentum exederunt. 10. Vetustas omnia consumit. 11. Ægritudo animum exedet, vitamque conficiet. 12. Modice ederunt et biberunt. 13. Sapiens modice edet.

LESSONS IN GEOGRAPHY.—XL.

CHIEF POLITICAL DIVISIONS OF SOUTH AMERICA.

In the following table the reader will find the principal political divisions of the continent of South America. In accordance with the plan adopted for exhibiting in a tabular form the principal states of the four great divisions of the land on the world's surface that have already been noticed, the table shows the capital or most important city in each division, and the river, etc., on which it stands; the approximate area in English square miles, the approximate number of inhabitants, and the number of persons resident on an average on each square mile, as far as these particulars can be ascertained without any regular survey of each country and any systematic census of the population.

Divisions.	Capitals or Chief Cities.	Rivers, etc., on which the Capitals stand.	Approximate Area in Square Miles.	Approximate No. of Population.	No. of Population to every Square Mile.
Brazil . . .	Rio de Janeiro	Sea-coast . .	3,219,000	10,200,000	$3\frac{1}{4}$
French Guiana	Cayenne . .	I. of Cayenne.	46,877	42,190	$\frac{9}{10}$
Dutch Guiana .	Paramaribo .	Surinam . .	46,070	52,100	$1\frac{1}{8}$
British Guiana	Georgetown .	Demerara . .	85,422	257,500	3
Venezuela .	Caracas . .	Sea-coast . .	566,159	2,122,000	3 [illegible]
United States of Columbia.	Santa Fe de Bogota . .	San Francisco	331,500	4,000,000	12
Ecuador . .	Quito . . .	Esmeraldas .	248,380	1,000,000	4
Peru	Lima . . .	Sea-coast . .	405,000	2,970,000	$7\frac{1}{3}$
Bolivia . . .	Chuquisaca .	Piicomayo .	481,600	2,325,000	$4\frac{4}{5}$
Chili	Santiago . .	Mapocho . .	307,525	2,300,000	$7\frac{1}{2}$
Paraguay . .	Asuncion . .	Paraguay . .	92,000	476,000	[illegible]
Uruguay . .	Monte Video.	Rio de la Plata	72,112	520,500	[illegible]
Patagonia . .	Punta Arenas	St. of Magellan	300,000	90,000	[illegible]
Argentine Republic. . .	Buenos Ayres	Rio de la Plata	1,357,896	2,540,000	$1\frac{7}{8}$
Falkland Islands . . .	Stanley Harbour. . .	Sea-coast . .	4,741	1,050	$\frac{2}{9}$

Of the South American States, Brazil is by far the greatest, occupying very nearly one-half of the area of the entire continent. The remaining states lie grouped around it on the north, west, and south, in the form of a crescent; every one of them, except Chili and Patagonia, having some part of its frontier contiguous to the frontier of Brazil. But although Brazil is the largest state in superficial area, it is by no means peopled in proportion to its extent. Taking the population per square mile as a test of the prosperity and productive power of a country, we find that Chili is far in advance of the remaining states. Until a few years ago Paraguay was also thickly populated for its extent, having some 1,400,000 inhabitants. In this fact we find the reason why Paraguay was able to contend for so long a time with the forces of Brazil, aided now and then by a contingent from the Argentine Confederation, for the former had her population concentrated in a comparatively small extent of territory, and therefore more available for the purposes of defensive warfare; while Brazil, with a long sea-board to defend, and a scattered population, found it a difficult matter to draw together and keep up a sufficient force to crush even a power so apparently insignificant as Paraguay. The war, however, caused Paraguay to suffer severely, and its population has greatly decreased during the last quarter of a century.

Brazil is divided into twenty-one provinces, of which only those on the sea-coast are of any commercial importance at present. The interior is inhabited by wandering tribes of Indians. It produces gold dust and diamonds in some parts; but among its mineral treasures are also large coal-fields and beds of limestone lately discovered by Captain Richard F. Burton, the African explorer, while on a journey of discovery through the country. Besides these, abundance of silver, iron, copper, salt, and precious stones exists in various parts; while among its vegetable productions, which include most of the fruits and vegetables raised in both tropical and temperate climes, may be named the useful medicines, ipecacuanha and quinine, and the Brazil-wood, or *braza*, a valuable dyewood, from which the country was named by its Portuguese discoverers.

It was discovered and annexed to Portugal in 1500 by Alvarez de Cabral, and, with the exception of sixty years, from 1580 to 1640, when Portugal belonged to Spain, it remained a Portuguese dependency until 1822, when its independence as a separate empire was declared under Pedro, or Peter I., the son of John VI. of Portugal.

The country now called Guiana was settled by the French and Dutch in the sixteenth and seventeenth centuries. The part which now belongs to Great Britain, and bears the name of British Guiana, consists of the three settlements of Demerara, Berbice, and Essequibo. It was taken from the Dutch in 1803, and finally assigned to Great Britain at the peace of 1814. The country is flat and swampy, and unhealthy for Europeans; the soil is fertile, and yields large crops of sngar, rice, coffee, and cottou. Cayenne, from which the pepper so called takes its name, situated on the island of Cayenne, is used by the French Imperial Government as a penal settlement for political offenders.

Venezuela, the Granadian Confederation, and Ecuador formed the Federal Republic of Columbia, after their emancipation from the Spanish yoke in 1821. Venezuela was the first to withdraw from the union, resolving itself into an independent state, composed of thirteen small provinces, or departments, in 1829. Ecuador, which is divided into three departments, soon after followed the example set by the people of Venezuela, and the three states existed as separate republics until 1858, when a further disintegration of New Granada took place, its nine departments, one of which is the Isthmus of Panama, becoming separate states, each independent of the rest for internal purposes, but maintaining an alliance for the purpose of mutual defence, and forming a federal union under the name of the United States of Columbia. The highlands of the Granadian Confederation and Ecuador are rich in minerals of all kinds and precious stones. The lowlands of these states and Venezuela are well wooded and well watered, yielding tropical products of all kinds, among which the fruit of the cacao tree deserves especial mention, while the *llanos*, or treeless plains on the banks of the Orinoco, afford fine and luxuriant herbage for cattle. Venezuela owns two of the West India Islands, namely, Margarita and Tortuga, which lie close to her sea-board on the Caribbean Sea.

Peru, the country of the Incas, noted for its inexhaustible mines of gold, silver, and mercury, and for the frequent occurrence of earthquakes, was a dependency of Spain from the time of its conqnest by Pizarro, in 1531, to the battle of Ayachuco, in 1824, by which victory its independence was achieved. It is now divided into thirteen departments. Wool of an excellent quality is yielded by the llama, alpaca, and vicuna, three animals which are natives of this part of South America. The llama is used as a beast of burden for carrying small weights up and down the rocky paths that traverse the slopes of the Andes. It is something like a sheep, but has a long neck, and a head resembling that of the deer, though it has no horns. Peru is remarkable for containing the highest city in the world, namely, Pasco, which stands at an elevation of 13,720 feet above the level of the sea. The Chincha Islands, and the Lobos Islands, two groups near the coast of Peru, yield abundance of the valuable manure called guano.

Bolivia, formerly called Upper Peru, received its present name from General Simon Bolivar, to whose efforts the achievement of South American independence was mainly due. It is divided into nine departments. Like the other countries of South America that have been noticed already, it produces minerals and tropical fruits and vegetables in great quantities, though but few of the mines at Potosi, and elsewhere, are now worked. It possesses but a very small length of sea-board, not more than 300 miles according to the most favourable estimate, and towards the north of this is the small seaport of Cobija. The country between the coast and the Andes is little better than a barren desert, and owing to the difficulty of transit across this waste, and the inefficiency of the harbour, the chief part of the cinchona bark, and other exports of Bolivia, are shipped for Europe at Peruvian ports, after being carried throngh Peruvian territory.

Paraguay is the only state of Sonth America that has no sea-board, the great rivers Parana and Paraguay forming the water-ways by which commercial transactions are carried on with other countries. It was the first to throw off the Spanish yoke, having revolted as early as 1811; but although it was at one time more thickly peopled than any other part of South America, and is rich in cattle and timber with which to carry on a brisk trade with Europe, the policy of its presidents was until lately to exclude foreigners, and to refnse commercial intercourse with other states. From 1865 to 1870 Paraguay was at war with Brazil, Uruguay, and the Argentine Confederation; but the persistent efforts of the three allied states at last came to a successful issue, peace was signed, and the republic of Paragnay was formed, modelled on the constitution of the Argentine Repnblic. *Matè*, or Paragnay tea, the leaves of a kind of holly, which are nsed throughont South America as we use tea, is grown in great qnantities on the slopes of the hills. An infusion of this leaf, with the addition of a little sugar and a few drops of lemon-juice, forms the ordinary beverage of all classes of Paraguayans.

On the north side of the great estuary of the Rio de la Plata is the little republic of Uruguay, or the Banda Oriental, sometimes called the republic of Montevideo, after the name of its capital. Adjoining Brazil on one side, and an object of desire to Buenos Ayres, whose presidents or dictators sought by its acquisition to command on both sides the approaches to the great rivers by which the very heart of the continent of South America may be reached, this conntry was long an object of contention between the two powers just named, until it solved the difficulty in 1828 by declaring itself an independent republic. It carries on a trade with Europe in dried beef, horns, hides, and tallow, the produce of the great herds that find pasture in the interior, and on the banks of the Rio de la Plata; and it was for some years the home of the Italian patriot, Garibaldi, during his enforced exile from his native land, and temporary sojourn in South America.

The Argentine Confederation, or La Plata, is a federal nnion, formed of fourteen states, the most powerful of which, and the only one which is contiguous to the ocean, is Buenos Ayres. The interior of the country is for the most part a succession of undulating plains, called *pampas*, intersected by salt lakes. The chief wealth of the Confederation lies in its herds of cattle and horses. The states once formed part of the great Spanish viceroyalty of Peru, but they achieved their independence, and combined to form a separate confederacy in 1816. Since that time Buenos Ayres has more than once withdrawn from the confederation, but it has again rejoined it, and at the present time is the most powerful among the federal states of this republic.

Chili, which gained its independence in 1817, after an arduous struggle of seven years, by the battle of Maypu, is a long, narrow strip of territory, bearing due north and south, and formed by the western slope of the Andes towards the Pacific Ocean. The country is divided into thirteen provinces, and bids fair to become the most prosperous of the South American republics through the abundance of its mineral treasures, the fertility of its soil, and, above all, the commercial enterprise of its inhabitants, who, contrary to the general rule with South Americans, are active in promoting the development of the resources of their country. Its chief seaport is Valparaiso, its principal island Juan Fernandez, famous for being the residence of Alexander Selkirk, whose story, doubtless, gave Defoe the idea of "Robinson Crusoe."

Patagonia, and the chain of islands, terminating to the south in Tierra del Fuego, and some smaller islets, that stretches along its western and southern coasts, is claimed by Chili, who has asserted her right by taking possession of two pieces of territory, one on the mainland, opposite the island of Chiloe, and the other on the Strait of Magellan, and forming thereon two settlements—namely, Puerto Montt on the former, and Punta Arenas on the latter. The claim of Chili is disputed, but without much chance of success, by the Argentine Confederation. Some years ago an attempt was made to settle a Welsh colony in Patagonia, but the scheme failed, and the colonists were invited by the Brazilian Government to seek a home in the empire of Brazil.

About 350 miles eastward from the east entrance to the Strait of Magellan lies a group of small islands, about 200 in number, belonging to Great Britain. This clnster, called the Falkland Islands, is tenanted by a small number of British colonists, who supply ships sailing round Cape Horn, and whalers bound to the southern seas, with fresh water and provisions.

LESSONS IN ALGEBRA.—XXIV.

In the following problems, the student may now employ two, three, or more unknown quantities in their solution, just as the nature of each may require; or he may still limit the number of the unknown quantities, by first supposing one unknown quantity, and then finding from the conditions of the question expressions for the other unknown quantities in terms of that which has been assumed.

Exercise 41.—Algebraical Problems.

1. Find two numbers such that their sum shall be a, and their difference b.

2. Divide the number 20 into such parts, that three times the one added to five times the other will make 76.

3. Two gamesters, A and B, sat down to play. A had 80 guineas, and B had 60. After a certain number of games were won and lost between them, it was found that A had three times as many guineas as B. How many guineas did A win of B?

4. Find two numbers such that half the first and a third part of the second shall make 9; and that a fourth part of the first with a fifth part of the second shall make 5.

5. Divide the number 2 into two such parts that a third of the one added to a fifth of the other shall make $\frac{3}{5}$.

6. Find three numbers such that the sum of the first and second shall be 7, the sum of the first and third 8, and the sum of the second and third 9; and give a general solution, by supposing these three sums to be a, b, and c respectively.

7. The sum of the three digits in a certain number is 16; the sum of the hundreds' digit and the tens' digit is to the sum of the tens' digit and the units' digit, as $4\frac{1}{2}$ is to $5\frac{1}{2}$; and if 198 be added to the number, the hundreds' digit and the units' digit will change places. What is the number?

8. Divide 72 into four such parts, that the first increased by 5, the second diminished by 5, the third multiplied by 5, and the fourth divided by 5, the sum, difference, product, and quotient, shall all be equal to one another.

9. A farmer hired 4 men and 8 boys for a week, and paid them in all £8; the next week he paid 7 men and 6 boys at the same rate each, and paid in all £10. How much did he pay each man and each boy by the week?

10. A father bequeathed £2,800 to his daughter and son, in such a manner that for every half-crown the daughter had, the son should have a shilling. What were their shares?

11. A bill of £100 was paid in half-guineas and crowns; and 202 pieces of money were employed in the payment. How many pieces were there of each kind?

12. Find four numbers such that the sum of the first, second, and third, shall be 13; the sum of the first, second, and fourth, 15; the sum of the first, third, and fourth, 18; and the sum of the second, third, and fourth, 20.

13. Two numbers are to each other as 20 to 30; but if 6 be added to each, then the sums are to each other as 40 to 50. What are the numbers?

14. There are two numbers such that the greater is to the less as their sum is to 20, or as their difference is to 10. What are the numbers?

15. Three boys were playing at marbles. In the first game, A loses to B and C as many as each of these two had when they began; in the second game, B loses to A and C as many as each of these two had at the end of the first game; in the third game, C loses to A and B as many as each of these two had at the end of the second game. Each has now 16 marbles; how many had each at first?

16. A person goes to a coffee-house with a certain quantity of money in his pocket, where he spends 2 shillings; he then borrows as much money as he had left, and going to another coffee-house, he there spends 2 shillings also. Then, borrowing again as much money as was left, he went to a third coffee-house, where likewise he spent 2 shillings; and thus repeating the same at a fourth coffee-house, he then had nothing remaining. What sum had he at first, and what was he in debt?

17. A man with his wife and child dine together at an inn. The landlord charges 1 shilling for the child; for the woman, as much as for the child and a quarter as much as for the man; and for the man, as much as for the woman and child together. How much was that for each?

18. A cask which held 60 gallons was filled with a mixture of brandy, wine, and cider, so that the cider was 6 gallons more than the brandy, and the wine was as much as the cider and $\frac{1}{3}$ of the brandy. How much was there of each?

19. Says A to B, "If you give me 10 guineas of your money, I shall then have twice as much as you will have left;" but says B to A, "Give me 10 of your guineas, and then I shall have three times as many as you." How many had each?

20. Three persons, A, B, and C, make a joint contribution, which in the whole amounts to £400; of which sum B contributes twice as much as A, and £20 more; and C as much as A and B together. What sum did each contribute?

21. The stock of three traders amounted to £760. The shares of the first and second exceeded that of the third by £240, and the sum of the second and third exceeded the first by £360. What was the share of each?

22. What two numbers are those which, being in the ratio of 3 to 4, their product is equal to 12 times their sum?

23. A certain company at an inn, when they came to settle their reckoning, found that had there been 4 more in company, they might each have paid a shilling less than they did; but that if there had been 3 fewer in company, they must each have paid a shilling more than they did. What, then, was the number of persons in the company, what did each pay, and what was the whole reckoning?

24. A farmer has two horses, and also two saddles, the one valued at £18, the other at £3. Now when he sets the better saddle on the first horse, and the worse on the second, it makes the first horse worth double the second; but when he places the better saddle on the second horse, and the worse on the first, it makes the second horse worth three times the first. What were the values of the two horses?

25. It is required to divide the number 24 into two such parts, that the quotient of the greater part divided by the less, may be to the quotient of the less part divided by the greater, as 4 to 1.

26. A cistern is to be filled with water from three different stop-cocks. From the first it can be filled in 8 hours, from the second in 10, and from the third in 14. How soon would they altogether fill it?

27. A labourer engages to work for 3s. 6d. a day and his board, but to allow 9d. for his board each day that he is unemployed. At the end of 24 days he has to receive £3 2s. 9d. How many days did he work?

28. Three workmen are employed to dig a ditch of 191 yards in length. If A can dig 27 yards in 4 days, B 35 yards in 6 days, and C 40 yards in 12 days, in what time could they do it if they worked simultaneously?

29. A farmer wishes to mix 28 bushels of barley at 2s. 4d. a bushel, with rye at 3s. a bushel, and wheat at 4s. a bushel, so that the whole may consist of 100 bushels at 3s. 4d. a bushel. How much rye and wheat must he use for this purpose?

30. A sum of money was divided equally amongst a certain number of persons. Had there been three persons more, each would have received 1 shilling less; and had there been two persons fewer, each would have received 1 shilling more. Required the number of persons, and what each received.

31. How may a bill of £7 4s. be paid with half-guineas and crowns, so that twice the number of crowns may be equal to three times the number of half-guineas?

32. A person rows a distance of 20 miles and back in 10 hours, the stream flowing uniformly in the same direction all the time. He finds that, with the stream, he can row three miles in the same time that it takes him to row 2 miles against it. How long was he going with the stream, and how long against it?

KEY TO EXERCISES IN LESSONS IN ALGEBRA.

Exercise 39.

1. $x = 6$, $y = 4$, and $z = 2$.
2. $x = \frac{1}{2}(a + b - c)$, $y = \frac{1}{2}(a - b + c)$, and $z = \frac{1}{2}(-a + b + c)$.
3. A's money = 64 dollars, B's = 72, and C's = 84.
4. A's distance is 46 miles, B's = 9, and C's = 7.
5. $x = 24$, $y = 60$, and $z = 120$.
6. $x = 30$, $y = 20$, and $z = 10$.

Exercise 40.

1. $\frac{4}{21}$.
2. 18, 22, 10, and 40.
3. 50, 65, and 75.
4. 10 and 2.
5. The port 3 guineas per dozen. the sherry 2 guineas.
6. 78 of brandy and 66 of water.
7. [illegible]

RECREATIVE SCIENCE.—VIII.

AMUSING OPTICAL INSTRUMENTS ILLUSTRATING THE LAWS OF REFLECTION AND REFRACTION — THE CAMERA-OBSCURA.

It would, of course, be difficult to say who was the first to conceive the idea of collecting and publishing a description, with appropriate engravings, of known experiments in physical science. That the idea is not new, and was thought useful in bygone times, is shown by the absurd though somewhat amusing "Recreation in Mathematics and Natural Philosophy," written nearly two hundred years ago, by Jacques Ozanam, and subsequently revised, enlarged, and improved by Jean Étienne Montucla, in the year 1793, in his new edition of the "Methodical Encyclopædia of Amusements in Mathematical and Physical Science," and dedicated to the Most Serene Republic of Venice. In the preface the reader is told "that the useful is combined nearly always with the agreeable, and that he may instruct and amuse himself;" no exaggerated statement, because the famous Dr. Charles Hutton, the mathematician, published a translation of the above work in 1803, and subsequently another edition in 1814. In the present paper some careful reproductions of Montucla's original diagrams will be given.

Fig. 1.

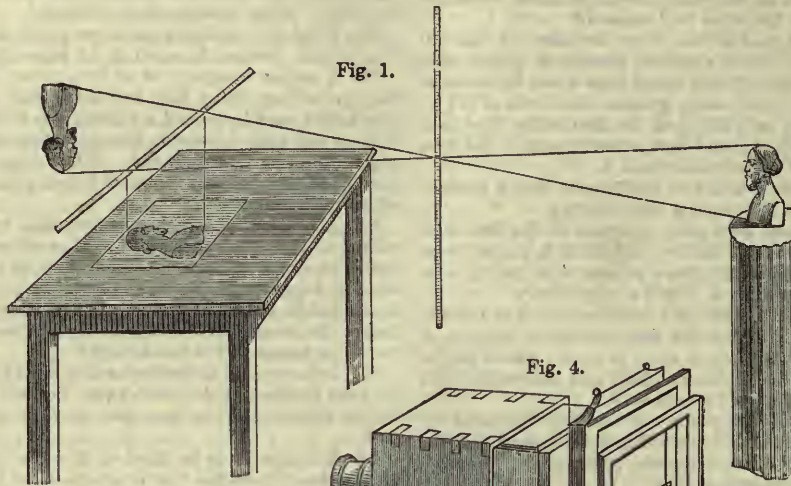


Fig. 4.

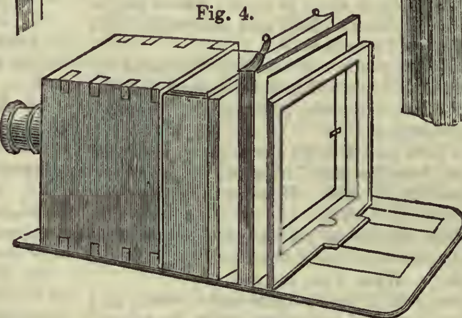


Fig. 2.

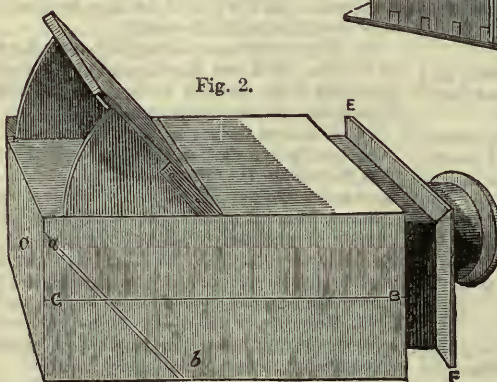
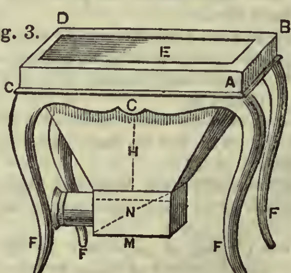


Fig. 3.



Nearly the first optical amusement proposed is how "to exhibit, in a darkened room, external objects, in their natural colours and proportions;" and in this description the principles and construction of the camera-obscura, or darkened chamber, are fully developed:—"Close the door and darken the windows of the chamber, so that no light can enter, except that which can pass through a very small and well-cut hole in the shutter or other wood-work used to darken the window facing some public street or pretty country landscape. Hang against the wall opposite the hole in the shutter a very white cloth, and if the external objects are well illuminated, and the chamber kept very dark, they will paint themselves on the wall or cloth with their natural colours, in a reversed position."

The experiment conducted in this very simple manner succeeds sufficiently well to surprise those who may witness it for the first time; but it is made much more striking with the help of a glass lens. Adapt to the hole of the shutter—which in this case must be some inches in diameter—a tube, having at its internal extremity a convex lens of four, five, or six feet focus. By holding a sheet of white paper or the cloth at that distance from the lens in a line perpendicular to the axis of the tube, the outer objects, such as the trees, houses, or persons promenading, are painted on it with wonderful fidelity, distinctness, and brilliancy of colouring, so much so that even the features of persons may be clearly distinguished.

A little of the effect is certainly destroyed by the inversion of the painting, and although there are various ways in which this may be corrected, it cannot be done without reducing the field of the picture and injuring the sharpness of the outlines of the figures projected on the paper or cloth. Nevertheless, if the spectator wishes to have the convenience of seeing the objects in their right position, he may proceed as follows:—

Place a plane mirror, inclined at an angle of 45°, at nearly half the focal distance of the lens, in such a way that it may reflect downwards the rays proceeding from the lens; arrange horizontally below it a sheet of paper, upon which the image of the external object (in this case a bust) will appear. The image will be seen in its natural position and upright by all those who look at it in a certain position—viz., with their backs turned towards the opening in the shutter containing the lens. The inverted image is shown at Fig. 1, and the cause of the reversal of the position of the bust is evident, from the fact that the rays cross at the aperture in the shutter. When the sheet of paper is laid out on a table, arranged to rise and fall by rack-work, or any other simple means, there will be painted upon it an exact picture of all the objects before the window. People, cows, horses, sheep, etc., are seen with the same movements and gestures which they exhibit under ordinary circumstances; whilst the trees, the sky, and clouds are painted in their natural colours, either calm or agitated by the wind as the case may be. The use of the rack-work is to enable the spectator to focus the more distant objects, and if great sharpness in the image is desired, the top of the table receiving the picture should be made of plaster of Paris, and hollowed out to the same curve as the lens.

A PORTABLE CAMERA OBSCURA.

Baptista Porta's amusing optical instrument admits of many modifications, and Fig. 2 represents another, and at one time very popular, form of the camera.

They were formerly much used by artists, on account of their very convenient dimensions, and were constructed of mahogany, and of various sizes, some so small as to be carried in the pocket.

The lens at the point A is fixed in the circular tube in front of a square draw-out tube, and is of a focus equal to the length of the box when the drawer is half drawn out. A plain mirror, placed diagonally at an angle of 45°, at the end of the box, as shown by the dotted lines *a b*, reflects the rays transmitted by the lens up to the upper side of the plane rough-ground glass, the rough side placed above, under the folding darkening cover, and there forms the images of the objects before the lens at A. The use of the drawer is to adjust the proper distance of the lens from the mirror, according to the variable distances of proximate objects. The images on the rough glass exhibit a beautiful perspective picture, also the profile of a person seated in a room in a strong light before the camera, and more particularly if the sun illumines the object; and may be readily traced on the rough surface of the glass by a blacklead pencil, or by what is preferable, red French chalk, and then white paper being gently placed on the glass, the lines will be correctly taken off.

If very thin white paper is merely placed upon the glass, the images may be discerned, though faintly, sufficient to afford the means of tracing correctly. The nearer the object or features are to the camera the larger will be the image, and an additional lens of a shorter focus is sometimes fitted, to be substituted for the other when the images of very near objects are wanted. "Some artists," says Reece (from whom the above description is taken), "who copy profiles, remove the rough glass from the cell, invert the camera, and by a stand support it about ten or twelve inches above the white paper on the table. The image will then invertedly be formed on the paper, and they trace it with a pencil in a correct manner, and with less trouble than by the other method."

An improved folding camera is made by joining the side of the camera and drawer in the middle with canvas cloth, as shown at the line B G (Fig. 2); the back C turns inwards with the mirror, close up to the rough glass, and the front E F above, over the top, so that the whole camera may fold down into a flat form, and go into a very portable, flat, leather strap case, making it the most portable possible for persons travelling. Inclusive of the rough glass, a double convex lens has sometimes been placed to receive the images; and as more light is then refracted, the images are shown with great beauty and extraordinary brightness, even surpassing the original. They are also more vivid when the rough glass is placed above this lens, though the contours or outlines are not so sharp and distinct as when the rough glass is used only by itself. This arrangement was noticed by Hooper, in his "Rational Recreation," written one hundred years ago, and was subsequently called "the Delineator," by Storer, who pretended to be the original inventor.

The camera may be reversed, and used as a show-box for displaying prints, etc.; of course the ground glass must then be removed. Any boy, with a little care and dexterity, and at a very small expense, may construct a camera out of an old hat; and as many hats are provided with ventilating holes at the top, the aperture is ready for the insertion of the lens, and the picture may be received upon a circular piece of tracing paper stretched on a thin wooden hoop or frame, which may slide backwards and forwards in the hat for the purpose of focussing the picture. The lens must be of a sufficiently short focus to suit the hat. This very simple arrangement will help the youthful student to understand the phenomena of vision, as the whole may be compared to the eye, and the oiled paper upon which the picture is painted will represent the expanded nerve, the retina, or mind of the eye, upon which the pictures seen by this organ are projected. That such images are projected on the retina is shown by using the eye of a sheep or bullock, which may be readily procured from any butcher's shop. If the back part of the eye is cut off so as to leave the retina, and if the cornea of the eye is substituted for the lens in the hat, the image of the external objects will be seen painted upon the retina at the back of the cornea.

As an amusing modification of the camera, and to show how thoroughly the old experimentalists worked out an idea, and applied it in various ways, may be instanced the next form.

THE MAGIC TABLE CAMERA.

A table, F F F F (Fig. 3), is provided with a top, A B C D, in which a sheet of ground glass (E) is fitted; below is the camera (M), with its lens in the tube, which may be thrust through a hole in the wall of the room against which the table stands; the images of the external objects are reflected from the mirror N in the lines N H O to the ground glass E. The picture (E) may be concealed by a tablecloth, and when the room is darkened by closing the shutters and the cloth removed, some wonder is excited by seeing the images of external objects in all their colours and with their natural movements delineated on the table-top.

A PHOTOGRAPHIC CAMERA.

In Fig. 4 is shown a more modern camera, such a one as would be employed for taking photographic pictures; it is called "a sliding body folding camera." It is usually made of the best Spanish mahogany, well seasoned, and brass-bound, because the instrument is frequently exposed to the direct rays of the sun, and if the wood cracked the light might be admitted, which would spoil the prepared collodion plate. When the picture intended to be taken has been focussed on the ground glass at the back, the latter is removed, and an ingeniously made box containing the prepared collodion plate substituted for it. When all is ready, a sliding panel of wood is drawn up, the prepared plate is then exposed to the light, which is allowed to act for a certain time until the picture is supposed to be obtained. The plate is afterwards developed and fixed in the regular manner. The tube containing the lenses is attached to a vertical and horizontal sliding frame, in order to enable the photographic artist to adjust the foreground and sky.

LESSONS IN GERMAN.—LIII.

§ 20.—DECLENSION OF PROPER NOUNS.

Singular Number.

(1.) Names of males and females, except when the latter terminate in e, take s to form the genitive, which is their only variation; as:—

Nom.	Heinrich, Henry.	Elisabeth, Elizabeth.
Gen.	Heinrichs, of Henry.	Elisabeths, of Elizabeth.
Dat.	Heinrich, to Henry.	Elisabeth, to Elizabeth.
Acc.	Heinrich, Henry.	Elisabeth, Elizabeth.

It is customary with some writers to affix en to the dative and accusative of proper names; but the better usage distinguishes these cases by prefixing the article; as, nom. Lessing, Lessing; gen. Lessings, of Lessing; dat. dem Lessing (instead of Lessingen), to Lessing; acc. den Lessing (instead of Lessingen), Lessing.

(2.) Names of females ending in e form the genitive in ens and the dative in en; those of males ending in s, ß, sch, x, or z take likewise in the genitive ens; as:—

Nom.	Luise, Louisa.	Leibnitz, Leibnitz.	Voß, Voss.
Gen.	Luisens, of Louisa.	Leibnitzens, of Leibnitz.	Vossens, of Voss.
Dat.	Luisen, to Louisa.	Leibnitz, to Leibnitz.	Voß, to Voss.
Acc.	Luise, Louisa.	Leibnitz, Leibnitz.	Voß, Voss.

(3.) Names, whether of males or females, when preceded by an article, are indeclinable; as:—

Nom.	Der Schiller, the Schiller.	Die Luise, the Louisa.
Gen.	Des Schiller, of the Schiller.	Der Luise, of the Louisa.
Dat.	Dem Schiller, to the Schiller.	Der Luise, to the Louisa.
Acc.	Den Schiller, the Schiller.	Die Luise, the Louisa.

§ 21.—PROPER NOUNS IN THE PLURAL.

(1.) Proper nouns, when employed in the plural, conform for the most part to the rules for the declension of common nouns; the masculines being varied according to the Old Declension, and the feminines according to the New.

Sometimes the plural is made by the addition of s to the singular; as:—Die Schillers, the Schillers; die Herders, the Herders. Those ending in o add for the plural ne or nen; as:—Cato, Cato; nom. plur. Catone or Catonen, the Catos, etc.

(2.) Their inflection is in no wise affected by the presence of the article, nor do the radical vowels a, o, u, au, ever assume the Umlaut.

EXAMPLES.

Nom.	Die Leibnitze, the Leibnitzes.	Die Schlegel, the Schlegels.
Gen.	Der Leibnitze, of the Leibnitzes.	Der Schlegel, of the Schlegels.
Dat.	Den Leibnitzen, to the Leibnitzes.	Den Schlegeln, to the Schlegels.
Acc.	Die Leibnitze, the Leibnitzes.	Die Schlegel, the Schlegels.
Nom.	Die Luisen, the Louisas.	Die Annen, the Annes.
Gen.	Der Luisen, of the Louisas.	Der Annen, of the Annes.
Dat.	Den Luisen, to the Louisas.	Den Annen, to the Annes.
Acc.	Die Luisen, the Louisas.	Die Annen, the Annes.

§ 22.—PROPER NAMES OF COUNTRIES, CITIES, ETC.

(1.) Proper names of places admit of no changes of form for the purposes of declension, beyond the mere addition of s to the genitive singular; as:—Berlin, Berlin; gen. Berlins, of Berlin.

(2.) If, however, the word end in a sound not easily admitting an s after it, the case is distinguished by placing before it a noun preceded by the article; or it is expressed by the prep. von; as:—Die Stadt Mainz, the city Mayence. Die Einwohner von Paris, the inhabitants of Paris.

§ 23.—OBSERVATIONS.

(1.) When several proper names belonging to the same person, and not preceded by the article, come together, the last one only is declined; as:—Johann Christoph Adelungs Sprachlehre, John Christopher Adelung's grammar; if, however, the article precede, none of them undergo change; as:—Die Werke des Johann Gottlob Herder, the works of John Gottlob Herder.

(2.) When a common and a proper name of the same person, preceded by the article, concur, the common noun alone is inflected; as:—Der Tod des Königs Ludwig, the death of King Louis; if no article precede, the proper noun is declined; as, König Ludwigs Tod, King Louis' death.

(3.) When a Christian name is separated from a family name by a preposition (specially von), the Christian name only admits of declension; as:—Die Gedichte Friedrichs von Schiller, the poems of Frederick of Schiller; if, however, the genitive precede the governing noun, the family name only takes the sign of declension; as:—Friedrich von Schillers Werke, Frederick of Schiller's works.

§ 24.—ADJECTIVES.

(1.) Adjectives are, in German, generally so varied in termination, as to indicate thereby the gender, number, and case of the words with which they are joined. Before treating of their inflection, however, we shall present and explain those significant suffixes which are most commonly employed in forming adjectives from other words.

(2.) Here, as was done in the case of derivative nouns (§§ 10, 11), each suffix is given with its corresponding English equivalent, its meaning explained, and its use further illustrated by a series of examples.

§ 25.—SUFFIXES USED IN FORMING ADJECTIVES.

SUFFIXES.	ENGLISH EQUIVALENTS.	
bar,	[*able, ible, ile*]	implies *ability*; sometimes *disposition*.
en, ern,	[*en*]	points to something *made of* that expressed by the radical.
haft,	[*ive, ish*]	denotes *tendency* or *inclination*; also *resemblance*.
ig,	[*y, ful*]	represents a thing as being *full of* that denoted by the radical.
icht,	[*y, ous, ish*]	denotes *similarity of nature* or *character*.
lich,	[*ly, ish, able*]	implies *likeness* or *sameness* either of manner or degree; also *ability*.
isch,	[*ish, some, al*]	represents something as *pertaining* or *belonging to*.
sam,	[*some, able*]	expresses *inclination*; sometimes *ability*.

§ 26.—EXAMPLES.

SUFFIXES.	WORDS.	
bar,	Dienstbar,	serviceable, tributary.
	Sichtbar,	that *can be* seen; visible.
en, ern,	Golden,	*made of* gold.
	Bleiern,* [Blei-er-(e)n]	leaden.
haft,	Tugendhaft,	*inclined* to virtue; virtuous.
	Meisterhaft	*resembling* a master; masterly.
ig, icht,	Blumig,	*full of* flowers; *abounding in* flowers.
	Blumicht,	flowery, that is, *like* flowers.
	Waldig,	woody, that is, *abounding in* woods.
	Salzicht,	saltish; somewhat *like* salt.
lich,	Brüderlich,	brotherly, or *like* a brother.
	Kränklich,	sickly.
	Süßlich,	sweetish, somewhat sweet.
	Beweglich,	movable.
isch,	Irdisch,	earthly; *belonging to* earth.
	Poetisch,	poetical.
	Zänkisch,	quarrelsome.
sam,	Arbeitsam,	*inclined* to work; diligent.
	Folgsam,	inclined to follow (orders), that is, obedient.

isch is the ending commonly added to names of places pointing to things belonging to them; as:—Englisch, schwedisch (§ 5 [*g*]), etc. If, however, a name be a town, the suffix er is used in place of isch; as, das Merseburger Bier, the Merseburg beer.

§ 27.—DECLENSION OF ADJECTIVES.

(1.) Whether an adjective is to be inflected at all or not, depends wholly upon the way in which it is used; for, when employed as a predicate, it is never declined; when as an attribute, almost always. Be the noun, therefore, masculine, feminine, or neuter; be it singular or plural; if the adjective to which it is applied be used as a predicate (Sect. IX. Note), its form remains unchanged; thus:—

Der Mann ist gut, the man is good.
Die Frau ist gut, the woman is good.
Das Kind ist gut, the child is good.
Die Männer sind gut, the men are good.
Ich nenne die Kinder schön, I call the children beautiful.

§ 28.—DECLINABLE ADJECTIVES.

(1.) There are two declensions of adjectives, as there are two declensions of nouns—the Old and the New. In either of these, according to circumstances, are attributive adjectives declined. The following are the terminations of

THE OLD DECLENSION.

	Singular.			*Plural.*
	MASC.	FEM.	NEUT.	FOR ALL GENDERS.
Nom.	-er,	-e,	-es.	-e.
Gen.	-es, en,	-er,	-es, en.	-er.
Dat.	-em,	-er,	-em.	-en.
Acc.	-en,	-e,	-es.	-e.

Adjectives ending in el, en, er, commonly drop the e upon receiving a suffix; as:—

Edel, noble.	Edler Mann, noble man.
Eben, even.	Ebner Weg, even path.
Lauter, pure.	Lautres Gold, pure gold.

Upon adding en, the e of the termination (en) may be dropped; as:—Den heitern, or heitren Morgen, the serene morning.

In the genitive singular masculine and neuter the termination en is preferable.

§ 29.—RULE FOR ADJECTIVES.

When the adjective stands either entirely alone before its substantive, or is preceded and restricted by a word that is undeclined or indeclinable, it follows the Old form of declension.

EXAMPLES.

	Singular.	*Plural.*
	MASCULINE.	
Nom.	Guter Vater, good father.	Gute Väter, good fathers.
Gen.	Gutes (en) Vaters, of good father.	Guter Väter, of good fathers.
Dat.	Gutem Vater, to good father.	Guten Vätern, to good fathers.
Acc.	Guten Vater, good father.	Gute Väter, good fathers.

* The letters er in this word are simply *euphonic*; while the e of the suffix en is dropped, also, for euphony (§ 2. [8]).

FEMININE.

Nom.	Gute Mutter, good mother.	Gute Mütter, good mothers.
Gen.	Guter Mutter, of good mother.	Guter Mütter, of good mothers.
Dat.	Guter Mutter, to good mother.	Guten Müttern, to good mothers.
Acc.	Gute Mutter, good mother.	Gute Mütter, good mothers.

NEUTER.

Nom.	Gutes Geld, good money.	Gute Gelder, good moneys.
Gen.	Gutes (en) Geldes, of good money.	Guter Gelder, of good moneys.
Dat.	Gutem Gelde, to good money.	Guten Gelden, to good moneys.
Acc.	Gutes Geld, good money.	Gute Gelder, good moneys.

KEY TO EXERCISES IN LESSONS IN GERMAN.

Exercise 147 (Vol. III., page 91).

1. Wollen Sie mir gefälligst eine Tasse Kaffe oder Thee geben? 2. Seit gestern habe ich mich nicht ganz wohl gefühlt. 3. Seitdem er sein elterliches Haus verlassen hat, haben wir nichts* von ihm gehört. 4. Seit meinem zwölften Jahre habe ich mein Vaterland nicht besucht. 5. Seitdem er die Nachricht erhielt, hat er keine Ruhe gehabt. 6. Damit mein Freund nicht vergebens komme, werde ich zu Hause bleiben. 7. Ich habe meinen Freund nicht gesehen, seitdem er von Deutschland angelangt ist. 8. Anstatt seine Stiefel anzuziehen, ging er in den Pantoffeln aus. 9. Sagen Sie gefälligst Ihrem Freunde, er könne uns zu jeder Zeit besuchen. 10. Warum benutzt er seine Jugend nicht, um die Kentnisse zu erwerben, die er gebraucht. 11. Wie haben Sie sich befunden, seitdem ich Sie zuletzt sah? 12. Beendige deine Aufgabe, wenn du sie noch nicht beendigt hast, dann wirst du von deinem Lehrer nicht bestraft werden.

LESSONS IN CHEMISTRY.—XXXII.

ALCOHOL AND ITS DERIVATIONS.

Both from their chemical interest and commercial value the alcohols form a prominent group. The word was originally applied to that spirit which is the product of the fermentation of sugar. But further researches extended the limits of this definition, and alcohols are now described by Miller to be "neutral compounds of carbon, hydrogen, and oxygen, which react directly upon the acids in such a manner that water is eliminated, whilst ethers are produced."

They are grouped under three heads—monatomic, diatomic, and triatomic alcohols; that is, alcohols which are formed on the type of one, two, or three molecules of water; thus $\left.\begin{matrix}H\\H\end{matrix}\right\}O$. If one atom of the H be replaced by ethyl (C_2H_5), thus $\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$, ethyl alcohol, or spirits of wine, is the result. If both atoms of the H be replaced, we have common ether, $\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O$. C_2H_5 plays the part which a monatomic element did in Inorganic Chemistry, and for this reason is termed a monatomic radical.

The only example of a diatomic radical as yet known is ethylene (C_2H_4). If this replace H_2 in its type $\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2$, we have $\left.\begin{matrix}C_2H_4\\H_2\end{matrix}\right\}O_2$, glycol, or ethylene alcohol. The ether of the series, or ethylene oxide, will be

$$\left.\begin{matrix}C_2H_4\\C_2H_4\end{matrix}\right\}O_2\text{, or }2(C_2H_4O)\text{, or }C_2H_4O.$$

An instance of a triad alcohol is furnished by glycerine, whose composition is founded on the type $\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_3$. Thus $\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}O_3$ is glycerine.

Monatomic alcohols may be represented by the general formula $C_nH_{2n+2}O$. By the following table it will be seen that the series is as yet incomplete; further research may supply the wanting members:—

ALCOHOLS.	FORMULA $C_nH_{2n+2}O$.
Methylic Alcohol, or Wood Spirit	CH_4O or $\left.\begin{matrix}CH_3\\H\end{matrix}\right\}O$.
Ethylic Alcohol, or Spirits of Wine	C_2H_6O „ $\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$.
Tritylic or Propylic	C_3H_8O „ $\left.\begin{matrix}C_3H_7\\H\end{matrix}\right\}O$.
Tetrylic or Butylic	$C_4H_{10}O$ „ etc.
Fusel Oil or Amylic	$C_5H_{12}O$.
Hexylic or Caproic	$C_6H_{14}O$.
Heptylic	$C_7H_{16}O$.
Octylic or Caprylic	$C_8H_{18}O$.
Laurylic	$C_{12}H_{26}O$.
Ethal or Cetylic	$C_{16}H_{34}O$.
Cerotin or Cerylic	$C_{27}H_{56}O$.
Melissin or Melissylic	$C_{30}H_{62}O$.

The relation which the various derivations from alcohol bear to each other is indicated in this table:—

Hydrocarbon or Radical.	Alcohol.	Ether.	Aldehyde.	Acid.	Compound Ether.
Ethyl. C_2H_5.	Ethylic. $\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$.	Ethylic. $\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O$.	Acetic. C_2H_4O.	Acetic. $C_2H_4O_2$.	Acetic Ether $C_2H_5C_2H_3O_2$

WOOD SPIRIT, METHYLIC ALCOHOL (CH_4O).

Specific Gravity at 0° = 0·8179; Boiling Point, 65°·5.

This spirit is one of the products of the destructive distillation of wood. It has never been procured by any process of fermentation: hence the derivation of the word from μέθυ (*wine*) is an error. Berthelot obtained it artificially, by acting on marsh gas with chlorine, thus forming CH_3Cl, and by treating this with potash the following reaction took place—

$$CH_3Cl + K,HO = CH_4O + KCl.$$

When wood is heated in closed iron retorts charcoal remains, and tar, mixed with water containing acetic acid and wood spirits, passes over into the condenser. When this is again distilled from chalk, the "wood naphtha" of commerce is the result, which is a mixture of methylic alcohol, methyl acetate, and certain oily hydrocarbons. This liquid is chiefly used for mixing with spirits of wine, to form "*methylated spirit*," which contains 10 per cent. of wood naphtha, and is permitted by Government to be sold free of duty, as a solvent for certain gums, resins, etc., which form varnishes, French polish, etc.

To procure wood spirit from naphtha an equal volume of concentrated solution of potash is added, and the mixture is allowed to stand for some hours. By this means the methyl acetate is decomposed, forming potassic acetate and wood spirit. The surface of the liquid is skimmed to remove any oily matters which rise. Potassic carbonate is now added, so long as it is dissolved, and the liquid arranges itself into two strata; the upper, containing the spirit, is decanted. Calcic chloride is now added, with which the spirit forms a compound which is not decomposed at 100°: hence the mixture is distilled in a water-bath, by which means everything is driven off save the alcohol. This is separated from the lime by adding a little water and distilling. It has many properties in common with spirits of wine; being soluble in all proportions in water, the mixture has a less volume than the sum of the volumes of its components. It burns with a non-luminous blue flame into carbonic anhydride and water, furnishing an admirable fuel for the chemist, as the flame is smokeless and hot.

When wood spirit is partially oxidised by means of spongy platinum, formic acid is produced; thus—

$$CH_4O + O_2 = CH_2O_2 + H_2O.$$

ALCOHOL, ETHYLIC OR VINIC ALCOHOL, OR SPIRITS OF WINE (C_2H_6O).

Specific Gravity at 0° = 0·815; Boiling Point, 78·3°.

This substance, which is a product of the fermentation of *grape* sugar, is the stimulant in all intoxicating drinks. From all such liquors it may be separated by distillation. It invariably carries with it some essential oil of the plant which has

* For the form of the adjective substantively employed after nichts or etwas, see Sect. XIV. 4.

yielded the sugar for the fermentation. There are also accidental circumstances which cause the alcohol to possess a characteristic flavour. For example, *whiskey* is spirit distilled from malt wort, and owes its flavour to the fact that the malt is dried over a peat fire. The flavour of *gin* is produced by adding juniper berries to the liquid in process of distillation. *Brandy* is truly "*spirits of wine*," being obtained from wines, and coloured more or less with burnt sugar. *Rum* comes from molasses. *Peppermint* carries with it the essential oil of the plant. Commercial "spirits of wine" is a mixture of *absolute alcohol* and 10 per cent. of water. This is the strongest spirit which can be got by simple distillation. To obtain from this spirit *absolute* or anhydrous alcohol, any spirit is rectified from charcoal, which retains the essential oils which give its characteristic flavour. Half its weight of quick-lime is now added, and in two or three days it falls to powder, being slaked at the expense of the water in the spirit. Another distillation of this gives absolute alcohol.

Proof spirit is defined by law as containing 49·24 per cent. of alcohol. It took its appellation from the process of testing it, which was by moistening gunpowder with the spirit, and then igniting it. If the powder fired, the spirit was said to be "over proof;" if, on the other hand, it contained sufficient water to prevent its combustion, it was "under proof." The presence of alcohol in a liquid may be made apparent by saturating it with potassic carbonate. This salt is not soluble in alcohol, whereas it is readily soluble in water: hence, the alcohol rises to the surface.

If the vapour of alcohol be passed through red-hot tubes, it is decomposed, yielding various products, according to the temperature; at a bright red heat, carbon is deposited and hydrogen escapes. At a lower temperature naphthaline appears; and, at a still lower heat, olefiant, marsh, and carbonic oxide gases, acetylene, and water are produced.

Alcohol burns thus—

$$\begin{array}{l} C_2H_6O + 6O = 2CO_2 + 3H_2O \\ \quad 2 \quad + \ 6 = \ 4 \qquad \text{Condensed.} \end{array}$$

The figures represent the volumes of the gases.

Aldehyde.—Alcohol readily oxidises, even in the presence of water, forming aldehyde (C_2H_4O); that is, two atoms of H are burnt by the oxygen. The process does not rest here. Another atom of oxygen is assimilated, forming acetic acid ($C_2H_4O_2$). This will account for the "souring" of beer, and the production of vinegar.

Wines are the fermented juice of the grape. Their various flavours depend upon the grapes from which they are expressed, of which there are more than 500 kinds. The colour of the wine does not depend on that of the grape, but is produced by allowing the skins of the fruit to remain in the *must* (the expressed juice of the grape) during fermentation, when the alcohol dissolves the colouring matter of the skin, and communicates to the wine the tint. "Fruity" and "dry" wines depend upon the point at which fermentation is checked. If all the sugar be transformed into alcohol, carbonic anhydride, and water, a "dry" wine is the result; but if not, a "fruity" wine is produced. If the wine be "bottled" before the fermentation is completed, an effervescing wine is secured. The alterations which wines undergo, if kept for a length of time, appear to be due to the gradual deposition of potassic tartrate ($KH,C_4H_4O_6$), which is rendered more insoluble as rich wines gradually continue to furnish more alcohol from a further fermentation of their sugar. This salt also carries down with it some of the colouring matter, and thus lightens the wine. This precipitate forms the *crust* in ports. As this slow process is going on, certain fragrant ethers are also produced, which give the wine its "bouquet." The quantity of alcohol in different beverages is given in this table:—

Port . . .	15	per cent.	Claret	8	per cent.
Madeira . .	14·5	„	Ale	6	„
Sherry . .	14	„	Porter	5	„

The characteristic fragrance of all wines is due to the presence of a minute quantity of œnanthic ether.

Alcohol acts on acids by replacing their H by a molecule of C_2H_5, thus—

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O + HCl = \left.\begin{matrix}H\\H\end{matrix}\right\}O + C_2H_5,Cl;$$

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O + HNO_3 = \left.\begin{matrix}H\\H\end{matrix}\right\}O + C_2H_5,NO_3.$$

Ethylic chloride and nitrate are the results of the actions; a further reaction will be noticed in the production of ether.

Propyl Alcohol $\left(\left.\begin{matrix}C_3H_7\\H\end{matrix}\right\}O\right)$.—When the distillation of French brandy is about to end, the temperature being at 96°, this alcohol comes off. It forms compounds which resemble the ethyl group. When it is oxidised, propionic acid is formed.

Butylic Alcohol $\left(\left.\begin{matrix}C_4H_9\\H\end{matrix}\right\}O\right)$ is found among the last products of the distillation of spirits from beetroot molasses.

Amylic Alcohol $\left(\left.\begin{matrix}C_5H_{11}\\H\end{matrix}\right\}O\right)$ derives its name from *amylum* (starch), since it is procured from fermented potatoes. It has a peculiar offensive odour, and is frequently an impurity in brandy derived from this source. It oxidises into valeric acid.

Cetyl Alcohol is a white solid which is present in spermaceti.

Melissylic Alcohol is also a solid contained in bees'-wax.

ETHER $\left(\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O\right)$. Boiling point, 35°.

When two volumes of strong spirits of wine are mixed with three of sulphuric acid, strong chemical action ensues:

$$\left.\begin{matrix}H\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O = \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}H\\H\end{matrix}\right\}O$$

represents the change which takes place. A molecule of ethyl takes the place of an atom of H in the sulphuric acid, thus forming hydric-ethyl-sulphate, or

Sulphovinic Acid.—This acid reacts on a second molecule of alcohol, thus—

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}SO_4 + \left.\begin{matrix}H\\C_2H_5\end{matrix}\right\}O = \left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O + \left.\begin{matrix}H\\H\end{matrix}\right\}SO_4K,$$

producing ether and sulphuric acid. Hence no sulphuric acid is removed during the etherification, but a constant supply of alcohol is added to the retort, which is kept at a temperature of 140°. A mixture of ether and water condenses in the receiver.

To procure the ether perfectly pure it must be distilled again from sodic hydrate, or even metallic sodium, by which the water and alcohol will be retained. Ether is a very mobile liquid, emitting the well-known ethereal odour; at 0°, its specific gravity is 0·736. It dissolves in 14 times its volume of water. If an insufficient quantity of water be present, ether containing about $\frac{1}{36}$ its volume of water appears as a supernatant stratum (Williamson). Its vapour is $2\frac{1}{2}$ times heavier than the air, and therefore can, like carbonic anhydride, be poured from one vessel to another. Owing to its rapidity of evaporation when poured on the hand, it produces great cold. The other alcohols produce corresponding ethers.

A large number of ethers of a compound structure can be made by replacement, such as—

$$\text{Methyl-ethyl ether, } \left.\begin{matrix}CH_3\\C_2H_5\end{matrix}\right\}O.$$

$$\text{Methyl-amyl ether, } \left.\begin{matrix}CH_3\\C_5H_{11}\end{matrix}\right\}O.$$

$$\text{Ethyl-butyl ether, } \left.\begin{matrix}C_2H_5\\C_4H_9\end{matrix}\right\}O, \text{ etc. etc.}$$

For the numerous compounds produced by replacing these hydro-carbon radicals by inorganic elements, and other organic radicals, a larger work must be consulted, as any attempt to notice them in our limited space can only lead to inevitable confusion.

Ether was much valued for its anæsthetic properties, but has been altogether superseded by chloroform, which does not leave such objectionable after-effects.

Chloroform ($CHCl_3$) is obtained by distillation from a mixture of water, spirits of wine, and bleaching powder.

The fact that Organic Chemistry is "the chemistry of compound radicals," is even more clearly illustrated by a series of compounds formed on the ammonia type.

Hitherto we have only noticed the replacement of H in the water type by the radicals of the group of alcohols given above. If we cause the ethyl molecule to replace successively one, two, or three atoms of the H in $\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N$, or ammonia, we have $\left.\begin{matrix}C_2H_5\\H\\H\end{matrix}\right\}N$, ethylamine; $\left.\begin{matrix}C_2H_5\\C_2H_5\\H\end{matrix}\right\}N$, di-ethylamine; and $\left.\begin{matrix}C_2H_5\\C_2H_5\\C_2H_5\end{matrix}\right\}N$, or tri-ethylamine.

These compound ammonias may be formed by the action of caustic alkalies on cyanates of the alcohol radicals. Similar compounds may be produced with methyl, propyl, phosphorus, arsenic, antimony, and bismuth, which also form compounds with three atoms of hydrogen, as $\left.\begin{matrix}H\\H\\H\end{matrix}\right\}P$, phosphoretted hydrogen.

The carbon radicals are capable of replacing the H in these componnds. Thus $\left.\begin{matrix}C_2H_5\\C_2H_5\\C_2H_5\end{matrix}\right\}P$ is tri-ethyl phosphine; $\left.\begin{matrix}CH_3\\CH_3\\CH_3\end{matrix}\right\}AS$ is tri-methyl arsine.

From these facts the student will gain some idea of the wide limits of Organic Chemistry. Had any of these compounds played any prominent part either in commerce or the process of organic life, we should have noted them; but, beyond the possibility of their existence, little is known of them.

READINGS IN GREEK.—VI.

THUCYDIDES.

"THUCYDIDES, the Athenian, compiled the history of the war between the Peloponnesians and Athenians"—these are the words with which the great Greek historian commences his immortal work, the most magnificent piece of history extant, as it is the first trustworthy record of Grecian affairs. The war in question is that tedious struggle for supremacy between the two leading nations of Greece called the Peloponnesian war, which lasted from B.C. 431 to B.C. 404. Thucydides was himself a witness of much that he describes, and during the course of the war held an important military command. Singularly enough, it is owing to his failure in this capacity that we may be said to owe his history, for, being sent with a fleet to the relief of the Athenian colony of Amphipolis, which was besieged by the Peloponnesians under Brasidas, he had the misfortune to miss his opportunity; the city fell, and the Athenians in consequence sent him into exile. He remained in this banishment for twenty years, nor did he return to Athens until after the termination of the war. Of this time, much was probably spent by him in Thrace, where he is known to have had estates; but he also took the opportunity of visiting many parts of Greece, hostile as well as neutral states. "However much," says Mr. Grote, the greatest of modern Greek historians, "we may deplore such a misfortune on his account, mankind in general has, and ever will have, the strongest reason to rejoice at it. The opportunities which an exile enjoyed of personally consulting neutrals and enemies contributed much to form that impartial, comprehensive spirit which reigns generally through his immortal work."

The history of Thucydides is divided into eight books. Of these the last is in a somewhat imperfect state, and was probably given to the world after the author's death, and never enjoyed the advantage of his revision. It contains none of the speeches which are such a distinctive feature in the other parts of the work. These speeches the historian does not profess to have been delivered in the form in which he gives them, but they rather represent what he believes, judging from his intimate knowledge of the speakers and the occasions on which they were uttered, might have been the sentiments expressed. Many of them are very fine specimens of oratory, and appear to have been very carefully elaborated. The style of Thucydides is throughout elevated and stately, his information is clear and precise, and his descriptions remarkably minute and vivid. In the narrative the student will find but little difficulty, when he has once mastered the technical terms of warfare to which the writer faithfully adheres; but the speeches are, as a rule, very difficult, the sentences being peculiarly long and involved, while occasionally the impetuosity of the speaker seems to override the bounds of strict grammatical regularity. The language is pure Attic Greek, which, at the time of Thucydides, had reached its most perfect form. The following is an account of a remarkable episode in the war. The little town of Platæa, on the confines of Bœotia, one of the firmest allies of Athens, was besieged by the Thebans, who were always their bitterest foes. Failing to take the town by assault, they blockaded it, raising walls of circumvallation, which effectually enclosed the besieged. After enduring the misery of this blockade for some months, a number of the besieged determined to try and escape through the enemy's lines to Athens. After laying their plans with consummate skill, they carried them into execution as follows:—

THUCYDIDES, III. 22.

Οἱ δ', ἐπειδὴ παρεσκεύαστο αὐτοῖς,[1] τηρήσαντες νύκτα χειμέρινον ὕδατι καὶ ἀνέμῳ καὶ ἅμα ἀσεληνον ἐξῄεσαν· ἡγοῦντο δὲ οἵπερ καὶ τῆς πείρας αἴτιοι ἦσαν. καὶ πρῶτον μὲν τὴν τάφρον διέβησαν ἣ περιεῖχεν αὐτούς, ἔπειτα προσέμιξαν τῷ τείχει τῶν πολεμίων λαθόντες[2] τοὺς φύλακας, ἀνὰ τὸ σκοτεινὸν[3] μὲν οὐ προϊδόντων αὐτῶν, ψόφῳ δὲ τῷ ἐκ τοῦ προσιέναι αὐτοὺς ἀντιπαταγοῦντος τοῦ ἀνέμου οὐ κατακουσάντων·[4] ἅμα δὲ καὶ διέχοντες πολὺ[5] ᾖεσαν, ὅπως τὰ ὅπλα μὴ κρουόμενα πρὸς ἄλληλα αἴσθησιν παρέχοι. ἦσαν δὲ εὐσταλεῖς τε τῇ ὁπλίσει καὶ τὸν ἀριστερὸν πόδα μόνον ὑποδεδεμένοι ἀσφαλείας ἕνεκα[6] τῆς πρὸς τὸν πηλόν. κατὰ οὖν μεταπύργιον[7] προσέμισγον πρὸς τὰς ἐπάλξεις, εἰδότες ὅτι ἐρῆμοι εἰσι, πρῶτον μὲν οἱ τὰς κλίμακας φέροντες καὶ προσέθεσαν· ἔπειτα ψιλοὶ δώδεκα ξὺν ξιφιδίῳ καὶ θώρακι ἀνέβαινον, ὧν ἡγεῖτο Ἀμμέας ὁ Κοροίβου καὶ πρῶτος ἀνέβη, μετὰ δὲ αὐτὸν οἱ ἑπόμενοι ἓξ ἐφ' ἑκάτερον τῶν πύργων ἀνέβαινον· ἔπειτα ψιλοὶ ἄλλοι μετὰ τούτους ξὺν δορατίοις ἐχώρουν, οἷς ἕτεροι κατόπιν τὰς ἀσπίδας ἔφερον, ὅπως ἐκεῖνοι ῥᾷον προσβαίνοιεν, καὶ ἔμελλον δώσειν[8] ὁπότε πρὸς τοῖς πολεμίοις εἶησαν. ὡς δὲ ἄνω πλείους ἐγένοντο, ᾔσθοντο οἱ ἐκ τῶν πύργων φύλακες· κατέβαλε γάρ τις τῶν Πλαταιῶν ἀντιλαμβανόμενος ἀπὸ τῶν ἐπάλξεων κεραμίδα, ἣ πεσοῦσα δοῦπον ἐποίησε. καὶ αὐτίκα βοὴ ἦν, τὸ δὲ στρατόπεδον ἐπὶ τὸ τεῖχος ὥρμησεν· οὐ γὰρ ᾔδει ὅ τι ἦν τὸ δεινὸν σκοτεινῆς νυκτὸς καὶ χειμῶνος ὄντος, καὶ ἅμα οἱ ἐν τῇ πόλει τῶν Πλαταιῶν ὑπολελειμμένοι ἐξελθόντες προσέβαλον τῷ τείχει τῶν Πελοποννησίων ἐκ τοὔμπαλιν[9] ἢ οἱ ἄνδρες αὐτῶν ὑπερέβαινον, ὅπως ἥκιστα πρὸς αὐτοὺς τὸν νοῦν ἔχοιεν. ἐθορυβοῦντο μὲν οὖν[10] κατὰ χώραν μένοντες, βοηθεῖν δὲ οὐδεὶς ἐτόλμα ἐκ τῆς ἑαυτῶν φυλακῆς, ἀλλ' ἐν ἀπόρῳ ἦσαν εἰκάσαι τὸ γιγνόμενον. καὶ οἱ τριακόσιοι αὐτῶν, οἷς ἐτέτακτο παραβοηθεῖν εἴ τι δέοι, ἐχώρουν ἔξω τοῦ τείχους πρὸς τὴν βοήν. φρυκτοί[11] τε ᾔροντο ἐς τὰς Θήβας πολέμιοι· παρανῖσχον[12] δὲ καὶ οἱ ἐκ τῆς πόλεως Πλαταιῆς ἀπό τοῦ τείχους φρυκτοὺς πολλοὺς πρότερον παρεσκευασμένους ἐς αὐτὸ τοῦτο, ὅπως ἀσαφῆ[13] τὰ σημεῖα τῆς φρυκτωρίας τοῖς πολεμίοις ᾖ[14] καὶ μὴ βοηθοῖεν, ἄλλο τι νομίσαντες τὸ γιγνόμενον εἶναι ἢ τὸ ὄν, πρὶν σφῶν οἱ ἄνδρες οἱ ἐξιόντες διαφύγοιεν καὶ τοῦ ἀσφαλοῦς ἀντιλάβοιντο.

NOTES.

1. Αὐτοῖς, dat. of the agent. *After they had made their preparations.*
2. Λαθόντες, *having escaped the sentinels' notice.*
3. Ἀνὰ τὸ σκοτεινόν, *through the darkness*, or rather, *amid the darkness.* Αὐτῶν refers to the sentinels.
4. Οὐ κατακουσάντων, genitive absolute agreeing with αὐτων, *and not hearing them, as the noise of the wind drowned the clatter of their approach.* Ψόφῳ, dat., is governed by ἀντι in ἀντιπαταγοῦντος, the wind roaring in opposition to the noise. Αὐτοὺς goes with προσιέναι, and the joint phrase is used as a substantive; ἐκ τοῦ προσιέναι αὐτοὺς being equivalent to ἐκ τοῦ προσόδου αὐτῶν.
5. Διέχοντες πολὺ, *keeping wide apart.*
6. Ἀσφαλείας ἕνεκα. The left was shod to prevent its slipping in the mud—(1) as being the weakest; (2) because he who is going to strike with his *right* arm wants a firm purchase for his *left* foot.
7. Μεταπύργιον is the space in the enemy's wall between two of the towers (μέτα-πύργος) that were erected at regular intervals upon it.
8. Δώσειν, *to give them* into their hand.
9. Ἐκ τοὔμπαλιν, *on the side opposite to that on which their comrades were climbing.*
10. Ἐθορυβοῦντο μὲν οὖν, *they caught the alarm, it is true, and remained in their stations.*
11. Φρυκτοί—πολέμιοι, *beacons were raised by the enemy to give the alarm at Thebes.*
12. Παρανῖσχον, held up *to counteract them.*
13. Ἀσαφῆ. The object was to confuse the friends of the besiegers by raising a duplicate signal.
14. ᾖ—βοηθοῖεν. The reason for this change of mood appears to be that the first is intended to express the *immediate*, the second suggests the *more remote* consequence.

The following extract is a part of the funeral speech delivered by Pericles, the greatest of Athenian statesmen, over the bodies of those who had fallen in the service of their country in the war of the previous year. The passage may be thus paraphrased:—Athens, as a nation, is the school of Greece, and her citizens are more accomplished than those of any other country. This is not an idle boast, but is a fact which experience proves. Every land feels the greatness of her powers, and the best evidence of this is found in the fear or the gratitude of the rest of mankind; and for such a country it is meet that her sons should die.

THUCYDIDES, II. 41.

Ξυνελών[1] *τε λέγω τήν τε πᾶσαν πόλιν τῆς Ἑλλάδος παίδευσιν εἶναι καὶ καθ' ἕκαστον δοκεῖν ἄν μοι τὸν αὐτὸν ἄνδρα παρ' ἡμῶν*[2] *ἐπὶ πλεῖστ' ἂν εἴδη*[3] *καὶ μετὰ χαρίτων*[4] *μάλιστ' ἂν εὐτραπέλως τὸ σῶμα αὔταρκες*[5] *παρέχεσθαι. καὶ ὡς οὐ λόγων ἐν τῷ παρόντι κόμπος τάδε μᾶλλον*[6] *ἢ ἔργων ἐστὶν ἀλήθεια, αὐτὴ ἡ δύναμις τῆς πόλεως, ἣν ἀπὸ τῶνδε τῶν τρόπων ἐκτησάμεθα, σημαίνει. μόνη γὰρ τῶν νῦν*[7] *ἀκοῆς κρείσσων*[8] *ἐς πεῖραν ἔρχεται καὶ μόνη οὔτε τῷ πολεμίῳ ἐπελθόντι ἀγανάκτησιν ἔχει*[9] *ὑφ' οἵων*[10] *κακοπαθεῖ, οὔτε τῷ ὑπηκόῳ κατάμεμψιν ὡς οὐχ ὑπ' ἀξίων ἄρχεται. μετὰ μεγάλων δὲ σημείων καὶ οὐ δὴ τοὶ ἀμάρτυρόν*[11] *γε τὴν δύναμιν παρασχόμενοι τοῖς τε νῦν καὶ τοῖς ἔπειτα θαυμασθησόμεθα, καὶ οὐδὲν προσδεόμενοι οὔτε Ὁμήρου ἐπαινέτου*[12] *οὔτε ὅστις ἔπεσι μὲν τὸ αὐτίκα τέρψει, τῶν δὲ ἔργων*[13] *τὴν ὑπόνοιαν ἡ ἀλήθεια βλάψει, ἀλλὰ πᾶσαν μὲν θάλασσαν καὶ γῆν ἐσβατὸν*[14] *τῇ ἡμετέρᾳ τόλμῃ καταναγκάσαντες γενέσθαι, πανταχοῦ δὲ μνημεῖα κακῶν τε κἀγαθῶν ἀΐδια ξυγκατοικίσαντες. περὶ τοιαύτης οὖν πόλεως οἵδε τε γενναίως δικαιοῦντες*[15] *μὴ ἀφαιρεθῆναι αὐτὴν μαχόμενοι ἐτελεύτησαν, καὶ τῶν λειπομένων*[16] *πάντα τινὰ εἰκὸς ἐθέλειν ὑπὲρ αὐτῆς κάμνειν.*

NOTES.

1. Ξυνελών, *compendiously—in a word, to sum up.*
2. Παρ' ἡμῶν, *from amongst* us.
3. Ἐπὶ πλεῖστ' ἂν εἴδη—παρέχεσθαι. The three ἂν's in this sentence go with παρέχεσθαι, adding to it the notion of *probability: would be likely to offer his person to the state for the most various kinds of action.*
4. Μετὰ χαρίτων, *gracefully.* Εὐτραπέλως signifies the power of easily turning (εὖ τρέπω) one's faculties to different pursuits. Arnold translates it *with the happiest versatility.*
5. Αὔταρκες, *efficiently, so as to be of service.*
6. Οὐ—μᾶλλον ἤ. Translate, *not so much—as.*
7. Τῶν νῦν—*i.e.*, πόλεων, *of states at the present day.*
8. Ἀκοῆς κρείσσων, *better than it is said to be.* Ἀκοή is used to signify *fame* or *rumour*—what you *hear said* of a man; so, ἀκούειν κακως is *to be ill spoken of*, and male audire in Latin has the same meaning. So Milton, "Paradise Lost," bk. iii., line 7—

"Or hear'st thou rather pure ethereal stream?"

which means, Or dost thou rather choose to be called pure ethereal stream?

9. Ἀγανάκτησιν ἔχει (ἔχει for παρέχει, *offers* or *occasions*), *occasions no indignation to an invading enemy—i.e.*, does not cause him to feel indignation.
10. Ὑφ' οἵων, *at any evils he suffers.* The form of the sentence is condensed from ὑπ' ἐκείνων οἷα κακοπαθεῖ. The relative is said to be *attracted* into the case of the antecedent.
11. Οὐ δὴ τοὶ ἀμάρτυρόν, *by no means unsupported by facts.*
12. Ὁμήρου ἐπαινέτου, *a panegyrist like Homer.* Of the value of a poet's praise, Horace speaks when he says (*Odes*, iv. 25)—

"Vixere fortes ante Agamemnona
Multi: sed omnes illacri mabiles
Urgentur ignotique longa
Nocte, *carent quia vate sacro.*"

13. Τῶν δὲ ἔργων, *while the truth of the facts will damage the reputation they bear.* He means that too often the poet's flowery descriptions are overthrown by a knowledge of the actual facts which he relates.
14. Ἐσβατὸν, *open to our daring.*
15. Δικαιοῦντες, etc., *claiming not to lose her.*
16. Λειπομένων. The survivors who are still left to fight her battles.

Our extracts from Thucydides would not be complete without one of his vivid accounts of a battle. The following is part of the story of one of the most famous naval engagements in the course of the war, in which Phormio, the Athenian admiral, upheld the supremacy of his country upon the sea. The Lacedæmonian fleet was cruising round the opening of the Gulf of Corinth, when Phormio came down upon them; on perceiving him they at once arranged their ships in a circle, with the prows outward, "like the spokes of a wheel," and awaited his attack.

THUCYDIDES, II. 84.

Οἱ δὲ Ἀθηναῖοι κατὰ μίαν ναῦν[1] *τεταγμένοι περιέπλεον*[2] *αὐτοὺς κύκλῳ καὶ ξυνῆγον ἐς ὀλίγον, ἐν χρῷ*[3] *ἀεὶ παραπλέοντες καὶ δόκησιν*[4] *παρέχοντες αὐτίκα ἐμβαλεῖν· προείρητο δ' αὐτοῖς ὑπὸ Φορμίωνος μὴ ἐπιχειρεῖν πρὶν ἂν αὐτὸς*[5] *σημήνῃ. ἤλπιζε γὰρ αὐτῶν οὐ μενεῖν τὴν τάξιν, ὥσπερ ἐν γῇ πεζὴν, ἀλλὰ ξυμπεσεῖσθαι πρὸς ἀλλήλας τὰς ναῦς καὶ τὰ πλοῖα ταραχὴν παρέξειν, εἴ τ' ἐκπνεύσαι ἐκ τοῦ κόλπου τὸ πνεῦμα, ὅπερ ἀναμένων*[6] *τε περιέπλει καὶ εἰώθει γίγνεσθαι ἐπὶ τὴν ἕω, οὐδένα χρόνον ἡσυχάσειν αὐτούς· καὶ τὴν ἐπιχείρησιν ἐφ' ἑαυτῷ*[7] *τε ἐνόμιζεν εἶναι ὁπόταν βούληται, τῶν νεῶν ἄμεινον πλεουσῶν, καὶ τότε καλλίστην γίγνεσθαι. ὡς δὲ τό τε πνεῦμα κατῄει*[8] *καὶ αἱ νῆες ἐν ὀλίγῳ*[9] *ἤδη οὖσαι ὑπ' ἀμφοτέρων, τοῦ τε ἀνέμου τῶν τε πλοίων ἅμα προσκειμένων, ἐταράσσοντο, καὶ ναῦς τε νηὶ προσέπιπτε καὶ τοῖς κοντοῖς διωθοῦντο,*[10] *βοῇ τε χρώμενοι καὶ πρὸς ἀλλήλους ἀντιφυλακῇ τε καὶ λοιδορίᾳ οὐδὲν κατήκουον οὔτε τῶν παραγγελλομένων οὔτε τῶν κελευστῶν*[11] *καὶ τὰς κώπας ἀδύνατοι ὄντες ἐν κλυδωνίῳ ἀναφέρειν ἄνθρωποι ἄπειροι*[12] *τοῖς κυβερνήταις ἀπειθεστέρας*[13] *τὰς ναῦς παρεῖχον, τότε δὴ*[14] *κατὰ τὸν καιρὸν τοῦτον σημαίνει, καὶ οἱ Ἀθηναῖοι προσπεσόντες πρῶτον μὲν καταδύουσι τῶν στρατηγίδων νεῶν μίαν, ἔπειτα δὲ καὶ πάσας ᾗ χωρήσειαν διέφθειρον, καὶ κατέστησαν ἐς ἀλκὴν μὲν μηδένα τρέπεσθαι αὐτῶν ὑπὸ τῆς ταραχῆς, φεύγειν δ' ἐς Πάτρας καὶ Δύμην τῆς Ἀχαΐας.*

NOTES.

1. Κατὰ μίαν ναῦν, *in single file.*
2. Περιέπλεον—ξυνῆγον. The force of the imperfect should be preserved in the translation: *kept sailing round—and contracting them.*
3. Ἐν χρῷ, lit., *on or close to the skin. Sailing past so as to shave or graze them.*
4. Δόκησιν, etc., *giving the impression that they would come to blows at once.*
5. Αὐτός, *himself, with his own lips.*
6. Ὅπερ (πνεῦμα) ἀναμένων. *In expectation of which he kept sailing round, and which* (supply ὅπερ in nom. as subject to εἰώθει) *usually happened towards morning.*
7. Ἐφ' ἑαυτῷ, *was in his own hands.* Τότε—*i.e.*, the favourable moment when the breeze would aid him.
8. Κατῄει, *came down upon them.*
9. Ἐν ὀλίγῳ, etc., *when they were now confined in a narrow space by the ships on each side of them.*
10. Διωθοῦντο (observe the middle voice), *kept pushing off each other.*
11. Κελευστῶν. It was the business of the κελευστής to make the rowers keep time by singing to them. This, in the confusion, was now inaudible, and the rowers consequently became unsteady.
12. Ἄπειροι, unskilled in seamanship. The fighting men on board ship consisted of ordinary land soldiers.
13. Ἀπειθεστέρας, made the ships less capable of being managed by the steersmen.
14. Τότε δή. The read r will notice the length of the previous sentence as a good example of the manner of Thucydides. The description of the situation is piled up bit by bit, and then this sentence comes in with surprising force of contrast.

TRANSLATION OF EXTRACT II. IN LAST READING.

Come now, and let us begin the chorus, since it hath seemed good to unfold our strain of vengeance, and to tell how our company distributes the lots among mankind, and we believe that our justice is unerring. To the man who holds forth his hands unstained no wrath from us accrues, and all unharmed he passes his life. But whoever, being a transgressor like this man, conceals his murder-stained hands, he finds us sure to visit him as avengers of blood coming to the aid of the dead with unerring testimony. Hear me, O Night! Hear me, mother mine, who barest me to the dead and living alike an avenger! Hear me, for Latona's son puts me to shame by robbing me of this trembling one, my own peculiar victim to avenge a mother's murder! And over the consecrated victim comes this strain, delirious, distracting, disturbing the brain — a hymn from the Furies, binding the soul in chains, not sung to the lyre, a blight to men.

LESSONS IN ASTRONOMY.—VII.

DIP OF THE HORIZON—EFFECTS OF THE ATMOSPHERE—REFRACTION—TWILIGHT—GREAT AND SMALL CIRCLES—EQUINOCTIAL — ECLIPTIC — DECLINATION — RIGHT ASCENSION.

THE "dip of the horizon" is a phrase which we sometimes meet with, and in nautical observations an allowance has frequently to be made for it; we must therefore explain what is meant by the expression.

Let B C E (Fig. 8) represent the earth, and A the situation of an observer above its surface. The circle B C D will represent the sensible horizon, that is, the rays drawn from the point A will touch the surface of the earth in a series of points which are situated on this line. Now as we have already seen, the more elevated the point A is, the larger will the circle B C D become; but at the same time the angle contained by the lines A C, A B will become less, so that although a larger extent of the surface is seen, yet it actually appears to be smaller. The simplest illustration of this is afforded by means of a pair of compasses, and any globular body—as, for instance, a cannon-ball, or a common round bottle. If we open the compasses so that the points just touch opposite sides of the body, we shall find that the angle contained between the legs is but small, while a considerable portion of the surface is included between the place touched by them. Now press the hinge nearer and nearer, and it will be seen that the angle becomes larger and larger, while at the same time the space included becomes less. When the hinge nearly touches, the two limbs will be almost in a straight line.

If now we imagine the hinge to represent the position of the observer and the limbs the visual rays, we shall understand that when the observer is at all elevated above the earth's surface, the sensible horizon appears depressed below him, and this angle of depression is called the *dip of the horizon*. Thus, in the figure, if F G be the horizontal line passing through the point A, as determined by a level, then the angle F A C or G A B (for they are equal) will be the dip.

The globe we inhabit is completely surrounded by a layer of invisible gases known as the air or atmosphere. We live, in fact, at the bottom of an aërial ocean, the depth of which is supposed to be about forty-five or fifty miles; it diminishes, however, very rapidly in density as we ascend. The physical properties of this envelope will be referred to at length in the Lessons on Pneumatics in another volume: we need not, therefore, inquire generally into them here; we must, however, refer to the influence of the air on onr observations. At many times, especially in our changeable climate, the amount of moisture in the air is so great that it is almost impossible to employ a powerful telescope. The higher powers of Lord Rosse's large instrument can, on this account, only be nsed at rare intervals, sometimes only for a few times in the course of the year. The main effect, however, which we must speak of, is that known as *refraction*. If a ray of light in its course pass from any medium into another differing from it in density, it becomes bent out of its original path. The simplest plan of showing this is to pnt a stick partly into a pond or a vessel of water, when it will appear to be bent at the surface of the liquid, owing to the rays from the lower part being refracted as they leave the water.

Now our atmosphere, though very rarefied when compared with bodies on the earth's surface, is much denser than the fluid which is supposed to pervade all space. The lower layers of the air likewise are much denser than those more elevated, and hence the rays of light which reach our eyes from the stars are more or less bent, so that we do not see these objects in the places in which they really are. Now if we are to ascertain the true position they occupy—and we must if we would calculate their movements—we must learn what the effect of refraction really is, and what allowance has to be made for it.

Fig. 9 in the next page will make the matter more clear. Let the line E C T represent a portion of the earth's surface, C being the position of the observer; the horizontal line H C O touching the earth at this point will then represent his sensible horizon. Also let M D and U P represent the limits of successive layers of the atmosphere, each being less dense than the one below it.

S is the actual position of the sun or any bright star in the heavens, and we should at first suppose that it would be seen by a ray of light passing straight from C to S. This, however, is not the case; for as soon as this ray meets the atmosphere it is bent downwards, and as it enters each successive stratum it is more and more deflected, so that it reaches the earth at a point situated some way to the right of C. The ray of light by which the star is in reality seen, is one which, but for the air, would pass on to L. It is, however, refracted at A to the direction A N, and again at B into the direction B C, each of these refractions bringing it more nearly into the vertical direction.

Now we always imagine an object to lie in the direction in which a ray from it reaches the eye. Hence, if we now prolong C B, we shall find the apparent place of the star, S′, differing considerably from its real place, S. We see thus that the effect of refraction is to cause the heavenly bodies to appear more elevated above the horizon than they really are.

The amount of alteration thus produced is greater when a body is near the horizon, and diminishes as it ascends, till at the zenith, as at S″, no effect at all is produced by it. All observations are accordingly, as far as practicable, made when the star or planet has attained its greatest altitude, and this is, as has been explained, when it is on the meridian.

In our figure we only draw two layers of air, but in reality the density diminishes very gradually, so that there are an infinite number; the only difference, however, that this causes, is to make the ray curve evenly instead of by a series of bends.

The amount of refraction when the object is situated near the horizon is about 33′, or rather more than the apparent diameter of the sun, so that its lower edge just appears to touch the horizon when in reality its upper edge is entirely below it. Another effect of refraction is somewhat to distort the form of the sun or moon when they are rising or setting. In this position they will frequently appear elliptical in form, as if they were a little flattened. The real canse of this is the rapid rate at which refraction increases as we approach the horizon. The lower portion of the sun's disc is, accordingly, more elevated in this way than the upper side, and thus the vertical diameter appears less than it otherwise would. The lateral diameter is, of course, quite unaffected by this cause. The increased size of the sun or moon when near the horizon does not arise from the effects of refraction. It is merely an illusion arising from the fact that we see these bodies by the side of terrestrial objects, and thus compare their sizes with known objects. If we measure carefully their apparent diameters, we shall find they are just the same as when higher up in the sky.

We have not yet referred to the effect of refraction which is of the greatest importance to us in our every-day life, namely, its influence in producing twilight. As we have seen, the snn is visible for a short time after it is in reality below the horizon, but after it has disappeared many of its rays continue for a considerable period to reach us. They cannot, of course, come direct to us, being prevented by the curvature of the earth; but they pass through the upper layers of the air, and in so doing get bent and reflected so as to reach the earth, and thns, for some time after the sun has set, the whole sky is brilliantly lighted. The floating particles of vapour in the atmosphere, and, it may be, even the particles of the air itself, reflect many of these rays, just as when a ray of sunlight shines through an aperture into a dusty room, the fragments of dust diffuse enough light feebly to illnminate the apartment.

Were it not for this effect of the air, the sun would set, and immediately the deepest darkness would overshadow and conceal everything, so that the period of sunset would be one of great danger. As it is, however, twilight continues until the sun is 18° below the horizon, the light of day only gradually giving way to the darkness of night, and thus we have the benefit of the sun's light for a much longer period than we should otherwise have. In our latitude, as a reference to the globe will show, the sun never descends 18° below the horizon from the end of May to the middle of July, so that during all that period we have no real night; and in Arctic regions the twilight in some places lasts several weeks, so that it nicely relieves the monotony of the long dark night. The diffused light of day is also owing to the air, and this adds in no small degree to our comfort, causing the beantiful gradations of light and shade in place of the dazzling light and black darkness which we should otherwise have.

We must now master a few more terms and definitions which we shall constantly be meeting with in the conrse of our stndy. In order to mark out the positions of any places on a globe, it is necessary for us to have some fixed points and lines to refer them to. Thus, if we wanted to describe the exact position of the point F in Fig. 10, and the only fixed lines we had to refer to it were A B and C D at right angles to one another, we could easily fix its place by drawing the lines F G and F H perpendicular to A B and C D. We should then say its distance above A B was equal to F G, and its distance to the right of C D was equal to F H or G E, and by these distances we could at any time fix again on the exact spot. Or we might join F E, and then we could fix the position of F, by giving the length of E F, and the angle F E G.

Now if we attempt to draw a straight line on the surface of a globe, it will pass completely round it and form a circle. It is clear, then, that we must have some fixed circles on the earth or in the sky if we are to ascertain the position of the varions heavenly bodies; and if we refer to an ordinary terrestrial globe we shall find that there are several circles drawn npon it, but we shall also observe that these are of different sizes, the parallels of latitude near the poles, and the polar circles, being much smaller than those nearer the eqnator. These circles are accordingly divided into two classes, called respectively Great Circles and Small Circles. Great circles are those whose plane passes through the centre of the globe, so that they divide it into two equal portions, and (assuming the earth to be perfectly spherical) all these will be exactly equal. All other circles are called small circles.

The most important of the great circles is the *equator*, which is an imaginary line drawn round the earth equally distant from the north and south poles, and therefore dividing the globe into two equal portions, called the northern and the southern hemispheres. If now we imagine the plane of this circle to be extended to the sky, we shall have a great circle of the heavens known as the *celestial equator*, or more usually the *equinoctial*. This latter name is derived from two Latin words signifying "equal" and "night," and is given to it because when the sun appears to be on this line, it shines equally on each hemisphere, and day and night are then of equal length in all parts of the world, the sun being above the horizon at every place for twelve hours, and below it for the same period. The days on which this happens are the 20th of March and the 23rd of September, and by counting the days between these dates, we shall find that in the northern hemisphere the summer is a few days longer than the winter, or, in other words, that the period during which the sun is north of the equator is longer than that during which he is south of it.

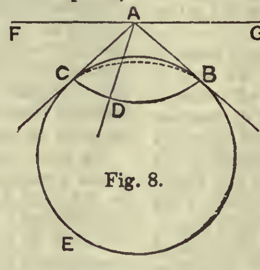


Fig. 8.

The sun's path is not, however, along the equinoctial, but in a great circle inclined to it at the present time at an angle of about 23° 27′ 30″, and known as the *ecliptic*. Round this the sun appears to travel, performing the complete circuit of it in the space of one year. The space extending for nine degrees on each side of the ecliptic, and thus constituting a band or belt 18° wide, is known as the *zodiac;* and within this space all the planets, with the exception of a few of the minor ones, are constantly found, so that we can always tell somewhat of the position in which they are. As already explained, the zodiac is divided into twelve equal portions, each containing 30°, and the stars in these spaces are mapped out into the constellations known as the "signs of the zodiac."

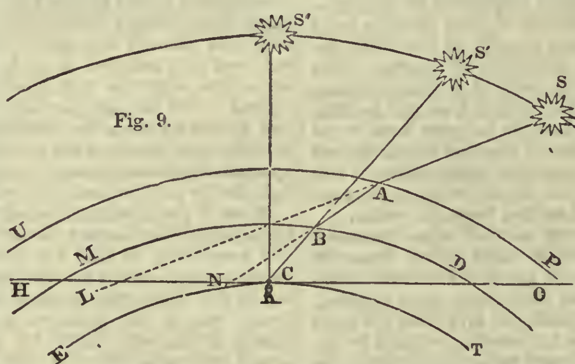


Fig. 9.

We have just stated that the inclination of the ecliptic to the equator, or, as it is called, the "obliquity of the ecliptic," was nearly 23½°. This amount, however, is not constantly the same, but varies a little in the lapse of centuries. The rate of this variation is very slight, being less than 1′ in 100 years, and it is found that it can only take place within very narrow limits. At present it is decreasing; but before it can have deviated as much as a degree and a half, the causes producing it will have been so modified as to act in a contrary direction and increase the inclination again.

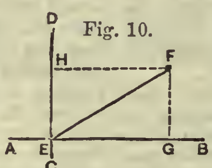


Fig. 10.

We shall see all through our lessons in Astronomy instances of these slow and gradual variations; but we shall find that all are confined within certain very narrow limits, and that instead of hurrying on the total change or destruction of the world and the system to which it belongs, they tend to increase its stability.

Now since these two great circles are thus inclined, there must be two points in which they intersect one another, and these are called the equinoctial points, or the vernal and autumnal equinoxes. One of these is the first degree in *Aries*, and the other the first in *Libra*. The first of these, or the vernal equinox, is the most important, as it is taken as the fixed point to be employed in reckoning distances from when we want to indicate the place of any body.

We take, then, the equinoctial or equator as our base line, and first of all measure the distance of any star north or south of that. On a terrestrial globe, circles called *parallels of latitude* are usually drawn at distances of ten degrees. We can, however, always measure the distance, by bringing the star to that side of the brass meridian which is numbered upwards from the pole to the equator, and reading off the degree. It must be remembered when we speak of degrees of latitude that what we really mean is the inclination which a straight line, drawn from the place to the centre of the earth, would have to the plane of the equator. A degree is a measure of an angle, and not of a distance. It is well to be clear on this point, as mistakes often arise through want of understanding it. Some people will say that a degree equals a little over sixty-nine miles, when in reality what they mean is that at the equator two lines meeting at the earth's centre, inclinedto one another as this angle, would include between them a portion of the earth's surface of that length.

On Saturn, or any globe larger than the earth, the amount thus subtended at the equator would naturally be much greater; and on the other hand, in any small circles which we may draw on a sheet of paper, there are still 360 degrees: each, therefore, is very minute.

In astronomy, the distance north or south of the equinoctial is called the *declination* of the star; and we have thus one of the two measures which we require to enable us to indicate the star's place. If now we draw another great circle passing through the poles, and also through the star, it will intersect the equator in two places, and the one of these on the same side as that on which the star is situated will furnish us with the other distance required. If we examine the equinoctial on a celestial globe, we shall find that it is divided into degrees, from 0° to 360°, reckoning from east to west, the starting-point being the first point in Aries.

The great circles which we have referred to as passing through the poles, are called *meridians*, and any number of them might be drawn; usually, however, twenty-four are drawn on the globe, their distance apart being fifteen degrees. They are then frequently termed *hour-lines*, as the sky appears to move just the interval between two of them in the space of an hour. We can obtain a clearer idea of these meridians by taking the globe out of its framework, and letting the brass meridian be free to turn round on the poles; we can then bring it over any star or place, and it will represent the meridian of that place. We shall also be able to see on the equator the distance of its intersection from the first point in Aries. This distance is known as the *right ascension* (usually abbreviated thus, R.A.).

We see now the way in which we can determine the position of a star, the two measures required being its right ascension and its declination. Suppose, for example, we want to point out the place of the star in the tip of the Great Bear's tail, we first find it on the globe, and bringing it to the brass meridian, we shall find that its elevation above the equinoctial is very nearly 50°; this then is its declination. We now look to the equinoctial, and find the point of it directly under the meridian is 204°, or 13 hours 36 minutes from Aries; and thus we assign its place as 50° north declination, and 204° R.A.

In a similar way, when the right ascension and declination are given we can find the star. Thus, suppose we have the following question:—What star has 99° 33′ R.A., and 16° 29′ south declination? We first find on the equinoctial the point 99° 33′, and bring this to the brass meridian. Keeping the globe in this position, we now look under the degree 16° 29′ south, and there we find the bright star Sirius, or the Dog-star.

The student should practise finding in this way the position of various stars, so as to render himself familiar with the use of the globes. On a map, too, the meridians and parallels are usually marked, so that these questions may be solved without a globe, though it is more convenient to have one.

NATURAL HISTORY OF COMMERCE.

CHAPTER VI.

BRITISH FISHERIES.

Declining Condition of British Fisheries—Staple Fishery—Salmon Fishery—Shell Fish—Whale Fishery.

THE British seas are wonderfully rich in food-produce, and, from our inborn love of the ocean, flourishing fisheries might be predicated; but, relatively to the progress of other industry, these have been languidly pursued. It was once thought necessary to pay bounties upon the take, a false economy happily discontinued, and without diminishing the supply.

The staple fishery of the United Kingdom is that of herrings, shoals of which, at the season of spawning, crowd the inlets and bays of Great Britain and Ireland. Of the English fishing stations Yarmouth possesses the greatest celebrity for its semi-smoked and salted bloaters, everywhere esteemed. From Yarmouth to the Shetlands, fleets of herring boats ply their nets, every town on the coast being more or less employed in the capture and curing of this important fish. The Scotch herrings are larger and higher dried than those of Yarmouth. The chief fishing station, probably, in the United Kingdom is Wick, within a few miles of John o' Groats. Peterhead and Fraserburgh are likewise places of great resort for curing herrings. The Scottish fisheries generally are prosecuted with energy in every firth and loch, as well as in the channels of the northern and western islands. The Irish fisheries, on the other hand, have thriven least. Some of the most considerable are on the Nymph Bank, south of Waterford, but the produce is principally taken to English ports, while salted herrings are obtained from Scotland.

Pilchards, allied to the herring, are taken chiefly during September and October. They are found in all the creeks of Ireland, and off the coasts of Devon and Cornwall. These fisheries fall but little short of the importance of that of Yarmouth; yet while herrings are the frequent frugal meal of the London poor, pilchards are hardly known to them, and are only seen when a few stray catches are used as prize sprats to embellish the fishmonger's silvery heaps. Many thousand hogsheads of pilchards are exported to the Mediterranean, whence we get the closely-related anchovy and sardine, the interchange adding to the variety of food on both sides. Sprats are found in enormous shoals during the winter months, and too often wasted for want of a ready market.

Between the Cornish and Yarmouth fishing grounds the mackerel intervene, extending mainly from the Isle of Wight to the Straits of Dover, and assuming during the season a very considerable value. From Ireland large supplies of remarkably fine mackerel have lately been received, packed in ice.

Turbot, soles, and other so-called flat fish, as well as cod, swarm on the sandbanks of the North Sea, especially the central great Dogger Bank. Here fishing-boats are now stationed for weeks together, and the produce of the nets is forwarded to London and elsewhere as fast as swift-sailing cutters or large screw steamers can carry it. By this means many additional hundreds of tons of fine fish, especially plaice and haddocks, are obtained for the poorer population of our large towns. There are extensive cod and white-fish fisheries in Scotland. The fishing grounds round Ireland abound with cod, hake, and ling, but have never yet been satisfactorily worked.

The salmon originates a peculiar fishery, in which again the Scotch are foremost. The rivers Tweed, Tay, Dee, Don, and Spey teem with this noblest of the finny tribes, whose capture is a fluctuating but very valuable division of industry, and an attraction to anglers from the most distant parts of the kingdom. The Irish rivers glisten with salmon, which, however, until lately were not sufficiently cared for, from an economic point of view.

A trade in salted cod, wet and dry, is carried on with St. John's, Newfoundland, the head-quarters of the British fisheries on the Great Bank, where the fish taken into St. John's for exportation are chiefly caught.

Shell Fish.

Shell-fish, as various forms of crustaceans and mollusks are called, provide us with a large amount of food. There is a lobster fishery along the rocky coast of Yorkshire, another in the Orkneys, and thousands of lobsters and crabs are caught yearly on the south and west coasts of England, to be sent to the London markets. Ireland supplies us occasionally with large quantities of lobstêrs, but we fetch our finest from Norway, where they are carefully preserved. In the opinion of naturalists, we might quadruple at least the produce of our own shores.

Prawns are "potted" on the south coasts, and shrimps are netted on most shallow shores; Boston, Lynn, and Leigh, near Southend, supply the choicest kinds. One eminent firm alone pays from £800 to £1,000 a-year carriage for this tea-table luxury. Just now the greatest quantities are obtained from the Briel, *viâ* Harwich—the *red* shrimps of the trade.

All round the coasts and the islands are spots noted for oyster culture. The finest variety is that of the Whitstable native. For some years past an increasing dearth in the supply, arising from climatic influences, or, as some think, from the destruction of the spat, or young oysters, through careless dredging, has made the choicer sorts an indulgence only within the reach of the rich, and has directed the attention of the Government to the subject. The oyster occurs chiefly in estuaries, the Thames, the Wash, and the Severn all having many great beds, as have likewise some of the estuaries of Ireland.

Great quantities of mussels aggregate on the rocks, attached by their byssus, and are used for food, mainly in the towns near their growth, while still more are used as bait. It is computed that from thirty to forty millions of mussels are gathered for this purpose annually in the Firth of Forth.

Enormous quantities of periwinkles are eaten where they can be easily obtained, principally by the humbler classes of society. Other mollusks, as the whelk, the scallop or pecten, and the cockle, are brought to market, but do not approach the importance of those described.

Whale Fishery.—To call the whale a fish, and its chase a fishery, is in either case a misnomer; yet industrially, there is a relation between the sea fisheries and the whale fisheries. The economic products derived from the *cetacea*, with which we may place as a natural alliance the *phocacea*, or seal tribe, and some large fishes, are oils, seal-skins, furs, balena or whalebone, spermaceti, ambergris, and ivory. It is Australia now that dispatches most vessels to the Southern Sea; Hull in England, and Peterhead in Scotland, are the chief ports identified with the whale-fishery of the northern seas.

CHAPTER VII.

EUROPEAN ANALOGUES OF GREAT BRITAIN.

Analogues or Counterparts of Great Britain—Analogues of Mining Industry—Of Animal Produce—Of Vegetable Produce—*Rationale* of our Corn Commerce.

Analogues or Counterparts of Great Britain.

Similar geological and climatic conditions yield analogous results in the flora and fauna of a country, and in the industrial pursuits of populations. Such analogues have already been shown between the United Kingdom and many parts of Europe. We exchange little raw produce with the people of the Continent, but we fetch and carry for our neighbours the crude materials of other soils and climes, and make our country the emporium of trade. Let us illustrate this by a few examples.

Analogues of our Mining Industry.

The departments of France, with scarce an exception, separately contribute to the mineral wealth of the empire, and their mines produce the largest amount of iron next to England; yet these mines are most productive in those provinces the geological structure of which ranges across the Channel, takes in the Norman islands, and is identical with the formations occupying the south-west of England and Wales. Again, the Ardennes are part of the rugged borders of Belgium, where iron mines are so numerous that, for its size, the country is richer than England. The region between the Sambre and the Meuse resembles the Staffordshire "Black Country:" Dudley and Wolverhampton find their counterparts in Liege and Namur. French coal is principally dispersed along the flanks of the rocks stretching from Brittany to Switzerland, which rocks, with the Alps, make the division between northern and southern Europe. Modern industry has caused the French coal-mines to be extensively worked, though the produce is not of the best quality. Belgium, within its narrow borders, possesses twice as many coal-mines as France. A great field, resting on mountain limestone, extends from Aix-la-Chapelle to Douai, forming basins, of which those of Charleroi and Liege are the most important. The coal-mines of Liege have been worked for seven centuries without making a serious impression upon the deposits.

Germany, and Prussia especially, possesses coal and iron ores of all qualities in abundance; but the distance between the mineral beds and the limestone quarries, with heavy transit charges, impede the development of iron industry.

Some of the rocky islands of Norway consist entirely of iron ore, and the finest ore produced is from Sweden. Again, however, carriage is so difficult as to render the metallic treasures of many districts in Scandinavia of no avail. Iron, copper, tin, and coal are dug in the Russian parts of this wide territory, the largest works being situated on Lake Onega.

Analogues of Animal Produce.

The sheep bred and reared in Saxony and Spain produce respectively a long silky fleece—the finest quality manufactured—and merino wool, a variety also of very high value, both of which enter into our manufactures. The alluvial plains of the Low Countries and Denmark are the counterparts of Ireland. Enormous imports of cattle, butter, cheese, poultry and eggs, from these parts, supplement our home supplies. During the few years that the foreign trade in cattle has been free, its development has been very rapid; the rate being 400 per cent. in ten years, and it is still increasing. The proximity of the Dutch to the sea has made them the fishermen, and their country the fish-market for nearly all Europe. Formerly they took most of the fish even off the British coast; and we still look to them for large supplies in answer to an indefinite demand for food at home.

Now it is self-evident that these countries do not require similar commodities from us in exchange, nor should we want their produce if we already possessed a surplus; but we send them manufactured goods, for the production of which they have not equal facilities; and we tranship to them the raw produce of our colonies and of foreign parts, which are wanted generally by the inhabitants of the civilised world.

Analogues of Vegetable produce have been already referred to. Southern Europe is eminently the region of oil and wine, with which the United Kingdom has but little in common. But adjoining to the north is the zone of cider and beer, of which our country forms a portion. The designation of the region implies the common growth of orchard fruits, hops, and barley; but it is equally the region of green vegetables and wheat. Indeed, in all parts of Europe, excepting polar Russia, corn-grains furnish the chief supplies of food—viz., barley and oats in the north; rye in the next lower latitudes; then wheat, which penetrates into the districts of rice and maize, the true tropical cereals.

Our pre-eminence in wealth enables us to add to our abundance by purchasing the surplus stores of food of the whole zone. We receive great quantities of early fruits, flowers, roots, and vegetables from France and Portugal. Wheat also comes to us from France, where it is the chief agricultural product, not excepting the vine.

The Sarmatian plain is the reserve granary of Europe: enough is here produced, even without manure, to feed the whole continent; but the means of transit are so bad, that much good corn is left to rot upon the ground, and a considerable part is two years in reaching a port for shipment.

The low lands of Prussia wave with great growths of wheat and other cereals, enabling its eminently agricultural people to provide for various unproductive provinces, and still to have an excess. Recent political alterations of territory make the Prussian corn exports at least as valuable as those of Russia.

Enormous as is the produce of the United Kingdom, it is far below the demand for food for man and beast. Such a state of things may be safe during peace and prosperity, but would be very dangerous in the event of an invasion. Almost every part of the cultivable earth sends grain to the British corn-market; freights of wheat arrive in England from the United States, from the ports of the Baltic and the Black Sea, from Spain, from the Danubian provinces, and from Turkey and Egypt—countries where an elastic growth expands or contracts in conformity with the demand. In Egypt wheat is a winter crop. Our imports are influenced by the changes of temperature, causing oscillations of value, and rendering the trade in corn very hazardous. If our home harvest promises abundance, our demand abroad is lessened, and farmers and merchants hasten to market to ensure sales; but if a fear of scarcity arise, they withhold their stores, in the view of higher prices; and the harvests of other countries compete, till prices again are equalised.

The insight which farmers and merchants have gained from experience ministers to human well-being; for high prices warn us of probable dearth, and enforce economy; while low prices add to our enjoyment by removing any dread of the future. If the harvest fails, we are prepared with stores laid up by speculators, who have acted as scouts, and have well earned the extra profit gained by their forethought. If the harvest turns out unexpectedly good, our caution has done us no harm. The judgment exercised by the merchants must be measured by their profits, by which, therefore, they may, in the absence of any monopoly, be measured as benefactors to society. Yet, in former years, to speculate in corn was a crime, and forestallers and regraters were punishable by law.

THE UNIVERSITIES.—X.

LONDON.—III.

In order to take the degree of Bachelor of Arts, two examinations must be undergone, in addition to that on matriculation. The first of these, called the Intermediate Examination in Arts, is held annually, commencing on the third Monday in July. All candidates, except such as have obtained a place in the Honours Division at the Matriculation Examination in the preceding January, must have passed that examination at least one academical year* previously, and must transmit to the Registrar of the University a certificate of good conduct, which will be received if signed by any person of character and position, at least one calendar month before the commencement of the examination. A fee of £5 must also be paid by each candidate on signing the University Register, of the time of which he will be informed by the Registrar on receipt of the certificate.

The examination is not a difficult one, and should not demand from those who have read conscientiously for the matriculation examination more than a year's additional study. The general rules prescribed for the guidance of students preparing for matriculation are equally applicable to the remainder of the university course; but during its progress individuality will be more likely to infringe upon them. The leading principles, however, should not be hastily abandoned; they have been tested by experience in many examinations, and have resulted in exceptional success. Concurrent study of the subjects of examination; systematic reading, regulated by judiciously constructed time tables; a discreet analysis of portions of the examination; and equal familiarity with all the subjects—to these the writer owes many academical distinctions, and the University Gold Medal on taking the highest degree, rather than to the possession of more than average ability or unusual opportunities for study.

The examination is, like that at matriculation, conducted by means of printed papers, the examiners seldom exercising the right reserved to them of putting *vivâ voce* questions. The whole of the subjects are continuations of those required at the previous examination, and are ranged under the four following divisions:—

I. Mathematics, including—
 α. Arithmetic.
 β. Algebra.
 γ. Geometry (including Mensuration and Conic Sections).
 δ. Plane Trigonometry.

II. Classics, including—(α) The Latin Language with Latin and Roman History, (β) Greek.

III. The English Language, Literature, and History.

IV. The French or the German Language.

Branch I.—In Branch I., Arithmetic and Algebra form the subjects of a paper, to which three hours are allotted. The student must be familiar with the ordinary rules of arithmetic, proportion, interest, vulgar and decimal fractions, and the extraction of the square root; in all of which the questions are merely somewhat more difficult than those set at the matriculation examination. This portion of the branch should, if it has been properly prepared previously, require but little additional study. In Algebra, the addition, subtraction, multiplication, and division of algebraical quantities; determination of common factors; algebraical proportion; algebraical fractions; arithmetical and geometrical progressions and simple equations, must not be entirely neglected; and considerable facility should be acquired in performing the operations they involve. In addition, ratio, proportion, and variation, permutations and combinations, simple and compound interest, present value, discount and annuities, quadratic equations, and the nature and use of logarithms, including the mode of finding the characteristic in every case, must be diligently studied; and problems in all of them should be repeatedly practised. The Lessons in Algebra in the POPULAR EDUCATOR contain the requisite materials for preparation, and will, with a slate, be amply adequate for the purpose; while an hour's work on alternate days during the year preceding the examination should be sufficient to enable the student to acquire the necessary proficiency. The names of the subjects are more appalling than the reality.

In Geometry, it will be desirable to study carefully the whole of the lessons and exercises on that subject in the POPULAR EDUCATOR, committing them to the understanding rather than the memory. The student must also be well prepared in the first six books of Euclid, of which four have been already learned, and in the eleventh book to the twenty-first proposition.

Conic Sections and Trigonometry are fresh, and not at first inviting or easy, fields. But they must be mastered, and should be attacked early. The elementary properties of the cylinder, cone, and sphere, treated geometrically, must be thoroughly understood. The mathematical treatment of the subject is limited to questions upon the equations to the straight line, the circle, parabola, hyperbola, and ellipse referred to rectangular co-ordinates; the equations to the tangent and normal of each of the conic sections; and simple propositions involving a knowledge of the characteristic properties of the curves. The equation to the ellipse will be found the most difficult, and, being frequently selected by the examiners, familiarity with it should be resolutely acquired. Candidates must possess such a knowledge of plane trigonometry as will enable them to solve all the cases of plane triangles, and must know the expression for the area of a triangle in terms of its sides.

II. *Classics.*—The Greek paper includes one subject from the works of Homer, Æschylus, Euripides, Sophocles, Herodotus, or Xenophon, to be selected two years previously by the Senate; and easy questions in Grammar. The Latin subjects are chosen from the Eclogues, two books of the Georgics, or two books of the Æneid, of Virgil; or from the Odes, Satires, or Epistles of Horace; a book of Livy, or the Annals or Histories of Tacitus; or one of the Orations or one book from any of the Philosophical or Rhetorical works of Cicero; the selection being made two years previously by the Senate. Information upon this point may be obtained either from the Registrar by letter, or from the University calendar. The examination papers contain passages of the selected authors to be construed into English, and short passages of English to be translated into Latin prose. The remarks made in reference to the corresponding portion of the Matriculation Examination are equally applicable to the first B.A.; but we again recommend a thorough study of Latin grammar, especial attention to the grammatical analysis of the selected texts, to the biography of the authors, and to the historical, geographical, and mythological allusions; and, in the preparation of the Latin Prose, to the Roman Calendar, the use of the subjunctive mood, and to Roman numerals and ordinals.

The History of Rome to the death of Augustus must also be carefully read.

III. *The English Language, Literature, and History.*—The English branch of the examination will involve considerable study. It will probably not be difficult to write out the substance of a paragraph previously read by the examiners, if the passage is delivered distinctly and as it should be written. Correct spelling and logical punctuation are the points requiring most attention. The requisite knowledge of the grammatical structure of the language and of composition will be more difficult to acquire, but may be attained by careful study of the Lessons in English in the POPULAR EDUCATOR. In addition, the examination in English includes special subjects defined from time to time, of which candidates may inform themselves by application to the Registrar, or by reference to the calendar. They consist usually of the history of some brief period of English Literature, which may be read from the Lessons in English Literature in the POPULAR EDUCATOR; of one of the plays of Shakespeare, which should be studied from a good annotated edition; of some other English classic, and of some other standard author.

The biographies of the authors, the names and dates of their works, the peculiarities of their styles, and the classes to which they belong, should be noticed; the text of the selected works should be carefully analysed; involved passages paraphrased; beauties or blemishes detected; archaic or obsolete forms and uses of words understood; historical and other allusions rendered capable of explanation; and familiar quotations and their context committed to memory.

The examination in English History is confined to a limited period, coinciding as a rule with the defined period of English Literature, the questions very frequently having reference to points of constitutional importance, and to legislation by charter and by statute.

IV. *French or German.*—The last branch of the examination consists of either the French or the German language, with one

* It may be as well to call attention to the fact that by the term "academical year" is ordinarily meant the period intervening between any examination and an examination of a higher grade in the following year; which period may be either *more* or *less* than a calendar year. Thus the interval between the *Intermediate* examinations in arts, science, and medicine, and the *Degree* examinations of the next year in those faculties respectively, is about sixteen months; whilst the interval between the B.A. Examination and the M.A. Examination of the next year, or between the B.Sc. Examination and the D.Sc. Examination of the next year, is less than eight months. Nevertheless, each of these intervals is counted as an "academical year."

of which candidates must be so familiar as to be able to translate French or German prose or poetry into English at sight; and to answer questions in Grammar.

Candidates must, in order to pass, satisfy the examiners in each of the above subjects of examination, those who are successful being arranged in two divisions, each in alphabetical order, and being entitled to a certificate signed by the registrar.

Those who have passed may, as we hope many of our readers will, present themselves for a further examination in honours in any one or more of the following subjects:—

1. *Mathematics*, including Algebra, Theory of Equations, Plane and Spherical Trigonometry, Pure and Co-ordinate Geometry of two dimensions, up to and including the properties of the conic sections; Differential Calculus, Integral Calculus, Statics, Kinetics, and Hydrostatics.

2. *Latin*, in which the examination consists of extracts for translation from the "Miles gloriosus" and "Menaechmei" of Plautus; the "Phormio" and "Hautontimorumenos" of Terence; the First and Second Books of Lucretius; Virgil; Horace; the Third, Fourth, Tenth, and Eleventh Satires of Juvenal; Cicero, "De Natura Deorum," "Orator," "Pro Publio Sestio," "Pro Plancio," "Ad Atticum," XIV. to XVI.; Lucan, I. and II.; the Fifth, Sixth, and Seventh Books of Livy; and Tacitus, Annals XI. to XVI.

The examination also includes the analysis of any of the selected subjects, original composition upon questions arising out of the selected classical authors, prose composition in Latin and English, and questions in grammar, history, and geography.

3. *English.*—The subjects of examination in this branch are defined from time to time; the papers include original composition upon questions arising out of the authors selected.

4. *French.* 5. *German.* Some proficiency in conversation is essential to first-class honours in French and German, and the papers usually contain questions upon a limited portion of the history of the literature of France and Germany.

The examination for honours in Mathematics and Latin continue during three days, for those in English during two days, and for honours in French and German, during one day. Successful candidates are arranged in three classes, according to their proficiency.

HYDROSTATICS.—II.

PRINCIPLE OF EQUALITY OF PRESSURE—HYDROSTATIC PRESS.

THE apparatus known as the hydrostatic bellows, and represented in Fig. 1, is an interesting illustration of the principle of equality of pressure. Two circular boards, A B, are connected together by flexible sides, so as to form a circular pair of bellows. A long tube opened out at the upper end into the shape of a funnel is made to open into this. The whole arrangement is then partly filled with water, not, however, so much so as to fully expand the bellows. If now several heavy weights be placed upon the upper board, and water be poured down the tube, the weights will be raised. A man may even stand on the board, and, if the tube be long enough, be raised by pouring in a jug of water. Let us suppose that the area of the tube be half a square inch, and that of the board 1 foot, and that a pound of water be poured into the tube. The pressure on the bottom of the tube is, of course, 1 pound; and a similar pressure is exerted on every half a square inch in the inner surface of the bellows. Now the surface of the board is 144 square inches, the pressure produced on it by the pound of water is therefore 288 pounds. On account of the great apparent gain this is sometimes called the Hydrostatic Paradox, but on consideration it is seen to be no more paradoxical than the gain effected by any other mechanical power; as, always, what is gained in power is lost in time.

In a similar way, if a cask be filled with liquid, and a long tube be inserted tightly into the top and filled also, the weight of water in this tube, though trifling in itself, will exert such a pressure as to burst open the cask. If the diameter of the pipe be rather over one-third of an inch, its area will be about one-tenth of a square inch, and 2 pounds of water poured into it will fill it to a height of about 46 feet. This will cause a pressure of 20 pounds per square inch; and as the surface may have an area of about 2,000 square inches, the total pressure produced by the 2 pounds of water will be about 40,000 pounds, a pressure sufficient to burst almost any cask. For this reason, when the parts of a town lie at different levels, and the water is supplied from a reservoir situated in an elevated part, the pipes have to be made very strong, as they have to sustain the pressure produced by a column of water as high as the most elevated part is above them.

Perhaps the most important application of this principle is seen in the hydrostatic press, an instrument which is largely used in the manufactures where a very powerful pressure is required. The general principle on which it acts is simply this: by means of a piston or plunger, of small diameter, water is forced into a cylinder in which a large piston works. The latter is forced out with a pressure as much greater than that exerted on the plunger, as its area is larger. If the large piston have 20 times the diameter of the small one its area will be 400 times as large; therefore a pressure of 1 pound will exert a force of 400.

Fig. 3.

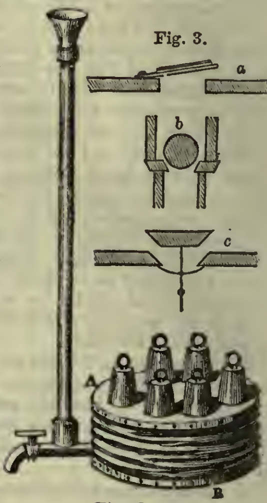


Fig. 1.

The annexed figure (Fig. 2) will give a good idea of the general construction of the machine. It varies, however, greatly in shape and minor details according to the power required or the special purpose to which it is to be applied. A B represents a lever hinged at B to an upright, and working a solid plunger, D, which is so arranged as only to move in a vertical direction. This plunger, which is of small dimensions, works water-tight in a small cylinder, C. When it is raised by means of the handle, A, water rises from the reservoir, G, into the cylinder through the valve, E, which then closes and prevents the water passing back again. The piston is now forced down, and drives the water through the pipe into the large cylinder, L, and thus communicates the pressure it receives from D. A second valve is placed at F, so as to keep the water from flowing back when D is raised again. The making of the large cylinder, L, requires the greatest care, on account of the immense pressure it has to withstand. When the *Great Eastern* steamer had to be launched, some presses were used in which the cylinder was made of iron 7 or 8 inches thick, and yet they were split open by the immense strain exerted on them. The piston, K, is made of as large dimensions as practicable, as on this mainly depends the power of the machine. It works water-tight through a collar at I, and it was here that the greatest practical difficulty was found, for the water oozed through, and thus the power of the machine was greatly diminished. The difficulty was at last met by making a collar of stout leather, and so that its section was of the shape of the letter U inverted. This ring is placed in a groove prepared for it, and it is easily seen that when the water presses on it, it tends to open the bend, and thus causes the collar to press more firmly against the piston. The books or other articles to be compressed are laid upon the flattened top of the piston, and pressed against a strong iron framework constructed for the purpose.

The advantage gained by the machine depends upon two things: first, the comparative sizes of the pistons; and second, the proportion between the distances A B and H B. Suppose, for example, that the diameter of K is 15 inches, and that of D half an inch; also that the length of A B is 3 feet and B H 2 inches, what power will a man pressing at A with a force of 50 pounds exert? Since the diameters are in the proportion of 1 to 30, their areas are in the proportion of 1 to 900, and therefore whatever pressure is exerted on D, K sustains 900 times the amount. But A B is a simple lever of the second kind, and the gain produced by its use is $\frac{36}{2}$, or 18. The pressure of 50 pounds at A produces, therefore, one of 900 on D; and thus the total force with which the books at M are compressed is $900 \times 900 = 810{,}000$ pounds, or upwards of 360 tons. As we can increase the length of the lever or diminish the diameter of the small piston greatly, the only practical limit to the power of the machine is the strength of the large cylinder. An additional tap, not shown in the figure, is arranged so that the water can be allowed to escape from the cylinder when it is desired to remove the pressure.

This machine is constantly used by manufacturers for many different purposes. Oil is expressed from seeds by it, goods are compressed for packing, and many other operations performed. The most remarkable application of it, however, was in the building of the tubular bridge over the Menai Straits.

The longest of the tubes of which this is constructed is 472 feet long, and the inside dimensions are about 14 feet wide, and 25 feet high. Each weighs about 1,200 tons: they were completely finished, and then conveyed on pontoons to the spot, and raised into their place by an hydraulic press, which was the largest ever constructed. Its cylinder was 22 inches internal diameter, 10 inches thick, and 9 feet long, and weighed upwards of 15 tons. The cross pieces to which the lifting chains were attached weighed 13 tons.

The lifting force this press was capable of exerting was estimated at over 2,000 tons. It was erected at the top of the

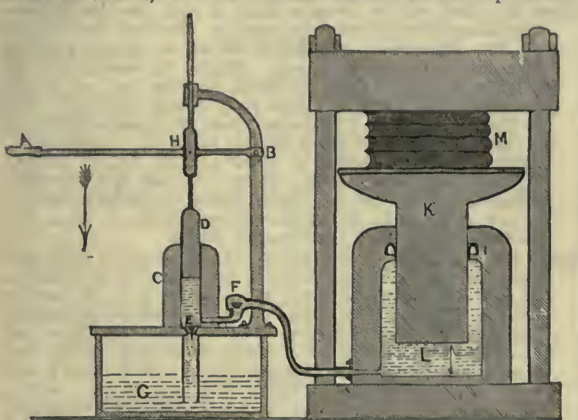


Fig. 2.

towers, and chains were fastened round the tube and attached to the cross head of the ram. At each lift the tube was raised about 6 feet; the space underneath was then filled in with masonry, and the chain shortened for another lift; and in this way each tube was raised to its elevation of 101 feet above high-water mark.

As valves are of frequent employment in hydraulic machines, it will be well just to give an explanation of their construction. The object to be attained by their use is to allow water to flow freely along a pipe in one direction, but to prevent it passing in the other. The simplest means of accomplishing this is by a common clack valve (Fig. 3, *a*). This consists of a plate of metal, hinged at one edge, and closing over the opening. A piece of leather larger than the plate is usually placed over the upper surface, and the weight of the water presses it against the other surface, thus closing the valve more tightly. Another kind of valve is shown at *b*, and consists of a ball which rises by the pressure of the water, but falls by its own weight, and closes the pipe when the water tries to pass back. The other variety in common use is the spindle valve shown at *c*. A conical piece of metal is made to fit into a setting, and confined by a guide rod so as to rise vertically. The best inclination for the sides of the valve is an angle of about 45°, as then there is little danger of its becoming stuck in its setting, and on the other hand it does not waste much room.

LESSONS IN BOOKKEEPING.—XXXI.

MEMORANDA OF THE TRANSACTIONS OF MESSRS. EVANS AND HAYWARD, TEA, COFFEE, AND SUGAR MERCHANTS (*concluded*).

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Feb. 22.—Drew Bills:—No. 27, on Wardlaw and Co., due @ 1 mo.; No. 28, on Mears and Fry, due @ 1 mo. Sold to Jenkins Bros., *Coffee*: Rio, 10 Robins = 15 cwt., @ 46s.; Mocha, garbled, 10 Robins = 15 cwt., @ 100s. Sold to Osmond and Co., *Coffee*: Jamaica, fine, 2 tierces = 14 cwt., @ 112s. 3d. Sold to L. F. Tyler and Son, *Sugar*: Brazil, 1 hhd. = 15 cwt., @ 27s. 9d.; Bengal, 1 hhd. = 18 cwt., @ 45s. 6d.

Feb. 23.—Received Cash from N. Reynolds. Received Cash for Bills Nos. 10 and 11. Sold to Freeman and Dale, *Tea*: Congou, good, 10 chests = 800 lbs., @ 1s. 6½d.; Hyson, 5 chests = 350 lbs., @ 2s. 2d.; *Coffee*: Jamaica, good, 1 tierce = 7 cwt., @ 86s.; *Sugar*: W. India, 1 tierce = 8 cwt., @ 40s. Effected by W. Lloyd, on account of H. Phillips, Barbadoes, an Insurance on £945, on 30 hhds. of Sugar, valued at £31 10s. per hhd., from Barbadoes to London, per the Comet, at 2½ % premium; Policy, £3 4s. 6d.; our Commission on do., ½ per cent.

Feb. 24.—Received Cash from Dean and Son and G. Finlan. Bought per Vaughan and Co., £1,000 Great Indian Peninsular Railway Stock, @ 105¾; Stamp and Fees, 10s.; Commission, ¼ per cent. Sold to Lumley and Co., *Tea*: Congou, finest, 10 chests = 800 lbs., @ 2s. 5d.; Souchong, 5 chests = 400 lbs., @ 2s. 4d. Drew Bills:—No. 29, on Freeman and Dale, due @ 1 mo.; No. 30, on Lumley and Co., due @ 1 mo. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

Feb. 26.—Paid Bayley and Co. Received Cash from F. Nicholls, and Cash for Bill No. 25. Paid Vaughan and Co. Sold to Owen and Co., *Tea*: Gunpowder, 20 chests = 1,600 lbs., @ 2s. 7½d. (Less 2½ % for Cash in a fortnight).

Feb. 27.—Received Cash for Bills Nos. 12 and 20. Sold to E. Davey, *Tea*: Congou, good, 5 chests = 400 lbs., @ 1s. 7d.; Hyson, 3 chests = 210 lbs., @ 2s. 1½d.; *Coffee*: Jamaica, good, 1 tierce = 7 cwt., @ 86s. Sold to Mason and Co., *Coffee*: Mocha, ungarbled, 10 bales = 20 cwt., @ 80s. 6d. Sold to Thompson and Co., *Coffee*: Costa Rica, 14 bags = 21 cwt., @ 67s.; Rio, 10 Robins = 15 cwt., @ 45s. 6d.; *Sugar*: Brazil, 1 hhd. = 15 cwt. @ 28s. 6d. Sold to Pickford and Green, *Sugar*: Bengal, 1 hhd. = 18 cwt., @ 45s.; W. India, 2 tierces = 16 cwt., @ 40s. Sold to H. Paton, *Tea*: Congou, finest, 10 chests = 800 lbs., @ 2s. 5½d.; Souchong, 5 chests = 400 lbs., @ 2s. 4d. Sold to Fox and Co., *Coffee*: Mocha, garbled, 10 bales = 15 cwt., @ 99s. 3d.; Jamaica, fine, 1 tierce = 7 cwt., @ 110s. 6d.

Feb. 28.—Received Cash from Duncan and Forbes; Bills:—No. 31, from Mason and Co., due 9 March; No. 32, from Pickford and Green, due 14 March; No. 33, from H. Paton, due 7 March. Drew Bills: No. 34, on Thompson and Co., due @ 1 mo.; No. 35, on Fox and Co., due @ 1 mo.

March 1.—Received Cash for Bill No. 13. Paid Freight of Coffee per Neptune, £67 3s. 4d. Paid Duties and Fees on do., £15 9s. 6d. Paid for Dock Dues, etc., on do., £9 7s. 2d. Paid Salaries, as before, £60.

March 2.—Sold to Marchmont and Co., *Tea*: Congou, good, 10 chests = 800 lbs., @ 1s. 6½d.; Souchong, 10 chests = 800 lbs., @ 2s. 3½d.; Hyson, 5 chests = 350 lbs., @ 2s. 2d.; Gunpowder, 10 chests = 800 lbs., @ 2s. 7d. Sold to F. Nicholls, *Tea*: Congou, finest, 10 chests = 800 lbs., @ 2s. 5½d.; Gunpowder, 5 chests = 400 lbs., @ 2s. 7½d. Sold to Duncan and Forbes, *Coffee*: Jamaica, good, 2 tierces = 14 cwt., @ 86s.; Mocha, ungarbled, 5 bales = 10 cwt., @ 80s. Sold to J. Tilley, *Coffee*: Jamaica, fine, 2 tierces = 14 cwt., @ 110s.; *Sugar*: W. India, 1 tierce = 8 cwt., @ 30s. 3d.

March 3.—Received Cash on acc. from Marchmont and Co., £98 4s. 6d.; Bill No. 36 from do., due 17 March, for balance of acc. Received Cash from F. Nicholls, Atkins and Fry, and L. F. Tyler and Son. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

March 5.—Received Cash from Jenkins Bros. and Osmond and Co. Received Cash for Bills Nos. 17 and 26. Sold to Clayton and Co., *Tea*: Congou, good, 5 chests = 400 lbs., @ 1s. 6½d.; *Sugar*: W. India, 2 tierces = 16 cwt., @ 39s. 6d. Sold to Owen and Co., *Tea*: Congou, finest, 5 chests = 400 lbs., @ 2s. 5½d.; Souchong, 5 chests = 400 lbs., @ 2s. 4d.; Hyson, 5 chests = 350 lbs., @ 2s. 1½d.; Gunpowder, 10 chests = 800 lbs., @ 2s. 8d. (Less 2½ % for cash in a fortnight). Bought of Durrant and Co., *Tea*: Congou, good, 50 chests = 4,000 lbs., @ 1s. 5½d.; Congou, finest, 50 chests = 4,000 lbs., @ 2s. 3½d.; Souchong, 50 chests = 4,000 lbs., @ 2s. 2d.; Hyson, 30 chests = 2,100 lbs., @ 1s. 11d. (Less 2½ %). Bought of J. Allport, *Tea*: Gunpowder, 75 chests = 6,000 lbs., @ 2s. 5d. (Less 2½ %). Bought of Bayley and Co., *Coffee*: Mocha, ungarbled, 30 bales = 60 cwt., @ 71s. 3d.; Costa Rica, 30 bales = 45 cwt., @ 60s. Bought of J. Gilbertson, *Coffee*: Rio, 40 Robins = 60 cwt., @ 36s. 6d.; Mocha, garbled, 30 bales = 45 cwt., @ 90s. (Less 2½ %).

March 6.—Paid Bills Nos. 2 and 4. Received Cash for Bill No. 18; and Cash from E. Davey. Accepted Bills: Nos. 21, 22, and 23, drawn by Durrant and Co., due @ 1, 2, and 3 months for one-third of amount of acc. each; No. 24, drawn by J. Allport, due @ 4 months; No. 25, drawn by Bayley and Co., due @ 3 mos.; No. 26, drawn by J. Gilbertson, due @ 2 mos.

March 7.—Received Cash for Bill No. 33. Sold to H. Meredith, *Tea*: Congou, good, 5 chests = 400 lbs., @ 1s. 7d.; Hyson, 3 chests = 210 lbs., @ 2s. 1d. Sold to Atkins and Fry, *Coffee*: Jamaica, good, 2 tierces = 14 cwt., @ 85s. 6d.; Costa Rica, 10 bags = 15 cwt., @ 68s. Sold to Fox and Co., *Coffee*: Jamaica, fine, 3 tierces = 21 cwt., @ 110s. 3d.; Mocha, garbled, 10 bales = 15 cwt., @ 97s. 3d. Sold to C. Maunder, *Sugar*: W. India, 2 tierces = 16 cwt., @

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40s. 3d.; Brazil, 1 hhd. = 15 cwt. @ 30s. 3d.; Bengal, 1 hhd. = 18 cwt., @ 44s. (Less 2½ % for Cash). Received Cash same time.

March 8.—Received Bills: No. 37, from Atkins and Fry, due 21 Mar.; No. 38, from Fox and Co., due 28 Mar.

March 9.—Received Cash for Bill No. 31. Sold per E. Hodgson, *Coffee*, per Neptune, 30 tierces = 210 cwt., @ 120s. His brokerage on do., at 1¼ %. Sold to A. Ledbrooke, *Tea*: Congou, finest, 10 chests = 800 lbs., @ 2s. 5½d.; Souchong, 10 chests = 800 lbs., @ 2s. 3½d.; *Coffee*: Mocha, ungarbled, 10 bales = 20 cwt., @ 80s. Sold to Winter and Co., *Coffee*: Rio, 10 Robins = 15 cwt., @ 45s. 3d.; *Tea*: Gunpowder, 10 chests = 800 lbs., @ 2s. 6½d.

March 10.—Drew Bill No. 39 on A. Ledbrooke, due @ 1 mo. Drew out of Cash: Petty Cash, £10; J. Hayward, Private acc., £20; J. Evans, Private acc., £20. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

March 12.—Received Cash from Owen and Co. Received Cash for Bill No. 21. Paid Bill No. 6. Sold to L. F. Tyler and Son, *Tea*: Congou, good, 20 chests = 1,600 lbs., @ 1s. 6½d. Sold to Smith and Brown, *Tea*: Hyson, 5 chests = 350 lbs., @ 2s. 0½d.; *Coffee*: Jamaica, good, 2 tierces = 14 cwt., @ 85s. 9d.; Costa Rica, 10 bags = 15 cwt., @ 67s. 10d. Sold to Osmond and Co., *Coffee*: Mocha, garbled, 10 bales = 15 cwt., @ 97s. 6d.; Jamaica, fine, 1 tierce = 7 cwt., @ 110s. 6d. Sold to North and Co., *Sugar*: W. India, 1 tierce = 8 cwt., @ 40s.; Brazil, 1 hhd. = 15 cwt., @ 30s.; Bengal, 1 hhd. = 18 cwt., @ 43s. 9d.

March 13.—Drew Bills: No. 40, on Osmond and Co., due @ 1 mo.; No. 41, on North and Co., due @ 1 mo. Sold to Hunter and Co., *Tea*: Congou, finest, 10 chests = 800 lbs., @ 2s. 5d.; Souchong, 10 chests = 800 lbs., @ 2s. 4d.; Gunpowder, 10 chests = 800 lbs., @ 2s. 6½d. Received Cash for Bill No. 4.

March 14.—Received from Hunter and Co., £100 on acc. Drew Bill No. 42 on Hunter and Co., due @ 1 mo., for balance of acc. Received Cash from Meredith and Co. Received Cash for Bill No. 32.

March 15.—Sold to Edwards and Co., *Coffee*: Mocha, ungarbled, 10 bales = 20 cwt., @ 79s.; Rio, 10 Robins = 15 cwt., @ 44s. 9d.; Jamaica, fine, 1 tierce = 7 cwt., @ 110s. 9d. Bought of Wingram and Co., *Sugar*: W. India, 13 tierces = 104 cwt., @ 31s. 6d.; Brazil, 7 hhds. = 105 cwt., @ 19s. 9d. (Less 2½ % for Cash). Bought of Reed and Co., *Sugar*: Bengal, 7 hhds. = 126 cwt., @ 34s. 6d. (Less 2½ % for Cash in a fortnight). Bought of H. Bateman and Son, *Coffee*: Jamaica, fine, 10 tierces = 70 cwt., @ 102s. (Less 2½ %).

March 16.—Paid Wingram and Co. Accepted Bill No. 27, drawn by H. Bateman and Son, due @ 2 mos. Received Cash for Bill No. 23. Received Cash from Winter and Co. Sold to Kebble and Williams, *Coffee*: Jamaica, good, 1 tierce = 7 cwt., @ 86s.; Costa Rica, 10 bags = 15 cwt., @ 67s. 6d.; Mocha, garbled, 10 bales = 15 cwt., @ 97s. 3d.

March 17.—Drew Bill No. 43 on Kebble and Williams, due @ 1 mo. Received Cash for Bills Nos. 24 and 36. Received Cash from Duncan and Forbes. Sold to Dean and Son, *Tea*: Congou, good, 20 chests = 1,600 lbs., @ 1s. 6½d.; Congou, finest, 5 chests = 400 lbs., @ 2s. 5d.; Hyson, 5 chests = 350 lbs., @ 2s. 1d. Sold to Allatson and Co., *Tea*: Gunpowder, 20 chests = 1,600 lbs., @ 2s. 6d.; Souchong, 10 chests = 800 lbs., @ 2s. 3d. Sold to Mears and Fry, *Sugar*: W. India, 2 tierces = 16 cwt., @ 39s. 3d.; Brazil, 1 hhd. = 15 cwt., @ 28s.; Bengal, 1 hhd. = 18 cwt., @ 43s. 6d. Paid Bill No. 9. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

March 19.—Received Bills: No. 44, from Dean and Son, due 26 Mar.; No. 45, from Mears and Fry, due 28 Mar. Drew Bill No. 46 on Allatson and Co., due @ 1 mo. Received Cash from Clayton and Co. and Owen and Co. Sold to Tucker and Co., *Tea*: Gunpowder, 10 chests = 800 lbs., @ 2s. 6½d. Received Cash same time. Sold to H. Rossiter, *Coffee*: Mocha, ungarbled, 5 bales = 10 cwt., @ 79s. 3d.; Rio, 10 Robins = 15 cwt., @ 44s. 6d.; Jamaica, fine, 2 tierces = 14 cwt., @ 110s. Bought of J. Vavasseur, *Tea*: Congou, good, 50 chests = 4,000 lbs., @ 1s. 5d. Bought of J. Gilbertson, *Coffee*: Jamaica, good, 10 tierces = 70 cwt., @ 78s.; Costa Rica, 40 bags = 60 cwt., @ 60s.; Mocha, garbled, 40 bales = 60 cwt., @ 90s. (Less 2½ % for Cash in a month).

March 20.—Accepted Bill No. 28, drawn by J. Vavasseur, due at 2 mos. Paid J. Gilbertson and H. Bateman and Son their invoices of 20 Feb. Sold to F. Notley, *Tea*: Congou, good, 10 chests = 800 lbs., @ 1s. 6½d.; Congou, finest, 5 chests = 400 lbs., @ 2s. 5d. Sold to Freeman and Dale, *Coffee*: Jamaica, good, 2 tierces = 14 cwt., @ 86s.; Costa Rica, 10 bags = 15 cwt., @ 67s.; Mocha, garbled, 10 bales = 15 cwt., @ 97s. Sold to Mitchins and Co., *Sugar*: W. India, 2 tierces = 16 cwt., @ 39s.; Brazil, 1 hhd. = 15 cwt., @ 28s. 3d.; Bengal, 1 hhd. = 18 cwt., @ 43s.

March 21.—Drew Bills: No. 47 on Freeman and Dale, due @ 1 mo.; No. 48, on Mitchins and Co., due @ 1 mo. Received Cash for Bill No. 37, and Cash from J. Tilley. Sold to Fox and Co., *Tea*: Souchong, 10 chests = 800 lbs., @ 2s. 3d.; Hyson, 10 chests = 700 lbs., @ 2s. Sold to A. Ledbrooke, *Tea*: Gunpowder, 20 chests = 1,600 lbs., @ 2s. 6d. Sold to G. Kennett, *Coffee*: Mocha, ungarbled, 5 bales = 10 cwt., @ 79s.; Rio, 10 Robins = 15 cwt., @ 45s.; Jamaica, fine, 2 tierces = 14 cwt., @ 110s. 3d.

March 22.—Drew Bills: No. 49, on A. Ledbrooke, due @ 1 mo.; No. 50, on G. Kennett, due @ 1 mo. Paid Freight of Sugar, per the Comet, £81 3s. 2d.; Paid Duties and Fees on do., £283 10s. Paid Dock Dues, etc., on do., £25 17s. 3d.

March 23.—Received Cash from E. Hodgson for Coffee sold at Public Auction, March 9, less his brokerage on do. Received Cash from L. F. Tyler and Son. Sold to H. Paton, *Tea*: Congou, good, 20 chests = 1,600 lbs., @ 1s. 6d.; Gunpowder, 5 chests = 400 lbs., @ 2s. 6d. Sold to Lockley and Fife, *Coffee*: Jamaica, good, 2 tierces = 14 cwt., @ 85s. 6d.; Costa Rica, 10 bags = 15 cwt., @ 66s. 6d.; Mocha, garbled, 10 bales = 15 cwt., @ 98s. Sold to Atkins and Fry, *Sugar*: W. India, 2 tierces = 16 cwt., @ 39s.; Brazil, 1 hhd. = 15 cwt., @ 28s. 3d.; Bengal, 1 hhd. = 18 cwt., @ 43s. 3d. (Less 1½ % for Cash).

March 24.—Received Cash from Atkins and Fry. Drew Bill No. 51 on H. Paton, due @ 1 mo. Received Cash for Bills Nos. 27 and 28. Drew out of Cash: Petty Cash, £10; J. Evans, Private acc., £20; J. Hayward, Private acc., £20. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each.

March 26.—Made up the Account Sales of *Coffee* per the Neptune. Our Commission 2½ % on gross amount. Received Cash for Bill No. 44. Paid Gibson and Milner £50 for one quarter's rent of Counting-house and Warehouse. Effected an Insurance in the Sun Fire Insurance Office on Stock, Fixtures, etc., on £4,000; Premium, £12; Duty, £3. One year, to Lady-day, 188 . Sold to Wheatley and Co., *Tea*: Congou, finest, 10 chests = 800 lbs., @ 2s. 4½d.; Hyson, 7 chests = 490 lbs., @ 2s. 1d. Bought of J. Allport, *Tea*: Gunpowder, 30 chests = 2,400 lbs., @ 2s. 5d.; Hyson, 15 chests = 1,050 lbs., @ 1s. 11d. (Less 2½ % for Cash). Bought of Bayley and Co., *Coffee*: Mocha, ungarbled, 20 bales = 40 cwt., @ 71s.; Rio, 20 Robins = 30 cwt., @ 36s. 3d. (Less 2½ % for Cash). Paid Rates and Taxes, £6 13s. 4d.

March 27.—Paid J. Allport and Bayley and Co. Received Cash from Wheatley and Co., and H. Rossiter. Received Cash for Bills Nos. 29 and 30. Sold to E. Davey, *Tea*: Congou, good, 10 chests = 800 lbs., @ 1s. 6d.; Souchong, 10 chests = 800 lbs., @ 2s. 3d.; Gunpowder, 5 chests = 400 lbs., @ 2s. 6d. Sold to Gilfillan and Co., *Coffee*: Jamaica, good, 2 tierces = 14 cwt., @ 85s. 9d.; Mocha, ungarbled, 5 bales = 10 cwt., @ 79s.; Costa Rica, 5 bags = 7½ cwt., @ 67s.; Rio, 5 Robins = 7½ cwt., @ 45s. Sold to Rabbit and Son, *Coffee*: Mocha, garbled, 5 bales = 7½ cwt., @ 98s.; Jamaica, fine, 2 tierces = 14 cwt., @ 110s. 6d. Received Cash same time. Sold to Day and Co., *Sugar*: W. India, 2 tierces = 16 cwt., @ 39s.; Brazil, 1 hhd = 15 cwt., @ 28s.; Bengal, 1 hhd. = 18 cwt., @ 43s.

March 28.—Drew Bills: No. 52, on E. Davey, due @ 1 mo.; No. 53, on Gilfillan and Co., due @ 1 mo. Received Cash for Bills Nos. 38 and 45, and Cash from Lockley and Fife. Sold to Lumley and Co., *Tea*: Congou, finest, 5 chests = 400 lbs., @ 2s. 4½d.; Hyson, 10 chests = 700 lbs., @ 2s.; Gunpowder, 10 chests = 800 lbs., @ 2s. 6d.

March 29.—Received Cash from F. Notley. Paid Reed and Co. Drew Bill No. 54 on Lumley and Co., due @ 1 mo. Sold to Wardlaw and Co., *Tea*: Congou, good, 10 chests = 800 lbs., @ 1s. 6½d.; Gunpowder, 5 chests = 400 lbs., @ 2s. 6½d. Bought of J. Vavasseur, *Tea*: Souchong, 25 chests = 2,000 lbs., @ 2s. 2d. (Less 2½ %).

March 30.—Received Cash from Day and Co. Sold to Edwards and Co., *Coffee*: Jamaica, good, 2 tierces = 14 cwt., @ 85s.; Mocha, ungarbled, 5 bales = 10 cwt., @ 79s. 3d.; Costa Rica, 5 bags = 7½ cwt., @ 66s. 6d. Sold to Thompson and Co., *Coffee*: Rio, 5 Robins = 7½ cwt., @ 45s.; Mocha, garbled, 5 bales = 7½ cwt., @ 97s. 6d.; Jamaica, fine, 2 tierces = 14 cwt., @ 110s. 3d. Received Cash from Smith and Brown.

March 31.—Received Cash from Wardlaw and Co. and Fox and Co., and Cash for Bills Nos. 34 and 35. Sold to Pickford and Greene, *Sugar*: W. India, 2 tierces = 16 cwt., @ 39s. Sold to L. F. Tyler and Son, *Sugar*: Brazil, 1 hhd. = 15 cwt., @ 28s. Sold to Clayton and Co., *Sugar*: Bengal, 1 hhd. = 18 cwt., @ 43s. Paid Wages, £5. W. Collins and E. George, Travelling Expenses, £7 7s. each, and Salaries, £60. Made up acc. of Petty Cash for Quarter ending 31 March, £46 4s. 7d. Received in Cash from City Bank Interest on our deposits. Valued Stock at Prime Cost and balanced books.

LESSONS IN FRENCH.—LXIII.

§ 56.—Remarks.

There is only one conjugation for passive verbs. It is formed of the auxiliary être in all its tenses, simple and compound, and the participle past of the active verb which we wish to conjugate in the passive voice. The past participle used with être agrees in gender and number with the subject. See § 44, (4).

*

§ 57.—Conjugation of Reflective Verbs [§ 44, (6).]

MODEL VERB.

SE FLATTER, *TO FLATTER ONE'S SELF.*

Infinitive Mood.

PRESENT.	PAST.
Se flatter, *to flatter one's self.*	S'être flatté, *to have flattered one's self.*

Participles.

PRESENT.	COMPOUND.
Se flattant, *flattering one's self.*	S'étant flatté, *having flattered one's self.*

Indicative Mood.

PRESENT.

Je me flatte,	*I flatter myself.*
Tu te flattes,	*thou flatterest thyself.*
Il se flatte,	*he flatters himself.*
On se flatte,	*one flatters himself* or *one's self.*
Nous nous flattons,	*we flatter ourselves.*
Vous vous flattez,	*you flatter yourselves.*
Ils se flattent,	*they flatter themselves.*

IMPERFECT.

Je me flattais,	*I was flattering* or *used to flatter myself.*
Tu te flattais,	*thou wast flattering thyself.*
Il se flattait,	*he was flattering himself.*
On se flattait,	*one was flattering one's self.*
Nous nous flattions,	*we were flattering ourselves.*
Vous vous flattiez,	*you were flattering yourselves.*
Ils se flattaient,	*they were flattering themselves.*

PAST DEFINITE.

Je me flattai,	*I flattered* or *did flatter myself.*
Tu te flattas,	*thou didst flatter thyself.*
Il se flatta,	*he flattered himself.*
On se flatta,	*one flattered one's self.*
Nous nous flattâmes,	*we flattered ourselves.*
Vous vous flattâtes,	*you flattered yourselves.*
Ils se flattèrent,	*they flattered themselves.*

PAST INDEFINITE.

Je me suis flatté, *m.* flattée, *f.*	*I have flattered myself.*
Tu t'es flatté *or* flattée,	*thou hast flattered thyself.*
Il s'est flatté,	*he has flattered himself.*
Elle s'est flattée,	*she has flattered herself.*
On s'est flatté,	*one has flattered one's self.*
Nous nous sommes flattés *or* flattées,	*we have flattered ourselves.*
Vous vous êtes flattés *or* flattées,	*you have flattered yourselves.*
Ils se sont flattés, *m.*	*they have flattered themselves.*
Elles se sont flattées, *f.*	*they have flattered themselves.*

PLUPERFECT.

Je m'étais flatté, *m.* flattée, *f.*	*I had flattered myself.*
Tu t'étais flatté *or* flattée,	*thou hadst flattered thyself.*
Il s'était flatté,	*he had flattered himself.*
Elle s'était flattée,	*she had flattered herself.*
On s'était flatté,	*one had flattered one's self.*
Nous nous étions flattés *or* flattées,	*we had flattered ourselves.*
Vous vous étiez flattés *or* flattées,	*you had flattered yourselves.*
Ils s'étaient flattés, *m.*	*they had flattered themselves.*
Elles s'étaient flattées, *f.*	*they had flattered themselves.*

PAST ANTERIOR.

Je me fus flatté, *m.* flattée, *f.*	*I had flattered myself.*
Tu te fus flatté *or* flattée,	*thou hadst flattered thyself.*
Il se fut flatté,	*he had flattered himself.*
Elle se fut flattée,	*she had flattered herself.*
On se fut flatté,	*one had flattered one's self.*
Nous nous fûmes flattés *or* flattées,	*we had flattered ourselves.*
Vous vous fûtes flattés *or* flattées,	*you had flattered yourselves.*
Ils se furent flattés, *m.*	*they had flattered themselves.*
Elles se furent flattées, *f.*	*they had flattered themselves.*

FUTURE.

Je me flatterai,	*I shall flatter myself.*
Tu te flatteras,	*thou wilt flatter thyself.*
Il se flattera,	*he will flatter himself.*
On se flattera,	*one will flatter one's self.*
Nous nous flatterons,	*we shall flatter ourselves.*
Vous vous flatterez,	*you will flatter yourselves.*
Ils se flatteront,	*they will flatter themselves.*

FUTURE ANTERIOR.

Je me serai flatté, *m.* flattée, *f.*	*I shall have flattered myself.*
Tu te seras flatté *or* flattée,	*thou wilt have flattered thyself.*
Il se sera flatté,	*he will have flattered himself.*
Elle se sera flattée,	*she will have flattered herself.*
On se sera flatté,	*one will have flattered one's self.*
Nous nous serons flattés *or* flattées,	*we shall have flattered ourselves.*
Vous vous serez flattés *or* flattées,	*you will have flattered yourselves.*
Ils se seront flattés, *m.*	*they will have flattered themselves.*
Elles se seront flattées, *f.*	*they will have flattered themselves.*

Conditional Mood.

PRESENT.

Je me flatterais,	*I should flatter myself.*
Tu te flatterais,	*thou wouldst flatter thyself.*
Il se flatterait,	*he would flatter himself.*
On se flatterait,	*one would flatter one's self.*
Nous nous flatterions,	*we should flatter ourselves.*
Vous vous flatteriez,	*you would flatter yourselves.*
Ils se flatteraient,	*they would flatter themselves.*

PAST.

Je me serais flatté, *m.* flattée, *f.*	*I should have flattered myself.*
Tu te serais flatté *or* flattée,	*thou wouldst have flattered thyself.*
Il se serait flatté,	*he would have flattered himself.*
Elle se serait flattée,	*she would have flattered herself.*
On se serait flatté,	*one would have flattered one's self.*
Nous nous serions flattés *or* flattées,	*we might have flattered ourselves.*
Vous vous seriez flattés *or* flatteés,	*you would have flattered yourselves.*
Ils se seraient flattés, *m.*	*they would have flattered themselves.*
Elles se seraient flattées, *f.*	*they would have flattered themselves.*

Imperative Mood.

Flatte-toi,	*flatter thyself.*
Qu'il se flatte,	*let him flatter himself.*
Qu'on se flatte,	*let one flatter one's self.*
Flattons-nous,	*let us flatter ourselves.*
Flattez-vous,	*flatter yourselves.*
Qu'ils se flattent,	*let them flatter themselves.*

Subjunctive Mood.

PRESENT.

Que je me flatte,	*that I may flatter myself.*
Que tu te flattes,	*that thou mayest flatter thyself.*
Qu'il se flatte,	*that he may flatter himself.*
Qu'on se flatte,	*that one may flatter one's self.*
Que nous nous flattions,	*that we may flatter ourselves.*
Que vous vous flattiez,	*that you may flatter yourselves.*
Qu'ils se flattent,	*that they may flatter themselves.*

IMPERFECT.

Que je me flattasse,	*that I might flatter myself.*
Que tu te flattasses,	*that thou mightest flatter thyself.*
Qu'il se flattât,	*that he might flatter himself.*
Qu'on se flattât,	*that one might flatter one's self.*
Que nous nous flattassions,	*that we might flatter ourselves.*
Que vous vous flattassiez,	*that you might flatter yourselves.*
Qu'ils se flattassent,	*that they might flatter themselves.*

PAST.

Que je me sois flatté, *m.* flattée, *f.*	*that I may have flattered myself.*
Que tu te sois flatté *or* flattée,	*that thou mayest have flattered thyself.*
Qu'il se soit flatté,	*that he may have flattered himself.*
Qu'elle se soit flattée,	*that she may have flattered herself.*
Qu'on se soit flatté,	*that one may have flattered one's self.*
Que nous nous soyons flattés *or* flattées,	*that we may have flattered ourselves.*
Que vous vous soyez flattés *or* flattées,	*that you may have flattered yourselves.*
Qu'ils se soient flattés, *m.*	*that they may have flattered themselves.*
Qu'elles se soient flattées, *f.*	*that they may have flattered themselves.*

PLUPERFECT.

Que je me fusse flatté, *m.* flattée, *f.*	*that I might have flattered myself.*
Que tu te fusses flatté or flattée,	*that thou mightest have flattered thyself.*
Qu'il se fût flatté,	*that he might have flattered himself.*
Qu'elle se fût flattée,	*that she might have flattered herself.*
Qu'on se fût flatté,	*that one might have flattered one's self.*
Que nous nous fussions flattés *or* flattées,	*that we might have flattered ourselves.*
Que vous vous fussiez flattés *or* flattées,	*that you might have flattered yourselves.*
Qu'ils se fussent flattés, *m.*	*that they might have flattered themselves.*
Qu'elles se fussent flattées, *f.*	*that they might have flattered themselves.*

GEOMETRICAL PERSPECTIVE.—XVIII.

PERSPECTIVE OF SHADOWS (*continued*).

We will now give some examples of the third position of the sun, as given in Lesson XVI., page 260, that is, when the sun is behind the picture, or in other words, when the object upon which the light falls is between the sun and the spectator.

We have said before that, when the sun is behind the picture, the vanishing line for the sun's elevation is *inclined upwards*, determining the VP for the sun's elevation *over* the VP for the sun's inclination. To assist in explaining this, we will again make use of a line to represent a pole.

Let $a\ b$ (Fig. 83) represent a pole. VPSI is the vanishing point of the sun's inclination at an angle of 50°; DVPSI is its distance point, from which is drawn the vanishing line at an angle of 40° with the horizon to VPSE, the vanishing point of the sun's elevation. Draw a line through a directed from VPSE until it cuts another line drawn through b directed from VPSI; these lines intersecting at c will give the extent and position of the shadow $c\ b$.

Fig. 83.

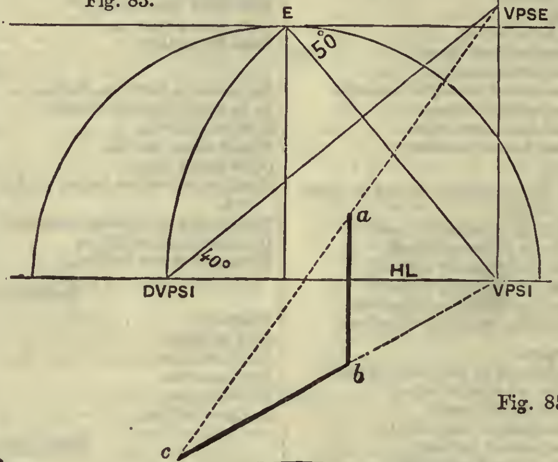
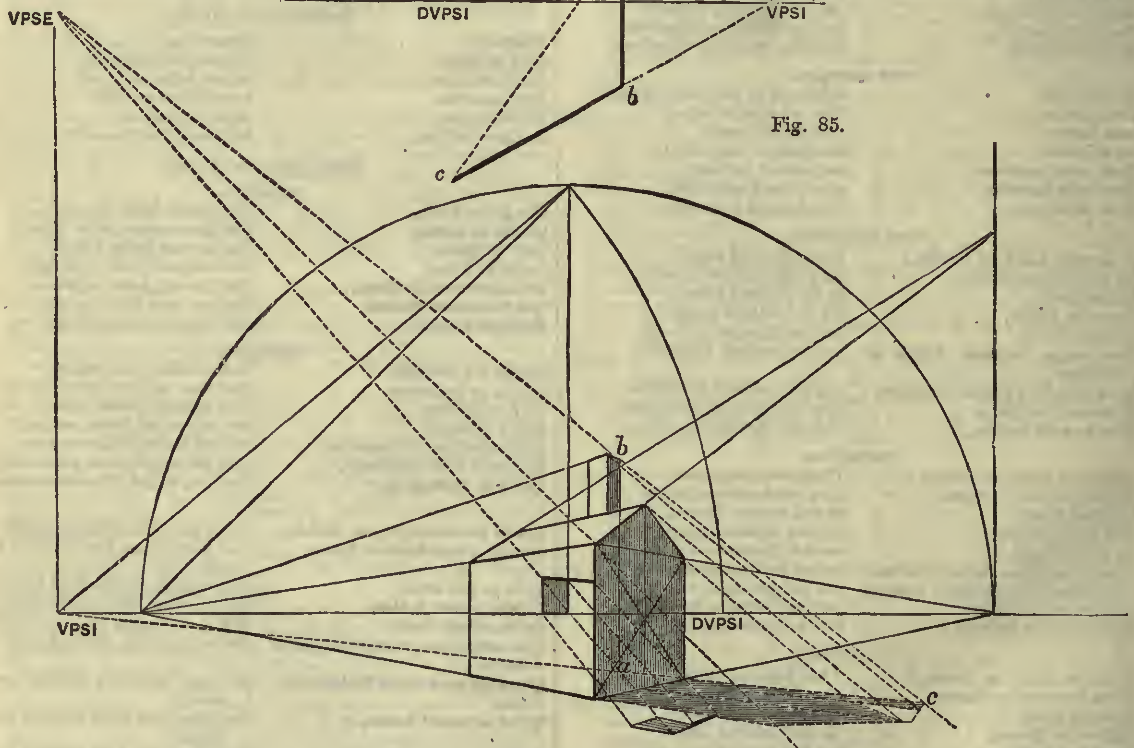


Fig. 85.



Problem LII. (Fig. 84).—*A Slab and a Block. The slab is placed on its edge at an angle of* 30° *with the* PP. *The block is in an upright position, and parallel with the slab at some distance beyond it; sun's elevation* 50°, *and inclination* 40°.

This problem being given as an exercise for our pupils, we will leave them to decide for themselves upon the proportions of the blocks, and upon the remaining perspective conditions; they will understand that the process for casting the shadow will be the same as shown by Fig. 83. At the same time we must draw attention to some parts of the shadows where the construction may not be clearly understood. The ray of the sun's inclination, through a of the block, meets the one through b from the sun's elevation, making the extent of the shadow of $a\ b$ to be $a\ c$. The other corresponding ray of elevation through d, meeting the ray of inclination at c, determines the shadow of $b\ d$ to be $c\ e$, which has the same vanishing point as $b\ d$, viz., VP¹. The shadow of the perpendicular edge $m\ n$ is $m\ o$; join $e\ o$, which will be the shadow of $d\ n$; then upon the same principle as in the case of the shadow of $b\ d$ will the shadow of $d\ n$, viz., $e\ o$, vanish at VP². To determine the edge of the shadow as it crosses the slab, draw a perpendicular line from the point in which the shadow line $a\ c$ cuts the base line of the slab, either from h or i, to meet the upper edge of the slab in s or v; if preferred, both lines may be drawn, then by joining s and v the edge of the shadow of the block crossing the slab will be determined; if one of the lines only is drawn, then the edge of the shadow represented by $s\ v$ must be directed towards VPSI.

The rays of the sun's inclination and those of the elevation must always be drawn in order to obtain the termination or extent of the shadow, let the position of the object be as it may, as in Fig. 85, where the chimney which is behind the building is brought down to the ground at a, although the line $b\ a$ coincides with the further side of the building, and thus, being on the same plane, is brought down to the ground-line of the wall, yet the edge of the shadow of the chimney is found by drawing a line through a from the vanishing point of the sun's inclination to meet the ray from the one of the sun's elevation; the same as though the chimney had projected from the wall, when the ray of inclination must be produced from the base of the chimney to obtain the edge of the shadow at c; because the plane of the wall does not vanish at the same vanishing point as the sun's inclination, the retiring edge of the shadow at c will vanish at the same VP for the corresponding edge of the chimney. The pupil will notice that the building being placed at an angle of 45° with the picture plane, the distance points of the station point are its vanishing points. If the sun's inclination is directly opposite the eye, the VP for its elevation will be over it, that is, over the point of sight, PS (Fig. 86). Then VPSE is found by drawing the angle of inclination from the distance point of the eye or station point, and the rays of inclination are ruled to the PS.

We advise our pupils to draw the cross and block of Fig. 86 at an angle with the picture plane, retaining the same elevation and inclination of the sun; it will be an exercise for drawing the edges of the shadow of the retiring sides, as previously explained in Problem LII. (Fig. 84).

Let the position of both be the same as those of Fig. 84, it will be seen how the vanishing edges of the shadows retire to the vanishing points of the solids; all this

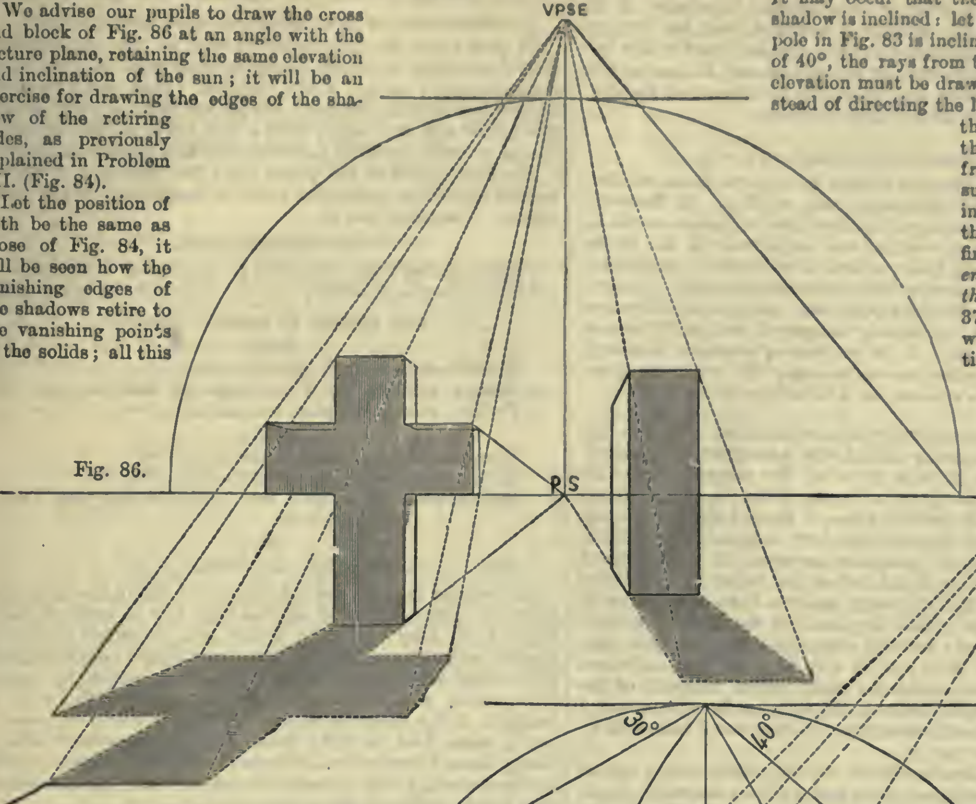


Fig. 86.

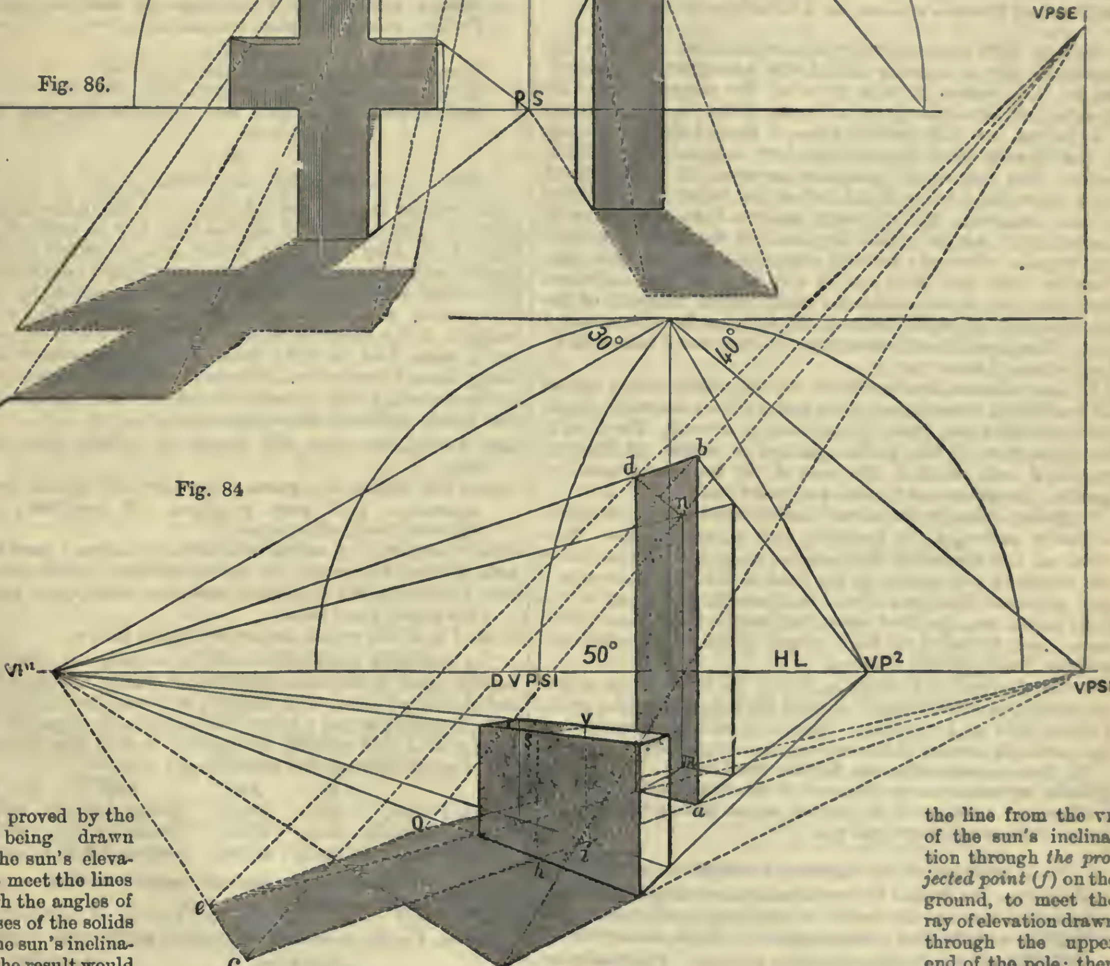


Fig. 84

can be proved by the rays being drawn from the sun's elevation to meet the lines through the angles of the bases of the solids from the sun's inclination; the result would be the same for producing the extent of the shadow as if we drew the retiring edges to the vanishing points. If the shadow projected by a solid crosses a second solid, and partly loses its shadow in that of the second, the rays drawn from the sun's elevation through the angles of the first solid will always determine the extent of the shadow that falls, in the first place, upon the second solid, and determine that part of the shadow upon the ground which is visible, and if necessary also that which is lost; and with regard to the shadow that falls on the second, if we draw perpendicular lines from the points where the lines from the VP of the sun's inclination intersect the edges of the second solid, to its surface, the extent of the shadow falling upon it will be decided.

It may occur that the object casting the shadow is inclined: let us suppose that the pole in Fig. 83 is inclined, say at an angle of 40°, the rays from the VP of the sun's elevation must be drawn as usual; but instead of directing the lines that are drawn through the base of the perpendicular pole from the VP of the sun's inclination to intersect those from the elevation, we must first *project the upper end of the pole on the ground* (see Fig. 37, Vol. III., page 72, where *f* is the projection of *m*), and draw the line from the VP of the sun's inclination through *the projected point* (*f*) on the ground, to meet the ray of elevation drawn through the upper end of the pole; then join the intersection of these two lines with the base of the pole, which will be the shadow. Let the pyramid (Fig. 35, Vol. III., page 72) be reconstructed, the same rule applies in this case as in that of the pole; for if after finding the vanishing points for the sun's inclination and elevation, we draw a line from the VPSI through *the centre of the base* (the plan of the vertex) to intersect a line drawn from VPSE *through the vertex*, and join the intersection with the angles at the base, the form of the shadow will be given.

LESSONS IN GREEK.—XXXIII.

VERBS PURE, IMPURE, AND LIQUID—UNCONTRACTED VERBS PURE.

The student has now obtained some general knowledge of the Greek verb. If he has accurately acquired what has been set forth, he will be able to construe the simpler forms of the language. Let him make trial as to what he can do, and so test his progress, by putting into English a few verses of the first chapter of the Gospel according to St. John.

THE GOSPEL OF ST. JOHN, I. 1—10.

1. Εν αρχῃ ην ὁ λογος, και ὁ λογος ην προς τον Θεον, και Θεος ην ὁ λογος. 2. Οὑτος ην εν αρχῃ προς τον Θεον. 3. Παντα δι' αυτου εγενετο, και χωρις αυτου εγενετο ουδε ἑν ὁ γεγονεν. 4. Εν αυτῳ ζωη ην, και ἡ ζωη ην το φως των ανθρωπων. 5. Και το φως εν τῃ σκοτιᾳ φαινει, και ἡ σκοτια αυτο ου κατελαβεν. 6. Εγενετο ανθρωπος απεσταλμενος παρα Θεου, ονομα αυτῳ Ιωαννης. 7. Οὑτος ηλθεν εις μαρτυριαν, ἱνα μαρτυρησῃ περι του φωτος, ἱνα παντες πιστευσωσι δι' αυτου. 8. Ουκ ην εκεινος το φως, αλλ' ἱνα μαρτυρησῃ περι του φωτος. 9. Ην το φως το αληθινον, ὁ φωτιζει παντα ανθρωπον ερχομενον εις τον κοσμον. 10. Εν τῳ κοσμῳ ην, και ὁ κοσμος δι' αυτου εγενετο, και ὁ κοσμος αυτον ουκ εγνω.

Verse 3. Here εγενετο may require explanation. Εγενετο (i.e. παντα, *all things*, a neuter plural with a singular verb, according to rule), *became* or *were produced*, the second aorist (like ελιπετο) indicative, third person singular, from γιγνομαι, *I become*.

5. Σκοτια, -ας, ἡ, *darkness*; φαινω, *I show, I shine*, generally in the classics used transitively, here intransitively.—Κατελαβεν. The student will recognise κατ as a shortened form of κατα, *down*, the α being elided before the following ε: ε is the syllabic augment; take it away, and we have still λαβεν to account for: ν is the ν that is placed at the end of a word for the sake of sound; so that removing ν we have left λαβε. Compare λαβε with λιπε, and it will be seen that λαβε is a second aorist; it is, indeed, the third person singular of the second aorist indicative active of the verb λαμβανω (ε-λαβ-ον), *I take*. Compounded with κατα, the verb signifies *I take hold of, I apprehend, I am aware of.*

6. Απεσταλμενος is a participle of the middle voice; cut off the participial termination μενος, and we have απεσταλ. Απ is the preposition απο, *from*. What, then, is εσταλ? The form is the tense-stem of the perfect passive or middle of the verb στελλω, *I send*, which is the root of the term αποστολος, *an apostle*. Απεσταλμενος therefore signifies *sent*.

7. Ηλθεν, *came*, is the second aorist, third person singular, indicative active, of the irregular verb ερχομαι, *I come*. Μαρτυρια, -ας, ἡ, *a testimony*, from μαρτυρ, -υρος, ὁ, *a witness* (hence our *martyr*); and μαρτυρ is the root of the verb μαρτυρεω, *I bear witness*. The form in the text, namely μαρτυρησῃ, is the third person singular, first aorist, subjunctive; πιστευσωσι (root πιστις, -εως, ἡ, *faith*), the third person plural, first aorist, subjunctive, from πιστευω, *I believe*.

9. Φωτιζει (root φως, -ωτος, το, *light*), the third person singular, indicative mood, present tense, of the transitive verb φωτιζω, *I throw light on, I enlighten*. Ερχομενον will be recognised as the participle present of the verb ερχομαι, explained in verse 7.

10. Εγνω is much like our English word *know*. The ε is the syllabic augment, γνω is the root of the verb, and εγνω is the third person singular of the second aorist indicative active, *he knew*—"the world knew him not."

FORMATION OF TENSES OF VERBS IN ω.

Verbs in ω are divided into two classes, according to their characteristics, that is, the nature of the letter immediately preceding the ω of the first person singular. These classes are—

1. *Pure Verbs*, whose characteristic is a vowel. Pure verbs are divided into two divisions:
   (*a*) *The Uncontracted*, whose characteristic is any vowel except α, ε, ο: as λυ-ω, *I loose*; βουλευ-ω, *I advise*.
   (*b*) *The Contracted*, whose characteristic is either α or ε or again ο: as τιμα-ω, *I honour*; φιλε-ω, *I love*; μισθο-ω, *I let for hire*.
2. *Impure Verbs*, whose characteristic is a consonant. Impure Verbs are divided into two divisions:
   (*a*) *Mute Verbs*, namely, π, κ, τ, β, γ, δ, φ, χ, θ, whose characteristic is one of the nine mutes: as λειπ-ω, *I leave*; πλεκ-ω, *I weave*; πειθ-ω, *I persuade*.
   (*b*) *Liquid Verbs*, whose characteristic is one of the liquids, namely, λ, μ, ν, ρ: as αγγελλ-ω, *I announce*; νεμ-ω, *I divide*; φαιν-ω, *I show*; φθειρ-ω, *I corrupt*.

FORMATION OF THE TENSES OF THE VERBS PURE.

In pure verbs, the contracted as well as the uncontracted, the tense-ending in general connects itself with the unchanged characteristics; as λυ-, λυ-σω, λελυ-κα. Pure verbs form no second, but only first tenses; the perfect they form with κ (κα), the future and the aorist with σ and θ (σω, σα, θην, θησομαι). The pure verbs, however, are subject to this regular change:—

The short vowel of the present and the imperfect, in uncontracted as well as contracted verbs, is lengthened in the other tenses. We speak first of

THE UNCONTRACTED.

ῐ into ῑ, μηνῐ-ω, *I am vexed with*; f. μηνῑ-σω, a. ε-μηνῑ-σα.
ῠ into ῡ, κωλῠ-ω, *I hinder*; f. κωλῡ-σω, p. κε-κωλῡ-κα.

THE TENSES OF κωλυω, *I hinder*.

Active.

Present κωλῡ-ω, impf. ε-κωλῡ-ον, —ῡ.
Future κωλῡ-σω, aor. 1 ε-κωλῡ-σα, inf. κωλῦ-σαι, —ῡ.
Perfect κε-κωλῡ-κα, plup. ε-κε-κωλῡκειν, —ῡ.

Middle.

Present κωλῡ-ομαι, impf. ε-κωλῡ-ομην, —ῡ.
Future κωλῡ-σομαι, aor. ε-κωλῡ-σαμην, —ῡ.
Perfect κε-κωλῡ-μαι, perf. fut. κε-κωλῡ-σομαι, plup. ε-κε-κωλῡ-μην, —ῡ.

Passive.

Aorist ε-κωλῡ-θην, fut. κωλῡ-θησομαι, —ῡ.

Contrary to the rule, several pure verbs retain the short characteristic vowel either in all the tenses or in some of them. These verbs take a σ in the perfect and pluperfect middle or passive, as well as in the first aorist and future passive, also in their verbal adjectives. This peculiarity is observed by several other verbs, which either have a long vowel in the root, or lengthen in the tenses a short vowel in the root; as, ακουω, *I hear*; εναυω, *I set on fire*; θραυω, *I break in pieces*; κρουω, *I dash*; ψαυω, *I touch*; σειω, *I shake*; κελευω, *I command*; λευω, *I stone*; κλειω, *I shut*; πταιω, *I knock against*; χριω, *I smear*. This fact is indicated thus—pass. with σ:—

Χρῐω, *I sting*, fut. χρῐσω, aor. εχρῐσα, inf. χρῐσαι; pass. with σ; but,

Χρῑω, *I rub, anoint*, fut. χρῑσω, aor. εχρῑσα, inf. χρῑσαι, aor. mid. εχρῑσαμην; perf. pass. κεχρῑσμαι, inf. κεχρῑσθαι; aor. 1 εχρισθην, verb. adj. χριστος.

Ανῠω, *I complete*, fut. ανῠσω, aor. ηνῠσα, inf. ανῠσαι; pass. with σ.
Αρῠω, *I draw*, fut. αρῠσω, aor. ηρῠσα, ηρῠσαμην; pass. with σ.
Μυω, *I close* (*e.g.* the eyes), fut. μῠσω, aor. εμῠσα, perf. μεμῠκα, *I am closed, I am silent.*
Πτῠω, *I spit*, fut. πτῠσω, aor. επτῠσα, pass. with σ.

The following dissyllabic verbs in υω lengthen the characteristic vowel in the future active and middle, the third future, and the aorist active and middle; and δυω also in the perfect and pluperfect active; but in the perfect and pluperfect active (except δυω) and middle, or passive, and in the aorist and future passive resume the short vowel; thus—

	Fut.	*Aor.*	*Perf.*	*Aor. Pass.*
Δυω, *I enter*,	δῡσω,	εδῡσα,	δεδῡκα, δεδῠμαι,	εδῠθην.
Θυω, *I sacrifice*,	θῡσω,	εθῡσα,	τεθῠκα, τεθῠμαι,	ετῠθην.
Λυω, *I loose*,	λῡσω,	ελῡσα,	λελῠκα, λελῠμαι,	ελῠθην.

Παυω, *I cause to cease*, has the perfect middle or passive πεπαυμαι, but aorist passive επαυσθην.

Κελευω, *I order, command*—PERFECT MIDDLE OR PASSIVE.

		Indicative.	*Imperative.*
Sing.	1.	Κε-κελευ-σ-μαι.	
	2.	Κε-κελευ-σαι,	κε-κελευ-ου.
	3.	Κε-κελευ-σ-ται,	κε-κελευ-σθω.
Dual.	1.	Κε-κελευ-σ-μεθον.	
	2.	Κε-κελευ-σθον,	κε-κελευ-σθον.
	3.	Κε-κελευ-σθον,	κε-κελευ-σθων.
Plur.	1.	Κε-κελευ-σ-μεθα,	
	2.	Κε-κελευ-σθε,	κε-κελευ-σθε.
	3.	Κε-κελευ-σ-μενοι, -εισι.	κε-κελευ-σθωσαν.

*

PLUPERFECT.

Singular.	Dual.	Plural.
1. Ε-κε-κελευ-σ-μην,	ε-κε-κελευ-σ-μεθον,	ε-κε-κελευ-σ-μεθα.
2. Ε-κε-κελευ-σο,	ε-κε-κελευ-σ-σθον,	ε-κε-κελευ-σθε.
3. Ε-κε-κελευ-σ-το,	ε-κε-κελευ-σ-σθην,	ε-κε-κελευ-σ-μενοι,-ησα.

AOR. PASS. Εκελευ-σ-θην. FUT. PASS. Κελευ-σ-θησομαι.

VOCABULARY.

Αισθανομαι (with gen. or acc.), I am aware of, I perceive.

Ασπις, -ἴδος, ἡ, a shield.

Δεινως, greatly, fearfully, exceedingly.

Δρομος, -ου, ὁ, a running.

Δυναμις, -εως, ἡ, power.

Καταπαυω, I terminate, bring to an end.

Σεισμος, -ου, ὁ, an earthquake.

EXERCISE 95.—GREEK-ENGLISH.

1. Οἱ στρατιωται προς τους πολεμιους πορευεσθαι εκελευσθησαν. 2. Σπαρτη ποτε ὑπο σεισμου δεινως εσεισθη. 3. Ἡ των Περσων δυναμις ὑπο των Ἑλληνων τεθραυσται. 4. Οἱ πολεμιοι εις την ακραν κατεκλεισθησαν. 5. Ὀτε οἱ βαρβαροι των ασπιδων προς τα δορατα ὑπο των Ἑλληνων κεκρουσμενων ῃσθανοντο, δρομῳ εφευγον. 6. Ὁ πολεμος κατεπαυσθη. 7. Ελπιζομεν παντα ευ ανυσειν. 8. Ειθε παντα καλως ανυσαιμι. 9. Ἡ συνθηκη ὑπο των βαρβαρων λελυται.

EXERCISE 96.—ENGLISH-GREEK.

1. The soldiers have been commanded to go against the enemy. 2. Our city has been broken by an earthquake. 3. That city will be broken by an earthquake. 4. The city is shaken (pres.) by an earthquake. 5. The power of the Persians was broken by the Greeks. 6. The enemy (plur.) has been shut up in the citadel. 7. The shields were struck against the spears by the enemy. 8. The war has been made to cease (*terminated*). 9. The war will have been terminated. 10. May we complete all things well! (opt. aor.) 11. To command (aor.) is easier than to complete (aor.). 12. The treaty will be broken by the enemy.

ETYMOLOGICAL VOCABULARY.

The word *στρατιωτης* is connected with a numerous list of terms, of which we give a list below. The root is *στρατ*, which is found in its simplest form in the noun *στρατια*, *an army*, and the root *στρατ* (compare the Latin *strat* in stratum from sterno) is connected in origin and import with *στρωννυμι*, *I spread out*, *I cover*, as a camp occupies a field, so that *στρατος* is properly *a camp* or an organised army, and *στρατια* an embattled troop.

Στρατια, -ας, ἡ, an army.

Στρατιαρχης, -ου, ὁ, a leader of an army (αρχος, a leader).

Στρατιος, 2 and 3, relating to an army.

Στρατιωτης, -ου, ὁ, a soldier.

Στρατιωτικος, 3 (that is, of three terminations), relating to a soldier.

Στρατιωτις, -ιδος, ἡ, a ship for transporting soldiers.

Στρατοομαι, I encamp, I am in camp.

Στρατοπεδον, -ου, το, a camp, an army in camp an army.

Στρατευμα, -ατος, το, an army.

Στρατευσειω, I desire an army, an expedition.

Στρατευσις, -εως, ἡ, army-service.

Στρατευω, more common στρατευομαι, I serve in the army.

Στρατηγεω (αγω, I lead), I lead an army, I am a general.

Στρατηγια, -ας, ἡ, the office of a general.

Στρατηγικος, 3, relating to a general's office.

Στρατηγος, -ου, ὁ, a general.

*** *The Key to Exercise 94 will be given in the next lesson.*

LESSONS IN ENGLISH LITERATURE.—VIII.

THE ELIZABETHAN AGE—SPENSER.

EDMUND SPENSER was born in London, probably in the year 1553. His descent was noble, but his family seem to have been in straitened circumstances. Of his early youth little or nothing is known; but in 1569 we find that he entered Pembroke Hall, Cambridge. That he there pursued his studies with diligence, and laid the foundation of a very unusual amount of learning and an immense knowledge of literature, no one who reads his poems can doubt; for few poets have drawn their materials from more varied sources, or used those materials more thoroughly with the ease and naturalness which spring from long and intimate familiarity, than Spenser. During his college career, Spenser formed a close friendship with a man who, in his own day, enjoyed a very high reputation for learning and literary ability, Gabriel Harvey—a friendship which ultimately exercised a great influence over Spenser's career. Harvey was the leader of a fashion, which his influence rendered not unusual for a time, of adapting the ancient classical metres—founded on quantity, not, like English metres, on accent—to English poetry; and Spenser, as his correspondence with Harvey shows, was infected by his friend's fancy for a time, though this eccentricity did not in Spenser's case last long. Harvey, however, did for Spenser the real service of introducing him to Sir Philip Sidney, who proved, as long as his short life lasted, Spenser's most faithful and generous friend and protector. To the friend and favourite of Sidney the society of all the most eminent men of the day was naturally open; and Spenser soon found friends or patrons in Leicester, Essex, Raleigh, and many more among the statesmen or courtiers who adorned the brilliant court of Elizabeth. Nor was it long before he became known to the Queen herself. Spenser had probably written much poetry which has since been lost, and perhaps some of the minor pieces which we still possess, before or very soon after he left the university; but the first poem by which he attracted the notice of the court, and established his reputation as the great poet of the day, was "The Shepherd's Calendar." This work is in form a series of twelve idyls, or pastoral dialogues, one for each month in the year. But the poems are pastoral only in form; for sometimes, under the guise of shepherds, we have Colin Clout (the poet himself) and Hobbinol (his friend Harvey), or others of like character, moralising upon old age; sometimes discussing the pleasures and pains of love; sometimes singing the praises of Queen Elizabeth; sometimes discussing the progress of poetry and the condition of poets; and sometimes the comparative merits of the Catholic and Protestant systems, and the vices of the worldly clergy.

By this work, and through the influence of Sidney and those to whose favour Sidney had recommended him, Spenser's connection with the court was established; and from time to time he seems to have received unimportant employment in the public service. But his favour with Leicester almost necessarily implied disfavour with Leicester's opponents; and thus at first no great benefit from the royal partiality fell to his share. Probably at this time, and almost certainly at a later period, the Lord Treasurer Burleigh was his foe; and the painfulness of what he then and afterwards endured is strikingly expressed by him in the well-known lines in "Mother Hubbard's Tale:"—

"Most miserable man, whom wicked fate
Hath brought to court to sue for had-y-wist,
That few have found and many one hath missed!
Full little knowest thou, who hast not tried,
What hell it is in suing long to bide;
To lose good days, that might be better spent;
To waste long nights in pensive discontent;
To speed to-day, to be put back to-morrow;
To feed on hope, to pine with fear and sorrow;
To have thy prince's grace, yet want her peers;
To have thy asking, yet wait many years;
To fret thy soul with crosses and with cares;
To eat thy heart through comfortless despairs;
To fawn, to crouch, to wait, to ride, to run,
To spend, to give, to want, to be undone.
Unhappy wight, born to disastrous end,
That doth his life in so long tendance spend."

At last, in 1580, Lord Grey de Wilton was appointed lord-deputy of Ireland, and Spenser went to Ireland with him as secretary. How long he filled this post, or any public employment in Ireland, is not quite certain; but he soon acquired a more lasting tie to that country. Through the influence, no doubt, of his powerful friends, he received a grant of land in the county of Cork, a portion of the forfeited estates of the Earls of Desmond, together with the castle of Kilcolman. This became thenceforth his usual and permanent place of abode, and was the scene in which he composed the greater and more important part of his works; though his visits to England and to the court, for the purpose of seeing his works through the press and presenting them to the queen and his other patrons, were frequent. But in 1598 a calamity befell him which embittered the short remainder of his life, and perhaps hastened his end. Rebellion again broke out in Ireland; the confiscated lands were overrun; Spenser and his family fled in haste from Kilcolman; the Irish seized and burnt the castle; and one of Spenser's children, who had, we know not how, been left behind, perished in the flames. Spenser returned to London, and the next year died, it has been said—with what truth we cannot tell—in great distress and poverty.

The first important contribution of Spenser to literature, during his residence in Ireland, was the publication of the first three books of the "Faëry Queen" in 1590. In an age of such intellectual activity, in which the popular avidity for poetry was so keen, and the patronage of the court towards literary men so liberal, it is easy to conceive the enthusiasm which the work excited. It was the first really great poem which had been produced in England since the "Canterbury Tales;" and the time was especially favourable for its reception, so that its merits were appreciated at once. The success of this work led to an eager demand for anything which Spenser could supply. The following year a collection of shorter pieces was published under the name of "Complaints." It included the "Ruins of Time," a poem mainly commemorative of the death of Sir Philip Sidney, and dedicated to his famous sister, the Countess of Pembroke; "The Tears of the Muses," "Virgil's Gnat," "Mother Hubbard's Tale," a social and political satire; "Muiopotmos, or the Tale of the Butterfly;" "The Ruins of Rome" and the "Visions of Bellay," translated from the French poet Bellay; "Visions of the World's Vanity," and "Visions of Petrach." In rapid succession followed "Daphnaida," an elegy on the death of a lady of the Howard family; "Colin Clout's come Home Again," a poem in which he returned to the pastoral form used by him in earlier life, which is dedicated to Sir Walter Raleigh, and contains many allusions to contemporary poets; "Astrophel," an elegy, likewise pastoral in form, on the death of Sir Philip Sidney; "Amoretti, or Sonnets," probably written during, and with reference to, his courtship; and "Epithalamium," a bridal hymn upon his own marriage. In 1596 were published three more books of the "Faëry Queen," making, with the previous three, the whole of that poem which was ever published in a complete form. In the short interval between this period and his death, he published "Prothalamium," a marriage song on the marriage of the daughters of the Earl of Worcester; four hymns in honour of Love, Beauty, Heavenly Love, and Heavenly Beauty; and a few shorter and less important poems. After his death were published some fragments of later and unfinished books of the "Faëry Queen." He also left behind him a remarkable prose work, a "View of the State of Ireland," which was not printed till long after his death.

Our space does not allow us to enter upon any detailed examination of Spenser's minor poems; and this is the less important, because the "Faëry Queen" is so much the most characteristic of Spenser's genius among his works, as well the poem of far the greatest intrinsic merit, that an acquaintance with the "Faëry Queen" will give a sufficient comprehension of Spenser's qualities as a poet.

The "Faëry Queen," even in its unfinished state, is a poem of great length; and the six books completed are only half of the poem as projected. The unfinished state of the poem, moreover, leaves it in a disjointed condition, the several books being connected with one another only by the slenderest thread. The general plan of the whole was intended to have been developed in a later portion. But, fortunately, we have a letter of the author addressed to Sir Walter Raleigh, and prefixed to the first three books of the "Faëry Queen," in which he set forth his plan with great clearness, and from which we give a few extracts rather than tell the story in any other than Spenser's own words. He says that "the general end of all the book is to fashion a gentleman or noble person in virtuous and gentle discipline; which for that I conceived should be most plausible and pleasing, being coloured with an historical fiction, the which the most part of men delight to read, rather for variety of matter than for profit of the ensample, I chose the history of King Arthur, as most fit for the excellency of his person, being made famous for many men's former works, and also furthest from the danger of envy and suspicion of present time. . . . So have I laboured to do in the person of Arthur; whom I conceive, after his long education by Timon, to whom he was by Merlin delivered to be brought up so soon as he was born of the Lady Igrayne, to have seen in a dream or vision the Faëry Queen, with whose excellent beauty ravished, he, awaking, resolved to seek her out; and so, being by Merlin armed, and by Timon thoroughly instructed, he went to seek her forth in Faëry land. In that Faëry Queen I mean Glory in my general intention, but in my particular, I conceive the most excellent and glorious person of our Sovereign the Queen, and her kingdom in Faëry land. And yet in some places I do otherwise shadow her; for, considering she beareth two persons, the one of a most royal queen or empress, the other of a most virtuous and beautiful lady, this latter part in some places I do express in Belphœbe. So in the person of King Arthur I do set forth Magnificence in particular: which virtue, for that (according to Aristotle and the rest) it is the perfection of all the rest, and containeth in it them all, therefore, in the whole course of it, I mention the deeds of Arthur appliable to that virtue which I write of in that book. But of the twelve other virtues I make twelve other knights the patrons, for the more variety of the history." He then explains that the first book contains the adventures of the Red Cross Knight, who stands for *Holiness;* the second, of Guyon, or *Temperance;* the third, of Britomartis, a lady knight, representing *Chastity.* The three books subsequently published contain the legends of Cambell and Triamond, the patrons of *Friendship;* Artegall, or *Justice;* and Calidore, or *Courtesy.* Spenser further informs us that "the beginning of my history, if it were to be told by an historiographer, should be the twelfth book, which is the last; where I devise that the Fairy Queen kept her annual feast twelve days, upon which twelve several days the occasions of the twelve several adventures happened, which being undertaken by twelve several knights, are in these twelve books severally handled and discoursed."

To a poet of Spenser's peculiar genius this plan afforded special advantages. Spenser's genius was in no degree dramatic. He has nowhere shown any power of conceiving or portraying character, or of giving human interest to his story by arousing our sympathies with the joys and griefs, the struggles and triumphs of his heroes. There is nothing in his mere narrative to excite interest or curiosity. The charm of his poetry is of a very different kind—indeed, it might almost be said, of an opposite kind. The very remoteness of all he describes from real life is one of its sources of pleasure. His unequalled fertility of imagination in producing images of beauty and purity, his power of invention as well as of description, and not less the singularly sweet though somewhat monotonous melody of his versification, find their most suitable field in visions of fairy land and vague allegories, the wanderings and adventures of elfin knights and fairy ladies.

But, in addition to the sources of pleasure in the "Faëry Queen," which are intrinsic and permanent, and no less appreciable by us than by the Elizabethan reader, Spenser's judgment in the selection of his subject was shown by the opportunity which it gave him of introducing a thousand allusions to things and people of his own day—allusions which probably had, and were intended to have, the effect of removing for contemporary readers the tone of monotony and sameness which it unquestionably has for modern readers. Thus the Fairy Queen herself is, as we have seen, Elizabeth. The evil witch Duessa was probably not only the representative of Falsehood, but stood for her rival, Mary Queen of Scots, as well. Artegall, the patron of Justice, is Lord Grey de Wilton, the lord-deputy of Ireland, under whom Spenser served. References to the Spanish wars and the various incidents in the ecclesiastical history of the reign are numerous; and there are, doubtless, many covert meanings of the same kind, which we now miss, but which were plain enough to Spenser's contemporaries.

The earlier books of the "Faëry Queen" are, by universal consent, of greater merit than the later; and probably we cannot in any way better assist the student in acquiring a knowledge of the general character of the poem than by a somewhat close examination of the first book. And the extracts which we give will enable every one to appreciate the metre in which it is written—a metre which, it must be remembered, was of Spenser's own formation, though to some extent founded upon an Italian model.

The first book contains the adventures of the Red Cross Knight, or Holiness. Like each of the other books, it is divided into twelve cantos; and there is little doubt that under the guise of the Red Cross Knight, the poet intended to describe the various fortunes of the Church of England.

The source and beginning of the adventures of this book are described by Spenser in the letter from which we have already quoted. The twelve-day festival of the Fairy Queen was being held. "In the beginning of the feast there presented himself a tall, clownish young man, who, falling before the Queen of Faëries, desired a boon (as the manner then was), which during that feast she might not refuse; which was that he might have the achievement of any adventure which during that feast should happen. That being granted, he rested him on the floor, unfit through his rusticity for a better place. Soon after entered a fair lady in mourning weeds, riding on a white ass, with a dwarf behind her leading a warlike steed, that bore the arms of a knight, and his spear in the dwarf's hand. She, falling before the Queen of Faëries, complained that her father and mother, an ancient king and queen, had been by an huge dragon many years shut up in a brazen castle, who thence suffered them not to issue; and therefore besought the Faëry Queen to assign her some one of her knights to take on him that exploit. Presently that clownish person, upstarting, desired that adventure; whereat the queen much wondering, and the lady much gainsaying, yet he earnestly importuned his desire. In the end, the lady told him that unless that armour which she brought would serve him (that is, the armour of a Christian man specified by St. Paul, Ephes. v.), that he could not succeed in that enterprise; which being forthwith put upon him, with due furnitures thereunto, he seemed the goodliest man in all the company, and was well liked of the lady. And eftsoons taking on him knighthood, and mounting on that strange courser, he went forth with her on that adventure; where beginneth the first book." The once clownish young man has become the Red Cross Knight, or St. George; the lady is Una, who represents true religion. They are thus introduced to us:—

"A gentle knight was pricking on the plain,
Y-clad in mighty arms and silver shield,
Wherein old dints of deep wounds did remain,
The cruel marks of many a bloody field;
Yet arms till that time never did he wield;
His angry steed did chide his foaming bit,
As much disdaining to the curb to yield;
Full jolly knight he seemed, and fair did sit,
As one for knightly jousts and fierce encounters fit.

"And on his breast a bloody cross he bore,
The dear remembrance of his dying lord,
For whose sweet sake that glorious badge he wore,
And dead, as living ever, him adored;
Upon his shield the like was also scored,
For sovereign hope, which in his help he had.
Right, faithful, true, he was in deed and word;
But of his cheer did seem too solemn sad;
Yet did he nothing fear, but ever was y-drad.

* * * * * * *

"A lovely lady rode him fair beside,
Upon a lowly ass more white than snow;
Yet she much whiter; but the same did hide
Under a vail, that wimpled was full low;
And over all a black stole she did throw,
As one that inly mourned; she was so sad,
And heavy sat upon her palfry slow,
Seemed in heart some heavy care she had;
And by her in a line a milk-white lamb she lad.

"So pure and innocent, as that same lamb,
She was in life, and every virtuous lore;
And by descent from royal lineage came
Of ancient kings and queens, that had of yore
Their sceptres stretched from east to western shore,
And all the world in their subjection held;
Till that infernal fiend with foul uproar
Forwasted all their land, and them expelled;
Whom to avenge, she had this knight from far compelled."

We find them first taking refuge from a storm in a wood, which proves to be the Wandering Wood, in which is the den of Error, a horrible monster, half woman, half snake, whom, after a terrible combat, the knight at last slays. They next meet an old man, seemingly a hermit, who leads them to his cell for the night.

"A little lowly hermitage it was,
Down in a dale, hard by a forest side,
Far from resort of people, who did pass
In travel to and fro."

The hermit turns out to be the great enchanter Archimago, who throughout the "Faëry Queen" is the constant representative of all that is false and evil. Here he stands for heresy and deceit. By his deceptions the knight is led to believe that the lady is false and unchaste, and leaving her behind, starts by himself from the hermitage. He has not gone far, when he meets and slays "a faithless sarazin"—Sansfoy, one of the three sons of Archimago. With Sansfoy was a lady calling herself Fidessa, but really the witch Duessa, daughter of Archimago, the representative of falsehood, in opposition to Una, or truth. Duessa represents herself as having been held in unwilling captivity by Sansfoy, and the Red Cross Knight travels onward in her company. In the meantime Una sets out in search of her lost knight. For some time she travels alone; but one day she descends from her ass to rest in the wood.

"It fortuned out of the thickest wood
A ramping lion rushed suddenly,
Hunting full greedy after savage blood.
Soon as the royal virgin he did spy,
With gaping mouth at her ran greedily,
To have at once devoured her tender corse;
But to the prey when as he drew more nigh,
His bloody rage assuaged with remorse,
And with the sight amazed forgot his furious force.

"Instead thereof, he kissed her weary feet,
And licked her lily hand with fawning tongue,
As he her wronged innocence did weet.
Oh, how can beauty master the most strong,
And simple truth subdue avenging wrong!
Whose yielded pride and proud submission,
Still dreading death, when she had marked long,
Her heart gan melt in great compassion,
And drizzling tears did shed for pure affection."

The lion becomes her protector, and with him she reaches the inhospitable cabin of Corceca, her daughter Abessa, and their confederate, Kirk-rapine, who represent the superstitions and corruptions of monasticism. Kirk-rapine is slain by the lion, and Una goes upon her way; this whole incident being manifestly an allusion to the suppression of the monasteries under Henry VIII. Una soon afterwards, partly by the guiles of Archimago, falls into the hands of Sansloy, another son of the enchanter, who carries her away.

The Red Cross Knight has been led by Duessa to the House of Pride, and the fourth canto contains an elaborate and very poetical allegorical description of the Court of Lucifera, or Pride, with the deadly sins as her attendants. Sansjoy, the third brother, comes likewise to the Court of Pride while the Red Cross Knight is there; they fight, and Sansjoy is overthrown. Duessa, to save him, visits the realms of darkness, the description of which is most powerful, and returns with the cure she sought. But she finds the Red Cross Knight departed.

We next return to Una, who is rescued from the power of Sansloy by a troop of fauns and satyrs, and a good Knight Satyrane, whose history is told us; but while Satyrane and the sarazin are fighting, the lady takes to flight in terror. In the meantime the Red Cross Knight has been rejoined by Duessa, and having drunk of an enchanted fountain, falls into the hands of the giant Orgoglio, by whom he is cast into a horrible dungeon. The dwarf, after his master's fall, goes to seek relief, and soon meets Una. They fall in with Prince Arthur, and Prince Arthur slays the giant, rescues the knight, and strips Duessa, who had become the mistress of the giant, exposing her foulness and deformity.

Prince Arthur then relates his own story and his wanderings in search of the Fairy Queen, and leaves the Red Cross Knight and Una. After he has parted with them, they meet Sir Trevisa flying from Despair, and return with him to the Cave of Despair, the description of which and of Despair himself, and his arguments urging to desperation and suicide, as given in the ninth canto, are among the most remarkable passages in the whole of the "Faëry Queen." The following lines are a part of the plea for suicide:—

"What frantic fit, quoth he, has thus distraught
Thee, foolish man, so rash a doom to give?
What justice ever other judgment taught,
But he should die who merits not to live?
None else to death this man despairing drive
But his own guilty mind, deserving death.
Is then unjust to each his due to give?
Or let him die that loatheth living breath?
Or let him die at ease that liveth here uneath?

"Who travels by the weary, wandering way,
To come unto his wished home in haste,
And meets a flood that doth his passage stay;
Is not great grace to help him over past,
Or free his feet that in the mire stick fast?
Most envious man, that grieves at neighbours' good,
And fond that joyest in the woe thou hast,
Why wilt not let him pass, that long hath stood
Upon the bank? why wilt thyself not pass the flood?

"He there does now enjoy eternal rest,
And happy ease, which thou dost want and crave,
And further from it daily wanderest;
What if some little pain tho passage have,
That makes frail flesh to fear the bitter wave;
Is not short pain well borne that brings long ease?
And lays the soul to sleep in quiet grave?
Sleep after toil, port after stormy seas,
Ease after war, death after life, does greatly please."

The Red Cross Knight is next led by Una to the House of Holiness, which is described in an elaborate and beautiful allegory, in which the contrast with the House of Pride is forcibly brought out. Here the knight receives purification and instruction. Thus fitted for his task, he encounters the great dragon he had come to meet, and after a three days' combat slays him. The book closes with the rejoicings over the slaughter of the dragon and the release of his victims, and with the marriage of the knight to Una.

The outline which we have given of this book will enable the student to form some idea of the character of Spenser's allegory; the detailed beauties of the poetry can be learned only from the poem itself.

EXERCISES IN EUCLID.—VI.

PROPOSITION XXXVII.—If the diagonals of a four-sided figure bisect each other, it is a parallelogram.

Let AC, BD (Fig. 37), the diagonals of the four-sided figure ABCD, intersect in O; then if AO = OC, and BO = OD, the figure is a parallelogram. For since AO = OC, and BO = OD, also the opposite angles AOB, COD, are equal (Euc. I. 15); therefore the triangles are equal in every respect (Euc. I. 4), and the angles are equal which are opposite to the equal sides in each—*i.e.*, the angle ABO is equal to the angle ODC; therefore, by Euc. I. 27, AB is parallel to CD. By an exactly similar course of reasoning, AD may be proved parallel to BC, that is, the figure ABCD is a parallelogram. Q. E. D.

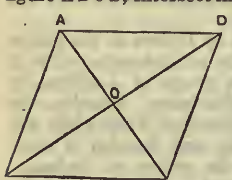


Fig. 37.

Corollary 1.—If the diagonals be equal, as well as bisecting each other, the figure is rectangular. For because the two triangles ABC, DBC (Fig. 38) have two sides, AB, AC, equal to DC, DB, each to each, and likewise their base BC common, therefore the triangles are equal in every respect; therefore the angle ABC equals angle BCD. But when a straight line falls upon two parallel straight lines it makes the two interior angles upon the same side equal to two right angles (Euc. I. 29); therefore ABC, BCD are equal to two right angles; and therefore, since they are equal, each is a right angle, and the figure is rectangular.

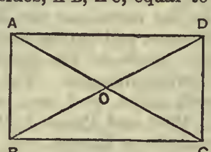


Fig. 38.

Corollary 2.—Hence, obviously, as is proved otherwise in Euc. III. 31, the angle in a semicircle is a right angle.

PROPOSITION XXXVIII.—If the diagonals of a four-sided figure bisect each other at right angles, the figure is a rhombus.

Let AC, BD (Fig. 39) the diagonals of a four-sided figure ABCD, intersect at right angles in O, then if AO = OC, and BO = OD, the figure is a rhombus. As in the last proposition, the figure is a parallelogram; and therefore, the opposite sides, AB, CD, and AD, BC, are equal; and because AO equals OC, and OB is common and at right angles, therefore base AB equals base BC; hence all the sides are equal, and the figure is a rhombus. Q. E. D.

Corollary.—If the diagonals be also equal, it is a square; for, as in Corollary 1 of the last proposition, the figure is rectangular, and a rectangular rhombus is a square.

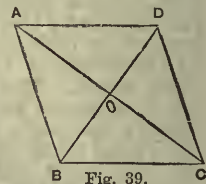


Fig. 39.

PROPOSITION XXXIX.—If a four-sided figure have its opposite sides equal, it is a parallelogram.

Let the four-sided figure ABCD (Fig. 39) have its opposite sides equal, that is, AB = CD, and AD = BC, then it is a parallelogram. Join AC; then since AB = CD, and BC = AD, also base AC is common to the two triangles ABC, ADC, therefore, by Euc. I. 8, the triangles are equal; hence the angle ACB equals angle CAD, therefore AD is parallel to BC (Euc. I. 27). But AD = BC by construction; therefore, by Euc. I. 33, CD is parallel to AB, and ABCD is a parallelogram. Q. E. D.

PROPOSITION XL.—If AB, BC, CD, DA (Fig. 40), be the sides of a parallelogram taken in order, and points E, F, G, H be taken in them, such that AE = CG, and BF = DH, the figure EFGH shall be a parallelogram. For since the opposite sides of a parallelogram are equal (Euc. I. 34), AB = CD. But by construction AE = CG, therefore remainder BE = DG (Axiom 3), and by construction, BF = DH; therefore in the two triangles, BEF, DGH, the sides BE, BF in the one are equal to the sides DG, GH in the other, and the included angles FBE, GDH are equal, being opposite angles of a parallelogram; therefore the triangles are equal (Euc. I. 4), and base FE equals base GH. By a similar course of reasoning GF = EH; hence the four-sided figure EFGH has its opposite sides equal, and is therefore a parallelogram by the last proposition. Q. E. D.

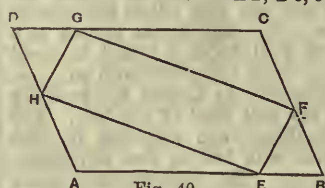


Fig. 40.

PROPOSITION XLI.—If ABC (Fig. 41) be any triangle, and DE the line joining the middle points of AB, AC, then shall DE be parallel to BC, and BC shall be double DE.

Join BE, DC, and bisecting BC in F, join DF, EF; then, since the triangles ADE, BDE are upon equal bases AD, BD, and have a common vertex E, they are equal. Again, because the triangles ADE, DEC are upon equal bases AE, EC, and have a common vertex D, they are equal, hence ADE is equal to both the triangles DEB and DEC; hence, by Axiom 1, triangle DEB equals triangle DEC, and they are upon the same base DE; hence they are between the same parallels by proposition, therefore DE is parallel to BC. By an exactly similar proof it may be shown that DF, EF are parallel to AC, AB; hence DFCE and EFBD are parallelograms; therefore, by Euc. I. 34, DE = FC, and DE = BF; hence DE equals half BC. Q. E. D.

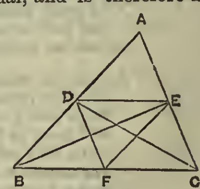


Fig. 41.

Corollary 1.—It is obvious that the angles of the triangle DFE are equal to the angles of the triangle BAC, for, by Euc. I. 34, the angle FDE equals angle FCE, and angle FED equals angle FBD; therefore also, by Euc. I. 32, the third angle DFE is equal to the third angle DAE.

Corollary 2.—It is obvious also that the sides of the triangle DFE are each equal to half the corresponding sides of the triangle BAC, and the area being equal to each of the triangles BDF, FEC, ADE is equal to one-fourth of the whole triangle. Hence, if with three straight lines, each of which is one-half the corresponding side of a given triangle, another triangle be formed, the area of the small triangle is one-fourth the area of the given triangle.

PROPOSITION XLII.—If O (Fig. 42) be any point within a triangle ABC, and D, E, the middle points of AB, AC, and F, G, the middle points of OB, OC, be joined, then will DEGF be a parallelogram. For by the last proposition, since E, G are the middle points of AC, CO, the sides of the triangle ACO, EG is parallel to AO; and since D, F are the middle points of the sides AB, BO of the triangle ABO, therefore DF is parallel to AO; but EG is parallel to AO, hence, by Euc. I. 30, EG is parallel to DF. Again, because D, E are the middle points of BA, AC, the sides of the triangle BAC, therefore DE is parallel to BC; and because F, G are the middle points of the sides BO, OC of the triangle BOC, therefore FG is parallel to BC, and DE is parallel to BC. Therefore, by Euc. I. 30, DE is parallel to FG; hence, since the opposite sides of the four-sided figure DEGF have been proved parallel, it is a parallelogram. Q. E. D.

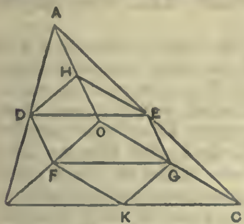


Fig. 42.

PROPOSITION XLIII.—If in the last proposition H, K (Fig. 42) be the middle points of OA, BC respectively, the six-sided figure DFKGEH shall be equal to one-half the triangle ABC. For, by Proposition XLI., since F, G, K are the middle points of the sides of the triangle OBC, the triangles OFG, FGK are each equal to one-fourth of the triangle OBC. Therefore the whole parallelogram OFKG is equal to one-half the triangle OBC; similarly, the parallelogram OGEH is equal to one-half the triangle OCA, and the parallelogram OHDF is equal to one-half the triangle OAB; hence by addition the whole hexagon DFKGEH is half the triangle ABC. Q. E. D.

PROPOSITION XLIV.—If D (Fig. 43) be the middle point of BC, the side of a triangle ABC, and AD be joined, then, if DA be equal to DB or DC, the angle at A is a right angle. For since DA = DB, therefore, by Euc. I. 5, angle DAB equals angle DBA; again, since DA = DC, angle DAC equals angle DCA, therefore, by addition, angles DAB and DAC are together equal to angles DBA and DCA. But angles DAB and DAC make up whole angle BAC; hence angle BAC is equal to the two angles ABC and ACB. But the three angles together are equal to the right angles (Euc. I. 32), hence BAC, the half of the whole, is equal to one right angle. Q. E. D.

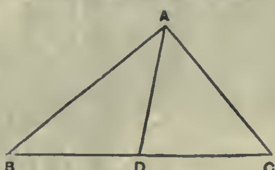


Fig. 43.

With this proposition we conclude our "Exercises in Euclid."

RECREATIVE NATURAL HISTORY.

THE COCOA-NUT PALM.

IT would be difficult to find amongst the legion of priceless gifts with which Nature has enriched the human race, one more marvellous in its range of usefulness than the cocoa-nut palm (*Cocos nucifera*). Not only are its numerous products capable of being utilised in an almost endless number of ways, but the tree itself may be viewed in the light of a pioneer amongst vegetable productions, by whose aid the first links of the great chain of plant-life amongst the newly-formed islands of the southern and eastern seas are established. In order to see how this great work is accomplished, we must first direct our attention to one of the so-called reef-ponds of the South Seas. The irregular ring of coral reef that encircles the central mirror-like pool in all but one narrow space which affords access to the interior, has been formed by the coral insect, which is always at work, rearing his structures directly upwards until the surface is gained. But the action of the waves often breaks down part of his work, and the broken fragments of tide and tempest help to fill up the cavities between the surrounding rocks, and bring the general mass nearer the true sea-level. Shingle, sand, dead and empty shells, and sea-weed all help in filling up the deep rock pools, and form lurking-places for crustaceans who feed on the dead and stranded fish, whose bones, with the cast-off carapaces of the crabs, and the thorn-covered crust of echini, gradually but certainly tend to fill up and make the rugged surface level. Sea-fowl, wearied by their long and devious flights, now take their rest on the newly-formed deposits, and add recent guano, feathers, and dead birds to the increasing store. At length the cocoa-nut, driven before the gale from some distant shore, comes floating along in its dense, tough, boat-like case; and as the breakers dash in on the newly-formed strand, it is cast high and dry amongst the very elements best suited to its development and growth. Warmed by a tropical sun, the germ rapidly shoots forth. The fibres of the old husk help to shelter the new rootlets, until the young palm, in its pride of life and vigour, shoots boldly up heavenwards, bears its crops of rich and massive treasures, which, falling on virgin and fertile soil, in their turn shoot up, fructify, and in turn die, to furnish vegetable elements to the earth by their decay. As the seasons pass on, and tropical storms sweep across islands and continents, land birds, driven from their homes by stress of weather, take refuge in our cocoa-nut grove, and bring with them in their crops the undigested seeds of the trees and plants indigenous to the land they have strayed from. These, falling to earth, grow, blossom, seed, and pass away, to be replaced by a crowd of descendants. Other visitors, bird and insect, follow in due course, until man, discovering the new land, claims it as his own, rears his hut amongst the cocoa groves, and avails himself of the results of Nature's unerring handiwork.

Thus without labour, or the aid of the appliances of semi-civilised life, savage man can find the means of subsistence prepared to his hand. The cocoa-nut palm, however, like most other valuable vegetable productions, has had a great deal of attention paid to its cultivation and management. Few trees of this description thrive well at a greater height above the sea than 600 feet. The range of the cocoa palm is very extensive, as it is found in Africa, the East and West Indies, South America, and throughout the countless clusters of islands which dot the southern seas. Little or nothing is known in this country of the different varieties of nuts produced in different regions; but by the native cocoa-nut growers they are as well understood as distinctive differences between apples and pears grown in our own gardens. In the island of Tahiti (in the Society group), the natives describe six kinds of cocoa-nuts, all of which are known by some particular name. In the island of Ceylon four descriptions of nuts are found, each kind possessing some peculiar and well-marked quality. The *tembili*, for example, is an extremely attractive, rich-looking nut; it is of oval form, and of a warm orange tint. Great numbers of tembili trees are usually cultivated by Buddhist priests in the vicinity of their temples, in order that a number of acceptable offerings to place at the disposal of the charitably disposed traveller may be always at hand when wanted. There are several sub-varieties of the tembili. Then there is the edible-skinned cocoa-nut, or *namasi*; this is of brighter colour than that just described, and is remarkable for the peculiar character of its husk. When the outer skin is removed, the inner rind quickly changes to a light-red colour, when it is eaten without further preparation. This nut is slightly heart-shaped. Another description is remarkable for its smallness and round form; whilst the most common is the ordinary commercial cocoa-nut.

Most of our readers who are in the habit of visiting museums or collections of curiosities, will not have failed to observe specimens of a large, dark-coloured and double-shelled cocoa-nut; the two cavities or bodies being held together by a sort of band, much as the Siamese Twins are united, only that in the case of the nuts the union consists merely of shell, instead of vital tissues. The origin of these double or *sea cocoa-nuts*, as they have been called, long remained enveloped in a cloud of dense obscurity, and all that was known of them was, that after the prevalence of certain winds, they were to be found stranded on the coasts of the Maldive Islands, and that fortunate mariners sometimes discovered them floating on the waves far at sea. Such nuts as reached the shore were considered the sacred property of royalty, and any attempt at concealment on the part of the discoverer was punished by immediate death.

Extraordinary virtues were in early days attributed to these double nuts. Their contents were considered unfailing antidotes to the most virulent poisons, whilst the fast-waning powers of the aged were supposed to be completely restored by a medicine prepared from the sea-nut. The value attached in past times to this production appears in these enlightened days perfectly fabulous. We are informed that the Emperor Rudolph II., when in treaty for one of these much-coveted rarities, caused 4,000 florins to be offered, but that sum being considered by the vendors insufficient, it was refused. We find another instance in which £400 was vainly offered for a specimen; and a third, where negotiations arrived at a more satisfactory termination by a merchant ship, "freighted and stored complete," being offered. Ignorance and superstition walking hand in hand, as they are always found to do, legends of the wildest character were not wanting to add weird mystery to the history of the potent double nut. A wide-spread belief long prevailed that far down in the valleys of the deep sea's bottom, grew green groves of enchanted palms, which faded away from the vision of any diver hardy enough to attempt to reach them; and that amongst these thickets hideous griffins lurked by day, but congregated by night to visit the land, where they made victims of such elephants and tigers as fell in their way. To these submarine griffins was also attributed the power of luring ill-fated barks within the range of their influence, when the hapless mariners navigating the doomed ships were instantly devoured. Backed up by these fell asseverations and royal prerogative, it is not to be wondered at that savage majesty made a rich harvest of the treasures cast upon the strand. The kernel of the nut was supposed to possess all the medical virtues, and it was directed to be associated with a number of ingredients just as useless and inefficient as the nut itself. We read that "*sea-nut* kernel, the antlers of deer, pounded and mixed with ebony filings, red coral dust, and some other inert trash, was capable of restoring decrepit age to the full power of youth." The shell is held in high repute by the religious mendicants of the East as an alms-box, as a notion still prevails that there is a powerful attractive influence residing within it, which seldom fails to extract the coin from the pockets of even the most reluctant. Did a germ of truth lie hidden in this Old World superstition, sea cocoa-nut shells would be still at a premium.

Research has entirely cleared away the mist which so long hung over the origin of this interesting production, which is found growing in the Seychelle Islands, is now known to naturalists as *Ladoicea Seychellarum*, and has been on minute investigation found to contain no virtues whatever to recommend it beyond those possessed by any other member of the cocoa-nut family. To return, then, to the common cocoa-nut of commerce, we find it, when growing in favourable localities, and within the influence of the sea breeze, reaching an altitude of from sixty to eighty feet; but it is rare to find a stem measuring much over two feet in diameter at the base of the tree.

Artists are fond of representing palms of this description growing upright, but it is rare indeed that one can be found which does not deviate considerably from the perpendicular. In fact, almost every imaginable angle of inclination may be studied in a grove of cocoa-nut palms; trade and other prevailing winds often influencing their line of droop or direction.

The rough, scale-like, and pitted nature of the bark, which prevails throughout the length of the trunk, depends on the progressive casting off of the old and matured fronds, as the tree shoots upwards and the head increases in altitude. This condition of matters is taken advantage of by the cocoa-nut growers, as we shall see as we proceed, and it is not these alone who avail themselves of the uneven, rasp-like nature of the palm trunk as a means by which the treasure of the crown may be reached.

If the reader will accompany us on a ramble through a wild cocoa-nut grove situated on one of the coral islands we have endeavoured to describe, we will show him piles of riven cocoa-nut husks, broken shells, tufts of tangled coir or cocoa fibre, and numerous deep subterranean burrows beneath the roots of the trees. The fragments of husk, shell, and fibre we have seen are the results of the depredations of the *ou ou*, or great cocoa-nut crab, the *Birgus latro* of naturalists, and the holes in the earth are its dwelling-places. The annexed illustration represents one of these robber crabs. We are not of opinion that, as some observers have stated, the crab possesses the power of ascending trees but slightly out of the perpendicular; we rather incline to the belief that the fruit of trees growing at a considerable angle, and that naturally falling to the earth, constitute the principal food supply of the crab. The immensely powerful and heavy nippers possessed by this creature enable him to rend asunder the tough envelope of the encased nut with the greatest ease. The husk being torn and slit open, the nut is laid bare; this the crab attacks by perforating one of the three round marks found on the end of every nut. These are devoid of shell, and are easily broken through and converted into one orifice by a series of heavy and well-directed blows which are dextrously delivered by the crab, who makes use of his large nippers as a hammer, and when the shell gives way, inserts his narrow-pointed or extracting nippers, and proceeds to feast on the dainty, won by cunning and strength of claw. Such cocoa fibre as may be formed during the process of nut opening, the *Birgus latro* carries carefully away to his den, cards it up, and lays it aside, to be used as a shelter or nest when the period of shell-shifting and seclusion arrives; and it is most curious that as this period approaches a natural reservoir placed beneath the tail gradually fills with clear, limpid oil, to the extent of a quart or more in large specimens. This oil serves by absorption to supply the waste of the tissues during a species of hybernation which takes place during the formation of the new shell, just as the fatty deposits laid up in the tissues of the bear during his autumn feastings on ripe fruits and honey, enable him, like a lamp slowly burning, to support the feeble flame of life until spring and plenty come again to earth and him. The cocoa-nut crab, although a denizen of the grove, pays occasional visits to the sea, near which his infant progeny are brought to light. He performs some rather odd freaks on these sea-side excursions, but a consideration of them, together with a further history of the cocoa-nut and cocoa-nut consumers, must be reserved for our next paper.

THE COCOA-NUT CRAB (*Birgus latro*).

ASTRONOMY.—VIII.

PRECESSION OF THE EQUINOXES—NUTATION—SOLSTITIAL POINTS—COLURES—LATITUDE AND LONGITUDE—ALT-AZIMUTH INSTRUMENT—PROBLEMS WITH THE GLOBES.

If we look to the celestial globe we shall find that, though the mark ♈ signifying the commencement of the sign *Aries* is placed at the intersection of the equinoctial and the ecliptic, yet the portion of the zodiac commencing at that sign is in reality occupied by the constellation *Pisces* The stars forming Aries are moved 30° to the east, occupying the place assigned to Taurus, and, in the same way, Taurus and all the other zodiacal constellations are moved one sign to the east.

The reason of this is the precession of the equinoxes, which has already been referred to as having been discovered by Hipparchus. The points of intersection of the equator and ecliptic, or, as they are frequently termed, the *nodes*, do not remain constantly in the same place, but are slowly moving towards the west, that is, in a retrograde direction.

This was first observed by noticing that the right ascension of all stars was slowly and uniformly increasing: this could only be accounted for in one of two ways—either they must all be slowly moving forwards, or the point from which we measure their right ascensions must be moving backwards. The latter of these explanations, being by far the most simple, has been adopted. The rate of this motion is but slow, so that its effect on the position of the stars from year to year can only be ascertained by the most careful and delicate observations. When, however, we compare the position of a star with that assigned to it by observers a few centuries ago, we soon become conscious of the change. The most careful observations fix the annual amount of this motion at 50·2″, so that the time occupied by the nodes in making a complete circuit of the heavens would be a little more than 25,800 years. By reckoning back it is found that the constellations and the signs of the zodiac corresponded with one another about the year 370 B.C.

The explanation of this phenomenon requires a higher degree of mathematics than could be introduced into these lessons. We may, however, state generally that it arises from the accumulation of matter at the earth's equator. On account of this the sun and moon exert a more powerful attraction on that part of the earth than on the poles, and thus the position of the axis is slightly altered and the changes spoken of are produced.

In addition to this motion of the pole, there is another of much smaller amount, which is known as *nutation*, or the nodding of the pole. It arises from the fact that the earth's distance from the sun varies at different times of the year, and thus the amount of precession varies slightly from day to day. The effect of this variation is to cause the pole to describe in the course of about eighteen and a half years a very small ellipse, the longer axis being about 18½″ and the shorter nearly 14″. This motion, combined with the other, produces a slightly wavy or undulating movement of the pole; it is only, however, in very accurate observations that this has to be considered.

One important effect of the precession of the equinoxes is to change the position of the pole-star. That at present known by this name is distant about 1½° from the true pole; its distance is, however, gradually diminishing, so that in the course of years it will be within half a degree, and it will then commence to recede from it. In about 12,000 years the brilliant star *Vega*, in the constellation of the Lyre, will be very close to the pole, and serve as pole-star.

A strange circumstance has been discovered in connection with this change in the position of the pole-star. Nearly 4,000 years ago the star *Etanin*, the third in magnitude in the constellation Draco, was very near the pole. About this period many of the pyramids of Egypt were built, and it is found that several of these have openings on their north sides inclined at an angle of about 26° to the horizon. These passages are all directed towards the meridian, and their inclination is such that an observer standing at the bottom of any one of them would have been able to see the pole-star at the time of its crossing the meridian below the pole. This corroborates the calculations of astronomers, and at the same time confirms the idea that the ancients were attentive observers of the motions of the stars.

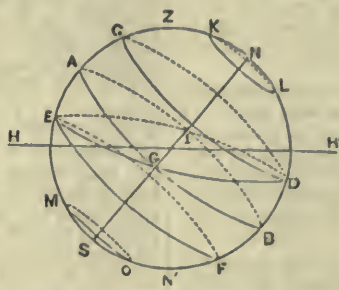


Fig. 11.

Fig. 12.

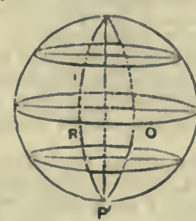


Fig. 13.

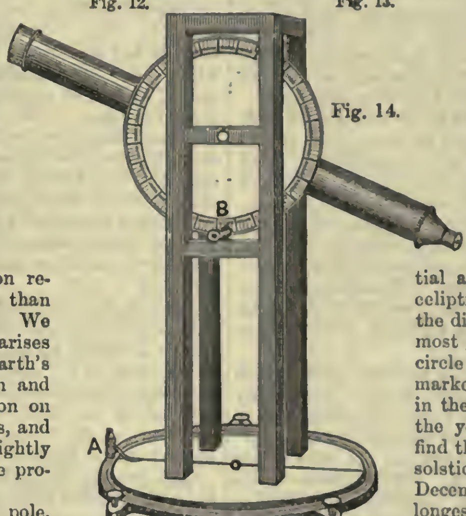


Fig. 14.

Fig. 11 represents the position of the globe to an observer in the latitude of London, the angle at which the axis N S is inclined to the horizon H H′ being just 51½°; Z is the zenith, and N′ the nadir. The great circle A G B I represents the equator, and E G D I, inclined to it at an angle of 23½°, the ecliptic, G and I being the nodes; G is sometimes called the ascending node, as at this point the sun passes north of the equator, and I is the descending node.

There are also two other points E and D in the ecliptic specially distinguished, and known as the *solstitial points*. These are situated midway between the nodes, and are at the commencement of the signs of Cancer and Capricornus. The term *solstitial* is derived from *sol*, the sun, and *stare*, to stand, and is applied to these points because when the sun reaches them it has attained its greatest north or south declination, and appears to stand still for a few days before commencing to retrace its steps. Two great circles are drawn on the celestial globe passing through the poles, the one, N G S I, passing likewise through the equinoctial points, and the other, N E S D, through the solstitial points, and these are known as the equinoctial and solstitial *colures*. They divide the ecliptic into four equal portions, and mark the divisions of the seasons of the year. On most globes there is on the wooden horizon a circle in which the days of the month are marked, so that by it the sun's actual place in the ecliptic can be found for any day of the year, and by reference to this we shall find that the days on which the sun is at the solstices are the 21st of June and the 21st of December, and these are respectively the longest and shortest days.

Two small circles, C D and E F, parallel to the equinoctial, and passing through the solstitial points, are known as the *Tropics*, that to the north being distinguished as the Tropic of Cancer, while the southern one is called the Tropic of Capricorn. These are, however, of more importance in the use of the terrestrial globe than in that of the celestial. There are also two circles, K L and M O, situated at a similar distance from the poles, which mark the limits of the polar regions, from which the sun is sometimes hidden for more than a complete day. These are known as the Arctic and Antarctic circles. The shading in Fig. 12 represents the extent of the earth's surface which is illuminated when the sun has attained its greatest south declination, at which time, as will be seen, the Antarctic circle is completely illuminated, while the sun is altogether hidden from the Arctic.

The most usual way of describing the position of any star in the heavens is by giving its declination and right ascension, as described in our last lesson, the distances being reckoned from the equinoctial. Sometimes, however, these distances are measured from the ecliptic, and are then called the latitude and longitude. Parallels of latitude are frequently drawn on the celestial globe to enable the latitude to be found without difficulty; the pole of the ecliptic is, of course, the centre of these circles. Longitude, like right ascension, is reckoned from the point Aries, and, like it, is reckoned only in one direction, from 0° to 360°. Terrestrial longitude, on the other hand, is reckoned from 0° to 180°, east or west.

In Fig. 13, if I represents the place of any heavenly body, and O be the point ♈ in the ecliptic, then the number of degrees in the arc I R will give its latitude, and the number in O R will give its longitude.

Another way in which the position of a star may be described is by giving its altitude and azimuth; as, however, these vary greatly from hour to hour, the exact time must be given likewise, and then they afford an easy way of ascertaining its position in the heavens, without reference to a globe or to any other stars. It is also easier for the amateur to note these measurements than to describe the position in either of the other ways mentioned.

To determine the altitude, a great circle of the heavens is supposed to pass through the star and also through the zenith, or part of the sky vertically over head, and the *nadir*, which is diametrically opposite to the zenith, and is the part of the heavens directly under our feet. We then measure the arc of this circle contained between the horizon and the star, and this is its elevation above the horizon, or, as it is called, its altitude. It is, in fact, the angle contained between lines drawn from the observer to the star, and to the point of the horizon directly under it.

Having measured this, we must then ascertain the distance of the point where this circle cuts the horizon from the north or south points, and this distance is called its *azimuth*. As will easily be understood, to an observer at the poles the altitude of a star will exactly correspond with its declination, and remain unaltered, while the azimuth will be continually changing, as it is reckoned from a point of the earth, and not from a fixed point in the sky. At the equator, the azimuth remains the same, but at all other places both vary constantly.

A telescope may easily be mounted so as to indicate at once the altitude and azimuth of any star, and an instrument of this kind will be found very useful. In actual practice a great many modifications and additions are made, but the form of mounting sketched in Fig. 14 will serve well to explain the construction, and guide the student should he resolve on making such an instrument for himself. The base consists of a flat circle of wood, and is fitted with levels and levelling screws, so that it may be placed perfectly horizontal. This circle is accurately divided into degrees, reckoning each way from the north and south points, and in use must be adjusted so that these points are due north and south.

The telescope and stand is fixed to another circle, which turns on the lower one, and has marked on it a line exactly corresponding with the direction of the tube. A microscope, A, placed at the extremity of this, serves to read off the azimuth.

A similarly graduated circle is attached to the tube of the telescope, so as to turn vertically with it. The divisions on this are so placed that, when the tube is perfectly horizontal, a second microscope placed at B shall read 0°, and thus when the tube is pointed to any star, and clamped in that position, its altitude and azimuth can at once be ascertained. A telescope thus mounted is called an *alt-azimuth* instrument.

As the sky appears to be in constant rotation, it will easily be seen that these measures are continually altering; by noticing, however, the exact time of observation, we shall be able to assign the place of the star on the globe.

To do this we must first bring the globe into such a position as exactly to represent the appearance of the sky at that particular time. This is a problem of very easy solution, but attention should be paid to it, as it will very frequently prove a great help to the student to place the globe in this position when he is endeavouring to become familiar with the constellations. If the globe is correctly adjusted, and placed so that its brass meridian points exactly north and south, any desired star can easily be found. The only difficulty is that we look at the globe from the outside, while we gaze on the vault of heaven from a point within it, and thus the relative positions of the stars are reversed. If, however, we take an ordinary pencil with a flat end, and place it on the star's place on the globe, so that its head may be directed backwards to the centre of the globe, the pencil will point to the star, and thus it may, after a little practice, be found without difficulty.

Now we have already learnt that at the equator the pole-star appears to be in the horizon, and as we recede from it this star increases in altitude; the first thing, then, which we have to do is to elevate the pole above the horizon as many degrees as are equal to the latitude of the place at which we are. We will suppose that London is the place of observation, and, as its latitude is $51\frac{1}{2}°$, we will elevate the pole this amount above the north point of the horizon. We next find the position of the sun in the ecliptic on the day by referring to the wooden horizon of the globe. Let us suppose the time of observation is eleven o'clock in the evening of the 3rd of June. We first find June 3rd on the horizon, and opposite to it we shall find the 13th degree in Gemini. Now refer to the ecliptic, and, having found this place on it, bring it to the brass meridian, and adjust the brass circle round the pole, called the hour circle, so that XII. on that shall be under the meridian. The globe then represents the position of the heavens at noon on the day, but it is constantly turning towards the west, and we must, therefore, turn it westward till the hour circle shows that eleven hours have been passed over, and the hour XI. comes under the meridian. Fixing the globe in this position we now place it in the open air, so that the north pole points to the north or to the pole-star, and we have it then accurately representing the visible sky.

When the globe has been set thus, we fix the quadrant of altitude to the brass meridian, exactly in the zenith. As one side of the brass meridian is graduated towards the pole, and the other from it, this is easily done by fixing it at the degree which marks the latitude, that is, at $51\frac{1}{2}°$, and by bringing the graduated edge of it to any star we can at once read off the altitude; the point, too, where it cuts the horizon will show its azimuth. Thus, with the globe in this position, we will find the altitude and azimuth of the bright star Regulus in the constellation Leo. On bringing the quadrant of altitude against its centre, we find its elevation above the horizon to be about $12\frac{1}{2}°$. This, therefore, is its altitude at the hour named, a trifling allowance being made for refraction, the extent of which for each degree of elevation is shown in refraction tables. On referring now to the inner circle of the wooden horizon, we shall find that the degree of it indicated by the quadrant is 84° west of the north point; this, then, is its azimuth and its place is fully known when we say that at eleven o'clock in the evening of the 3rd of June its altitude is $12\frac{1}{2}°$, and its azimuth 84° west of north.

We will give one more problem of the same kind. On the 15th of November, at half-past seven in the evening, a bright star is observed at London, whose altitude is about $17\frac{1}{2}°$, and its azimuth is 85° east of north; find the star. On referring, as before, to the globe, we shall learn that the star is Aldebaran, situated in the head of Taurus, or the Bull, and in close proximity to the V-shaped cluster of the Hyades. This the student should verify for himself by reference to the globe.

Occasionally, the *polar distance* of a star is given, that is, the arc contained between it and the pole. A moment's thought, however, shows that this is merely the *complement* of the declination, or the amount required to make it up to 90°. In a similar way, the *amplitude* of any object is the complement of its azimuth, or its distance from the east and west points of the horizon. It is only applied to the sun or a star when rising or setting, and signifies the arc of the horizon included between their position at that time and the east or west points. At the period of the equinoxes the sun rises due east and sets due west; in the winter months, however, he rises some distance to the south of the east point, and sets a similar distance to the south of the west; while in the summer, when he has north declination, he rises and sets to the north of these points. The exact position of its rising and setting on any given day can very easily be found. We have only to elevate the pole of the globe to the latitude of the place, and then, having found the sun's place in the ecliptic, turn the globe slowly round, and note where this point cuts the eastern horizon in rising and the western in setting. Thus, for example, it is required to find at what points of the horizon the sun will rise and set at Madras on the 1st of January. Having elevated the pole 13° 10′ above the horizon (that being the latitude of Madras), we find the sun's place on the given day to be 10° in Capricornus, and, bringing this point successively to each side of the horizon, we find it rises 24° south of the east, and sets a similar distance south of the west. These measurements are chiefly employed in testing the accuracy of the compass.

The magnetic needle, though commonly said to point due north, does not in reality do so, as may be easily seen by comparing the direction as shown by it with that of the pole-star. This deviation of the compass from its true bearing is called the variation of the compass, and is found to vary from year to year; it is likewise different in different parts of the world at the same time.

About the year 1660 the variation was zero, the needle then pointing due north; previous to this it had pointed east of the north, but since that time it has pointed west of it. The variation then gradually increased till in 1818 it had attained a maximum of 24½°; since then it has been diminishing, and at the present time it points about 21° west of the north point. A line is usually drawn on a compass-card at the right angle for the year in which it is made, and when the needle is parallel with this the compass-card indicates the correct bearings.

We append a few problems for the student to solve by the aid of the globe.

1. Find the declination and right ascension of the stars *Vega* in Lyra, and *Arcturus* in Bootes.
2. Give the latitude and longitude of *Aldebaran* in Taurus, and *Sirius* in Canis Major.
3. What star has 32° N. decl. and 111° R.A.?
4. Find the altitude and azimuth of the star *Regulus* in Leo, as seen at Paris at 8 P.M. on the 3rd of February.
5. In a place situated in 45° N. latitude, a star is observed at 9.30 P.M. on the 25th of October; its altitude is found to be about 31° N., and its azimuth 56° E. of N. Find the star.
6. What is the sun's amplitude in London on the 24th of June?

LESSONS IN ITALIAN.—XIX.

THE PREPOSITION *CON*.

WHEN the preposition *with* denotes company, society, union, community, connection, or when it denotes the instrument or means by which something is effected, it coincides with the use of *con* in Italian. In the former case, the words *together with*, *besides*, *to*, or similar ones, and in the latter, the words *by means of*, *by agency of*, *by dint of*, *by*, *through*, are frequently equivalents of *with*, and are translated by *con*. For example :—

An-dá-re col fra-tél-lo, to go with the brother.
Si as-so-ciò con un mer-cán-te, he entered into partnership with a merchant.
És-se-re, stá-re con ú-no, to be with one, to belong to one; *i.e.*, to one's family, company, etc.
Con chi stá-te voi? with whom are you? (*i.e.*, in whose service are you? or, with whom are you on a visit? or, with whom do you stay and take dinner? etc.)
Vén-go con voi, I come with you.
Com-bát-te-re col ne-mí-co, to fight with the enemy.
Con-giú-gne-re un sog-gét-to col sú-o pre-di-cá-to, to join a subject to its predicate.
Con-cer-tá-re ú-na có-sa con ú-no, to concert a thing with one.
Pa-ra-go-ná-re ú-na có-sa con un' ál-tra, to compare one thing with another.
Con qué-ste má-ni, with these hands.
Con gran fa-tí-ca, with great pains.
Con fró-de ed in-gán-no, with fraud and deceit.
Con un col-tél-lo, with a knife.
Con un scú-do gua-da-gnár-ne tre, with one crown or dollar to gain three.
La-vo-rá-re cól-la líma, col pen-nél-lo, col scar-pél-lo, to work with the file, with the pencil, with the chisel.
Fá-re ú-na có-sa con pia-cé-re, con do-ló-re, con fa-ci-li-tá, con dif-fi-col-tá, con de-stréz-za, con buón gár-bo, to do a thing with pleasure, with grief, with ease, with difficulty, with skill, with good grace.

The adverb *in-siê-me*, together, very frequently has the preposition *con* after it, and exactly coincides with the English *together with*. For example :—

In-sié-me con lui, together with him.
In-sié-me con un' ál-tro, together with another.
I'-o in-sié-me con mí-o pá-dre, I together with my father.*

It is obvious that it is not allowed to translate *with* by *con* whenever this preposition does not represent any of the above-stated meanings; for example, I am satisfied with him, *só-no con-tén-to di lui*; I am delighted or greatly pleased with you, *mi ral-lé-gro di voi*. In these cases, to translate *with* by *con* would completely alter the sense. *Só-no con-tén-to con lui*, and *mi ral-lé-gro con lui* (*di quál-che có-sa*), would mean, I am satisfied *along with him* (*i.e.*, as well as he), and I am delighted or greatly pleased *along with you* (*i.e.*, as well as you = *I congratulate you on something*).

Con, with a noun following, frequently supplies the place of adverbial expressions. For example:—*Con pru-dén-za*, with prudence; *con ci-vil-tá*, with politeness; *con so-brie-tá*, with sobriety; *con su-pér-bia*, with haughtiness, etc.: for *pru-den-te-mén-te*, prudently; *ci-vil-mén-te*, politely; *so-bria-mén-te*, soberly; *su-per-ba-mén-te*, haughtily, etc.

Con, before an infinitive, which in this case occupies the place of a real noun, is quite an idiom, and will be best translated by the prepositions *by*, *through*, by the conjunctions *while*, *when*, *as*, and particularly *and*, or by the *present participle* of the English verb. For example :—

Coll' an-dá-re a spás-so non si può ar-ric-chí-re, by taking walks (*i.e.*, by idling) one cannot get rich.
E'-gli si scu-sò con dí-re . . . he excused himself by saying, saying, and said, while he said.
E'-gli fé-ce te-sta-mén-to con fár-mi e-ré-de di túl-to il sú-o, he made his will, and constituted (or constituting) me heir of all his property.

VOCABULARY.

Andar, to go, going, pace, walk, course.
Bottone, button.
Coda, tail.
Colore, colour.
Colpo, blow, knock, shot.
Con sua buona grazia, with your kind permission.
Egli lo prese, he tock it.
Favorite, please.
Fazzoletto, handkerchief, pocket-handkerchief.
Forza, power, strength, force (*con ogni forza*, or *con tutta la forza*, with all one's might, with might and main, by main force).
Fu ucciso, he was killed.
Garbo, good grace, pleasing manners (*bel garbo*, address, skill).
Grazia, grace, charm, favour, kindness, permission, gracefulness.
Guardar, to look.
Lanterna, lantern.
Magnificenza, magnificence (*con ogni magnificenza*, most magnificently or superbly).
Me, me.
Meco, with me.†
Mi disse, he told me.
Non s' accordano, do not match.
Occhio, eye (*guardar uno colla coda dell' occhio*, to look at one from the corner of one's eyes, generally from contempt, also from suspicion or envy, to look askance or cast a suspicious glance at one, to look at one with an evil eye).
Ogni, each, every, all.
Parlando, speaking (*con rispetto parlando*, with respect).
Pistola, pistol.
Poco, little (*poco garbo*, want of good grace, unskilfulness, awkwardness).
Porta, carry.
Rispetto, respect, regard, deference.
Salvo, m., *salva*, f., safe, secure, saved unhurt.
Se, himself, him.
Sembiante, visage, face, countenance, appearance, air, aspect.
Si netta, he wipes himself clean.
Studio, study, diligence, care (*con istudio* or *a studio*, on purpose, intentionally).
Stupore, astonishment, surprise, amazement.
Te, thee.
Temperare, to mix, dilute.
Tempo, time (*coll' andar del tempo* or *col tempo*, in time, in time to come, hereafter).
Turbato, disturbed, alarmed, troubled.
Venia, f., remission, forgiveness (*salva venia*, with your permission).
Venir, to come.
Via di quà, away with.
Vino, wine.

EXERCISE 21.

1. Si nét-ta col faz-zo-lét-to. 2. Guar-dár cól-la (con la) có-da dell' óc-chio. 3. Tem-pe-rár il ví-no coll' á-cqua. 4. Fa-vo-rí-te di ve-nír con me (or *mé-co*). 5. Pòr-ta té-co (con te) la

* It is also allowable to separate *in-sié-me* from *con*, and to place it after the case governed by *con*. For example, *con lui in-sié-me*, together with him; *mé-co* (i.e., *con me*) *in-sié-me*, together with me. The adverb *in-sie-me-mén-te* also means together with, but it is not so much in use as *in-sié-me con*.

† In the place of *con me*, with me; *con te*, with thee; and *con se*, with himself, herself, itself, themselves, *meco*, *teco*, and *seco*, are frequently used; and in elegant style *con* as a mere expletive, *con meco*, *con teco*, *con seco*.

lan-têr-na. 6. E'-gli lo pré-se sé-co (con se). 7. Coll' an-dár del têm-po. 8. Fu uc-cí-so con un cól-po di pi-stô-la. 9. Con sem-bián-te tur-bá-to mi dís-se. 10. Con i-stú-dio. 11. Con i-stu-pó-re. 12. Qué-sti bot-tó-ni non s' ac-côr-da-no col co-ló-re. 13. Ví-a di quà con qué-sta cô-sa. 14. Con bêl gár-bo (or *con bêl-la grá-zia*). 15. Con pô-co gár-bo. 16. Con sú-a buô-na grá-zia. 17. Con ó-gni ma-gni-fi-cên-za. 18. Con ó-gni fôr-za. 19. Con ri-spêt-to par-lán-do (or *sál-va vê-nia*).

Vocabulary.

A-dôl-fo, Adolphus.
Am-ma-lá-to, distempered, diseased, out of health, sick, ill.
An-có-ra, yet, still, also, even, again.
An-tô-nio, Anthony.
Ar-ri-vá-to, arrived.
Car-lí-na, Caroline.
E' di, belongs to (*i.e.*, is of).
En-rí-co, Henry.
Fer-di-nán-do, Ferdinand.
Fran-cé-sco, Francis.
Gió-va-ne, young.
Gu-gli-êl-mo, William.
Il giar-di-niê-re, m., the gardener.
Il gió-va-ne, the young man, youth.
Il sêr-vo, m., the servant.
Il sol-dá-to, m., the soldier.
Il vi-cí-no, m., *la vi-cí-na*, f., the neighbour.
L' ál-bero, m., the tree.
L' a-mí-co, m., the friend; *l' a-mí-ca*, f., the female friend.
L' uô-mo, m., the male person, human being, man, husband.
La dôn-na, f., the woman, wife, lady, mistress.
La giar-di-niê-ra, f., the female gardener, the gardener's wife.
Lôn-dra, London.
Lo sco-lá-re, m., the pupil, learner, scholar.
Lo scul-tó-re, m., the sculptor, statuary.
Lu-í-gi, Lewis.
Lu-í-gia, Louisa.
Pa-rí-gi, Paris.
Par-tí-to per, departed for.
Pó-ve-ro, poor, needy, wanting.
Ríc-co, rich, wealthy, opulent.
Ri-dôl-fo, Rodolph, Ralph.
Si chiá-ma, is called.
Stê-fa-no, Stephen.
Ve-né-zia, Venice.
Vi-ên-na, Vienna.

Exercise 22 (Colloquial).

1. Hô ve-dú-to l' om-brêl-la di vô-stro pá-dre. 2. L' a-mí-co di mí-o zí-o è ríc-co. 3. Quest' uô-mo è l' a-mí-co di mí-o pá-dre. 4. Il fan-ciúl-lo di quest' uô-mo è am-ma-lá-to. 5. Qué-sto fan-ciúl-lo è an-có-ra gió-va-ne. 6. A-vé-te voi ve-dú-to l' ál-be-ro che mí-o pá-dre ha com-prá-to? 7. L' uô-mo, che a-vé-te ve-dú-to, è mól-to pô-ve-ro. 8. Sú-o fí-glio è am-ma-lá-to. 9. Hô dá-to la pén-na a qué-sto pô-ve-ro fan-ciúl-lo. 10. A-vé-te voi ve-dú-to, l' o-ro-lô-gio che mí-o zí-o ha ri-ce-vú-to? 11. E'-gli ha ven-dú-to qué-sto o-ro-lô-gio a mí-o pá-dre. 12. La zí-a di qué-sto gió-va-ne è an-có-ra am-ma-lá-ta. 13. Qué-sto pô-ve-ro fan-ciúl-lo ha per-dú-to sú-a má-dre. 14. Il mí-o a-mí-co è un uô-mo mól-to ríc-co. 15. Quest' uô-mo è il nô-stro giar-di-niê-re. 16. Qué-sta dôn-na è la nô-stra giar-di-niê-ra. 17. Il nô-stro vi-cí-no è ric-chís-si-mo. 18. La vô-stra vi-cí-na è ú-na buô-na dôn-na. 19. Il fan-ciúl-lo di qué-sto scul-tó-re si chiá-ma Gu-gli-êl-mo. 20. La zí-a di Fer-di-nán-do è ar-ri-vá-ta; ma sú-o pá-dre è par-tí-to per Lôn-dra. 21. La so-rêl-la di Lu-í-gi è gran-dís-si-ma. 22. Pên-so ad En-rí-co ed a Stê-fa-no. 23. La zí-a di Lu-í-gia ha scrít-to ú-na grán-de lêt-te-ra ad A-dôl-fo. 24. Fran-cé-sco ha ri-ce-vú-to qué-sta pén-na da un gió-va-ne, che si chiá-ma Ri-dôl-fo. 25. Il cu-gí-no di Gio-ván-ni è par-tí-to per Pa-rí-gi. 26. Il nô-stro sêr-vo è ar-ri-vá-to da Lôn-dra. 27. Mí-a so-rêl-la pên-sa a Car-lí-na. 28. Stê-fa-no ha per-dú-to il tem-pe-rí-no ch' é-gli ha ri-ce-vú-to da A-dôl-fo. 29. Lu-í-gia è la so-rêl-la di Car-lí-na, ed An-tô-nio è il fra-têl-lo di Gio-ván-ni.

Exercise 23 (Colloquial).

1. My book is on the form. 2. I have given my hat to this poor child. 3. The book which I have received from a friend is lost. 4. Louisa has lost her bonnet. 5. Have you (*sing.*) found Charles's ring? 6. Henry's father (*i.e.*, the father of Henry) is very rich. 7. John's garden is very small. 8. William's friend has departed. 9. My cousin has (*i.e.*, is) arrived. 10. We have received a letter from Louis; he is at Milan. 11. Have you seen Francis and Ferdinand? 12. Rodolph has departed for Venice. 13. We have written a letter to Stephen in Paris. 14. Have you (*sing.*) seen the watch of Louis? 15. Has (*i.e.*, is) your (*sing.*) uncle departed for Paris? 16. Caroline's aunt is in London. 17. Our (male) neighbour has a son, who is called Adolphus, and a daughter who is called Louisa.

Vocabulary.

And we always have to do, *e si ha da far sêm-pre.*
Came here, *ar-ri-vò qui.*
Coach, *car-rôz-za*, f.
Country, *cam-pá-gna*, f.
Courier, *cor-riê-re*, m.
Cousin, *cu-gí-no*, m.
Dead, *mór-to*, m.
Express order, *ór-di-ne es-prês-so*, m.
For, *per.*
First part, *prí-ma pár-te*, f.
General, *ge-ne-rá-le*, m.
Has gone to dine, *è an-dá-to a pran-zá-re.*
Himself, *sè stês-so.*
His life, *la sú-a ví-ta.*
Horse, *ca-vál-lo*, m.
Is filled with, *è piê-no di.*
Last, *úl-ti-mo*, m., *úl-ti-ma*, f.
Living, *ví-vo*, m.
Nephew, *ni-pó-te*, m.
News, *nuó-va*, f.
Next, *ven-tú-ro*, m., *ven-tú-ra*, f.
Ought to spend, *dê-ve pas-sá-re.*
Park, *par-co*, m.
Peace, *pá-ce*, f. (*i.e.*, news of the peace).
Second, *se-cón-do*, m., *se-cón-da*, f.
(There) has arrived, *è giún-to.*
They will go, *vô-glio-no an-dá-re.*
Together (all), *túl-ti in-siê-me.*
To buy, *di com-prá-re.*
Ungrateful (person), *in-grá-to*, m.
We live, *si ví-ve.*
We work, *si la-vó-ra.*
Week, *set-ti-má-na*, f.
World, *món-do*, m.

Exercise 24.

1. The nephew has gone with the general's son and daughter into the park to dine there. 2. Next week they will go together into the country. 3. A courier has arrived with the news of the conclusion of peace. 4. The cousin came here with the express order to buy a horse and a coach. 5. Man ought to spend the first part of his life with the dead, the second with the living, and the third with himself. 6. The world is filled with ungrateful persons: we live with the ungrateful, we work for the ungrateful, and we always have to do with the ungrateful.

KEY TO EXERCISES IN LESSONS IN ITALIAN.—XVIII.

Exercise 18.

1. She is in the next room. 2. I am almost in port. 3. He is in Austria, in Italy, in the country, spending the summer season. 4. He goes into the garden, into that room, to France, to the country, to Scotland, to Turkey. 5. Both died in one day, and in one hour. 6. Thou wast in church. 7. Is there nobody at home? 8. He is in the yard, in the kitchen, in the cellar. 9. He has gone to church, to town, to the square, to the tavern, to the theatre. 10. He lived in that house. 11. I found him in bed. 12. Anthony is angry with me. 13. It is spoken of in the whole city. 14. He departed in haste. 15. He went there in a carriage. 16. To-morrow we shall be able to go in a sledge. 17. They have gone out at this moment. 18. You are now in my hands. 19. I came before him on tiptoe, and here I wait till he comes. 20. I rely on my brother's ability. 21. Some copies will be printed on parchment. 22. You are in the bloom of youth, the prime of life. 23. You have had fine weather for your journey.

Exercise 19.

1. Il giardino di mio zio è grandissimo. 2. Abbiamo veduto la tavola ed il letto di tuo padre. 3. Avete voi trovato l'ombrella di tuo padre? 4. Ho ricevuto questo mantello da mia zia. 5. Avete voi ricevuto un libro da questo fanciullo? 6. Abbiamo prestato il nostro ombrello a vostro fratello. 7. Avete voi trovato questa penna nella vostra scuola? 8. Abbiamo scritto una lettera a nostro zio ed a nostra zia. 9. Vostra madre ha dato una cuffia a mia sorella. 10. Avete voi veduto un piccol fanciullo nel nostro giardino?

Exercise 20.

1. Gl' infelici trovano consolazione in isperanza. 2. In libri si trovano i mezzi per devenir dotto. 3. Vostra sorella non è nella camera, ella sara andata o nella cucina o nella cantina. 4. Vogliamo andare e far colazione nel casinetto? 5. In un' aggradevole campagnia il tempo passa assai presto. 6. C' è nissuno nel castello? 7. No, il castaldo è uscito in questo punto. 8. Voi avete avuto bel tempo nel vostro viaggio. 9. Voi avrete (ella avra) in questo biglietto l'indirizzo del conte. 10. Egli nascose la chiave in quell' armadio.

COMPARATIVE ANATOMY.—XXII.

MAMMALIA—CLASSIFICATION—(*conclusion*).

To trace the history of the various classifications to which naturalists have subjected the animals comprising the mammalian division of the Vertebrata, would in itself form an interesting subject of inquiry. We must, however, only briefly review it, and confine ourselves more exclusively to the classification now adopted.

Constituting the highest group in the animal kingdom, being gifted with the most complex organisation and highest intelligence, possessing strongly marked differences—with the exception of those transitions by which Nature gradually passes from one to another form—and the facilities which they afford for the observation of their habits, and the examination of their organs and tissues, have rendered mammals the chief objects of attention to naturalists, even from the earliest times. Numerous passages in Holy Writ, and the language spoken by ancient monuments long prior to the time of the Greeks and Romans, clearly and conclusively confirm the fact that knowledge of the habits and distinctions of these animals must have been of very early date. The name of that descendant of the Æsculapian race, and disciple of Plato, Aristotle (born 384 B.C.), stands foremost in the rank of zoologists as the author of a classification, but not so much of animals as of the organs of animals. This may be accounted for by the tale which Pliny tells us, "that Alexander the Great being smitten with the desire of knowing the natures of animals, ordered several thousand persons over the whole of Asia and Greece, who lived by hunting, bird-catching, and fishing, or who had the care of parks, herds, rivers, stews, and aviaries, to furnish Aristotle with materials for a work on animals." Many ancient writers followed in the wake of Aristotle; but it is only within the last three hundred years—more especially the last hundred—that decided advance has been made towards that desirable end, an accurate classification of this very important kingdom.

In 1551 Conrad Gesner, an eminent naturalist, adopted, in his "History of Quadrupeds," the simple method of classifying them alphabetically.

The first step towards a scientific classification was made by one of our own countrymen, John Ray, justly called the precursor of Linnæus. He divided the Mammalia into two great classes: the ungulated, or hoofed animals; and the unguiculated, or animals with nails or claws. Both Linnæus and Buffon borrowed largely from the works of Ray. The former adopted the same divisions as Ray, each of which he further divided into five families, and at a later period added several new genera. In 1780 Storr published his "Prodromus," in which he divided this class into three phalanxes: the first consisting of those mammals which have feet proper for walking; the second, of those whose feet are fin-shaped, but with distinct toes; and the third, of those which have true fins, without any apparent toes. Five years later Boddaert divided them into two great groups: the terrestrial and the aquatic mammals. In 1798 Cuvier published the "Elementary Table of Animals," which afterwards he developed into his "Comparative Anatomy and Animal Kingdom." He separates mammals into fourteen orders, and these again into families.

Desmarest, taking Cuvier and Storr for his guides, makes three sections: the unguiculated, the hoofed, and the finned Mammalia. The most recent classification is that by Professor Huxley, founded upon the ingenious one of the celebrated French anatomist, M. Blainville, who divided them into three primary groups, according to the characters of their reproductive organs, especially the reproductive organs of the female; viz., the Ornithodelphia, Didelphia, and the Monodelphia.

1. The *Ornithodelphia* (ὄρνις, *a bird*; δελφύς, *a womb*) comprises those two remarkable genera of mammals, the Ornithorhynchus and Echidna, which constitute the order Monotremata.*

2. The *Didelphia* (δι, *two*; δελφύς, *womb*) contains only a single order, the Marsupials.

3. The *Monodelphia* (μονος, *single*; δελφύς, *womb*) comprises all the orders of Mammalia with a single uterus, or womb, in which the young are developed and nourished by means of a placenta, which, closely attached to the uterine walls, enables the maternal blood to pass to the offspring, and the waste products, which result from the rapidly developing tissues, to be removed away from it. Certain orders have a discoidal deciduate placenta. These are:—

1. The *Primates*, containing three sub-orders. (*a*) *Anthropoidæ*, man. (*b*) *Simiadæ*, apes and monkeys. (*c*) *Lemuridæ*.

2. The *Insectivora*.—The so-called flying lemurs (galeopithecus). The hedgehogs, shrews, and the moles belong to this order.

3. *Cheiroptera*.—Bats.

4. *Rodentia*.—Rats, hares, squirrels, etc.

Three orders possess a zonary deciduate placenta:—

1. The *Carnivora*.—This order contains all the cats, hyænas, civets, dogs, bears, weasels, racoons, and seals.

2. The *Proboscidea*.—The elephants, mastodons, and dinotheria constitute this order.

3. *Hyracoidea*.—Containing the single genus hyrax.

The following orders have a non-deciduate placenta:—

1. The *Ungulata*.—This order is divisible into two sub-orders, which pass into one another. (*a*) The Periss-odactyla (horses, rhinoceroses, tapirs, palæotheria, macrauchenia), with the third digit of each foot symmetrical in itself, etc. (*b*) The Artiodactyla (hippopotamuses, pigs, anoplotheria, ruminants).

2. *Cetacea*.—In this order the whalebone whales, the dolphins, and the extinct zeuglodonts, are comprised.

Two orders of monodelphous Mammalia remain—the Sirenia and the Edentata. The placentation of the first is unknown; and of the second, variable.

The existing Sirenia are the estuarine, or littoral, dugongs and manatees. The sloths, the extinct megatherium, and its allies the ant-eaters, the pangolins, and the armadilloes belong to the order Edentata (Huxley).

If we deny Divine agency, there is something utterly incomprehensible in the whole of Nature's works. Through a progressive series of years we find plant and animal alike faithful to their individual kind, propagating beings similar to themselves with undeviating regularity; and, except under certain abnormal or artificial conditions, never departing from their peculiar type. Each species, and the individual families which it comprises, as well as animals, have their history traceable back to the time of the light-giving genesis mentioned in the first page of sacred history. Through the long period of time which has elapsed since then—while nations have risen from a barbaric to a powerful and wealthy condition; while cities have been raised up in all the lofty grandeur and magnificence which characterise wealth and power; and while nations and cities alike have passed away, either suddenly by the disasters of war, or by the gradual process of decline and decay, till they have become mere historic affairs—the world of plants and animals have preserved, in all the pristine excellence of their original conditions, every essential feature of their primitive type.

Every living being can, in a greater or less degree, contribute towards the reproduction of beings like itself.

This power of reproduction of kind, possessed alike by plants and animals, constitutes one of the most important and interesting subjects which the naturalist has to deal with. From the simple method of subdivision, or that of budding, in the lowest forms of living beings, to that more complex process by which reproduction is effected in the higher forms of animal life, we can trace a similar agency. As Dr. Watts has beautifully remarked, "Ever since the week of creative wonders God has ordered all these creatures to fill the world with inhabitants of their own kind. And they have obeyed him in a long succession of almost six thousand years. He has granted a divine patent to each creature for the sole production of its own likeness, with an utter prohibition to all the rest."

In the lowest scale of animal life the law "increase and multiply" is more energetically and abundantly carried out than in the higher forms. With complexity of tissues, increased number of independent organs, and increased intelligence, a longer time is required for the maturation of the embryonic young. To this end, the higher animals are provided with a distinct set of organs, devoted exclusively to reproduction. There are two distinct modes of development in plants and animals—the non-sexual and the sexual. The non-sexual mode of reproduction occurs only in the lower forms of animal life, and consists of fission, or simple cleavage; or of gemmation, or budding. By fission is meant a constriction occurring in the soft body of an animal, ultimately cutting off a part, which is a complete and independent individual in every respect, as the parent from which it has been severed (Marshall). The constriction may occur at one or several parts. Infusorial animalculæ, and the segments of some of the intestinal vermiform entozoa, are developed after this manner. Some of the annelida (worms) when cut across develop a new head to the lower half and a new tail to the upper portion of the divided body.

By gemmation offshoots or buds spring from the body of the parent animal, in some instances adhering to the parent stem, and in others, becoming detached, move away and develop themselves as independent organisms.

In the sexual or oviparous mode of reproduction, an ovum

* Μονος, *single*; τρῆμα from τιτραίνω, *to pierce*: having only one opening for the urinary, genital, and intestinal canals.

or germ cell, and a sperm or fertilising cell, are always necessary. Sometimes both products are developed in the same individual, which is then said to be monœcious or hermaphrodite, as the Cœlenterata, certain Scolecidæ, trematode Entozoa, Medusæ, etc. In snails and other pulmogasteropods, there is an interchange of office. In the remaining animals, which are termed diœcious, the reproductive elements are found in separate individuals belonging to opposite sexes. In fishes and amphibia the ova are fertilised without the body, as already described; in reptiles, birds, and mammals, within the body of the ovigerous or female parent. From this fertilised ovum the embryo is developed. For a brief review of this process we cannot do better than quote the following words of Carpenter:—"The earliest part in the history of embryonic development is nearly the same in all animals; for it consists in the multiplication of the simple cell of which the original germ is composed, until a cluster is formed, all the cells of which appear to be in every respect similar to one another. Each of these cells either takes into itself, or draws around it, a portion of the vitellus or yolk, which is the nutrient substance of the ovum; and thus either the whole or a portion of this vitellus is subdivided into a number of minute spherules, altogether constituting what is known as the mulberry mass. Among the Invertebrata generally, the embryo comes forth from the egg in a very simple condition, a large part of its structure having undergone but little change from the state of the 'mulberry mass,' and in these the whole yolk undergoes subdivision. The same is the case, too, in the batrachian reptiles, which issue from the egg in a form very different from that into which they are to be subsequently developed. And it is the case even with Mammalia, but for a very different reason, their embryonic structure, first formed at the expense of the yolk, being destined to acquire additional material for its full development from a source altogether different. In the highest mollusks, however, as also in fishes, ordinary reptiles, and birds, the portion of the yolk which undergoes subdivision is comparatively small; and the great mass of the vitellus is destined to be subsequently absorbed into the substance of the germ. When the whole of the yolk is taken into the mulberry mass, the formation of the embryo is usually the result of the progressive metamorphosis of its parts, the cells of its surface being converted into integument, and those of its inner part into the internal organs. This is the case, for example, in the intestinal worm. The embryonic condition of many of the organs is frequently retained at the time when the young animal comes forth from the egg, those parts only being completed which are necessary to enable it to obtain its nutriment. Other organs are subsequently evolved at the expense of the food thus introduced; and thus a complete change or metamorphosis may take place, in regard alike to external form and to internal structure, between the larval and the adult states. Of this phenomenon we have characteristic examples in the groups of Insects and Batrachia. The change is sometimes gradual, as in the progressive advance of the tadpole into the condition of the frog. But it is sometimes apparently sudden, as when the chrysalis skin is thrown off, and the perfect insect comes forth. In the latter case, however, the change is just as gradual as in the former, since the organs characteristic of the perfect insect are undergoing development during the whole of the chrysalis period."

In animals supplied with a food-yolk the embryo is nourished until it has nearly acquired its adult condition, although far from having attained its adult size (Carpenter).

In the lowest forms of the Invertebrata the ova are developed in loose filamentous tissue, or in membranous folds, or upon stalks, or processes in the interior of the body, as in the Cœlenterata, or are actually embedded in its substance, as in the Protozoa. In the higher forms the ovaries consist of sacs, cæca, or tubuli, which may be simple or ramified, and which have an attached duct, named the oviduct. In fishes the ovaries are double and symmetrical, as previously described. They are double in the Amphibia, and the ova are brought to maturity simultaneously, not in succession, as in reptiles, birds, and mammals; being received into the oviducts, they are conveyed to the cloaca, and then deposited into the water, either singly or in masses, and there undergo development. In reptiles, as in birds, the ovary is usually simple. In the latter the Dorking fowl is an exception to this rule. In the embryonic condition of birds both ovaries are present; the right one, however, disappears. The ovary consists of a number of small spherical bodies named ova (Fig. VI., 1, page 265), invested by delicate membranes called ovisacs (2). To the lower part of the ovary is attached the infundibulum (5), or wide funnel-shaped opening of a single tortuous tube called the oviduct (6, 6); this terminates below in the cloaca (12), which, as before mentioned, constitutes the common outlet of the alimentary, urinary, and reproductive organs.

For the successful incubation of birds' eggs a steady and continuous temperature of about 100° Fahr. is requisite. The period of incubation varies, in different birds, from ten to fifty or sixty days. In mammals the ovaries are double, one on each side of the uterus, to which they are connected by means of a duct called the Fallopian tube, which corresponds to the oviduct of birds, and through which the ovum passes into the uterus, where it remains until it is sufficiently developed.

We have described the most important features in the animal kingdom, step by step, from those organisms which constitute the simplest forms of life, to those more complex beings which constitute the highest. The student will have observed already that the different members are marvellously connected. In fact, we might exclaim with Faust, in the sublime language of Goethe—

> "How all things in a whole here weave and blend,
> One in the other working, moving, living."

Or with Huxley, that "Every animal has a something in common with its fellow; much with many of them; more with a few; and usually so much with several that it differs but little from them." As the same talented writer has further asserted,* "The powers or faculties of all kinds of living matter, diverse as they may be in degree, are substantially similar in kind." Again, "A threefold unity pervades the whole living world—namely, a unity of power, or faculty, a unity of form, and a unity of substantial composition."

The bodies of animals are seemingly made up of a variety of tissues, which differ from each other; and, so far as the unaided eye can judge, such is the case. But microscopic analysis clearly and indisputably demonstrates the wonderful fact, that the relationship which these tissues bear to each other, in their early condition, is not so far removed as we should otherwise imagine. All are alike made up of a number of cells, constituting protoplasm, or what has been termed the physical basis of life. It is by the combination and superaddition of these cells that tissues are formed and animals built up. How or why that power which we term life originates, and by what laws it so admirably and persistently arranges its materials, so as to constitute a living being, is beyond man's power of understanding to conceive. It is this life manifested to our senses under such an immense variety of conditions which, while it interests, yet astounds us. Humboldt truly remarks: "When the active spirit of man is directed to the investigation of nature, or when, in imagination, he scans the vast fields of organic creation, among the varied emotions excited in his mind there is none more profound or vivid than that awakened by the universal profusion of life." The whole globe is a swarming and teeming world of living things, amid which man himself, also a living being, conducts those operations which justly earn for him the reputation of the most intellectual and intelligent of all animals. It matters not whether we turn to the extensive regions comprised under the name of Siberia, characterised by its three degrees of cold and its Arctic tracts doomed to everlasting snow, or to the tropical verdure and fertility of the plains of the Indus and the Ganges, and the large sandy or gravelly deserts situated between these plains, doomed to utter barrenness, or to lands favoured with the blessings of a temperate clime—in each and every situation we find life existing, adapted by structure and general configuration for that sphere in which it may be found. But if land is thus tenanted, what shall we say of the vast expanse of waters which enter so largely into the composition of the globe? The Arctic and Antarctic, the Indian and Atlantic, and the mighty Pacific Oceans, have each their countless millions of living beings. Even the microscopic medusæ exist in such vast numbers that Scoresby intimates that it would require

* *Fortnightly Review.*

80,000 persons, working unceasingly from the creation of man to the present day, to count the number of minute beings contained only in the space of two miles of the turbid ocean water. And of the myriads of other creatures which live there imagination may disport itself without limit, and mind lose itself in the fathomless abyss of figures.

No science affords to us more conclusive evidence of design than that of Comparative Anatomy. Examine attentively the organisation of any being—how admirably is its outward form adapted for the sphere from which you removed it; what wonderful genius is displayed in the arrangement of its individual tissues; and how perfectly each perform their respective functions. This evidence of design is not confined to a few isolated organisms, but pervades the whole animal world, from the simplicity of the Gregarinidæ to that crowning effort of God's work, the human being. At the very threshold of life the plant and animal worlds claim kindred. Both commence their basis as cellular structures, with difficulty distinguishable, and both proceed through an infinity of grades, till Nature exhausts herself in the production of animals which, by their upright forms, their expressive and intellectual features, their power of communication by language, and the arrangement of their limbs constructed to serve the purposes of progression, prehension, and labour, far outstrip all other animals in point of superiority and usefulness; and of plants whose size is simply gigantic, and whose age we can only conjecture; but it is not incompatible with fact to suppose that some may have been silent witnesses to the disasters of the terrible Noachian Deluge.

Nutrition is necessary for the purpose of supporting life, and we find it common to all animals without exception. In the lowest organisms this function is effected by the simple process of imbibition. But the majority of animals are provided with organs of locomotion by which they are enabled to seek and obtain their food, and are further provided with a canal in which the food is lodged until sufficiently prepared for utilisation. In the lowest orders the digestive canal is nothing more than a simple continuous tube. As, however, we proceed through the successive links in the great chain of organised creation, we have seen that this tube becomes more complex in character. The orifice is guarded with lips and movable jaws armed with teeth for the purpose of breaking down hard substances and rendering them fit for swallowing; and a part of the tube becomes dilated into one or more chambers, for the purpose of lodging the food while it undergoes both physical and chemical change. The succeeding part of the tube, or intestines, is variously lengthened, according to the habits of the animals. In the digestive apparatus of the insect tribe, both carnivorous and herbivorous, we meet with a multitude of new and peculiar formations. Some of these animals undergo transformation or metamorphosis. In the larval condition the stomach is of proportionate size to the amount of food required. It has been computed that caterpillars sometimes devour and digest three times their own weight of aliment in twenty-four hours. The perfect condition having been attained, the digestive tract is altered to meet the new conditions which the change and smaller quantity of the food demand. Those insects which live on hard animal substances are provided with firm horny jaws—sometimes having tooth-like edges—large in proportion to the size of the animal. In bees, wasps, ants, etc., the organs of mastication have a suction apparatus appended, which is further developed in gnats and flies. The latter are also provided with minute lancet-like darts for the purpose of penetrating the integuments of other animals.

In the vertebrate kingdom the evidences of design are not more wonderful, though more evidently manifested. The outward form of fishes, diverse to an extraordinary degree, and the general structure—embracing the fins, by which rapid movement is effected; the digestive tract, short and wide, for the simple reason that the food on which these animals live is, as a rule, so nearly allied to their own tissues, that it requires but little preparation; the respiratory gills, whose delicacy of mechanism is so beautiful as to be beyond expression; and, in fact, the whole system—is so wonderfully contrived, that we are lost in silent admiration at the adapting power of the Almighty Creator.

In the Batrachia—connecting links between the aquatic and terrestrial scales—though but once removed from the fish tribe, a huge stride is evident towards that perfection of structure found in some of the higher forms of life. There is some similarity, as mentioned in the lesson on these animals, in the moth and frog metamorphosis. But this transit from the imperfect to the perfect condition is, indeed, a wonderful process for effecting the completion of an animal.

In birds our attention is again powerfully attracted by the same evidence of design, but displayed in beings whose sphere is to move in air. Here we find the bones light and permeated with air, the epidermis developed into feathers, and the general structure of the body that best adapted for flying; while in some we find webbed feet, to enable them to move on the surface of water. The bills are so disposed as to serve the end which habits and food require; and as regards the digestive tract, the stomach presents every gradation in structure, from the membranous sac of the carnivorous tribes to the true muscular gizzard of graminivorous birds—varying according as the food consists of animal or vegetable materials. It is the covering of birds which adds, probably more than any other part, to the wonderful evidence of design. As Paley says, "This cannot escape the most vulgar observation. Its lightness, its smoothness, its warmth, the disposition of the feathers all inclined backwards, the down about their stem, the overlapping of their tips, their different configuration in different parts, not to mention the variety of their colours, constitute a vestment for the body so beautiful, and so appropriate to the life which the animal is to lead, as that I think we should have no conception of anything equally perfect if we had never seen it, or can now imagine anything more so."

In mammals the most complex organisation prevails. In each one a set of organs is devoted to the performance of functions requisite for maintenance, reproduction, etc. The digestive apparatus in man and the higher apes is simple; but in some lower in the order it is more complicated, especially in the herbivorous mammals. The respiratory, nervous, muscular, and glandular systems are alike admirably arranged, and work so harmoniously, that under natural conditions the system maintains a healthy balance. There is yet one system, the absorbent, but too often ignored, yet perhaps the most delicate of all. It is that by which the lymph and chyle, from various parts of the system and intestines, are carried into the blood, the former to be again utilised, the latter as new material. This process is effected by a chain of glands and a delicate network of vessels, which are distributed over various parts of the body. These are found in all the Vertebrata, but are most numerous in mammals. Many of the different orders of mammals possess a great diversity in their outward appearances, habits, and sphere of action. Thus, the mole, with its short, powerful, and well-developed fore-limbs, and its glossy fur, so arranged that the hairs composing it will lie smooth in any direction, is admirably adapted to live and move in its underground tenements. The bat tribe, varying in size and situation, from the little English bat to the *Pteropus Javonicus* are mammals modified to lead the life of birds.

The well-known and so oft-described carnivora, the cetacea, or whale tribe, in which the adaptation of the mammiferous structure to the life of a fish is remarkably displayed, the lemurs, the monkeys of the Old and New Worlds, etc., possess remarkable differences from each other in outward form.

But the theme is inexhaustible, whether we examine the jelly-like rhizopods, the Radiolaria, with their silicified skeletons, contributors to the earth's strata; the Spongidæ, once supposed vegetables; the innumerable Infusoria, Hydrozoa, Actinozoa, Polyzoa; the double-necked jar-like Ascidioida, or those fabricators of the bivalve shells, the Lamellibranchiata: the host of star-fishes, sea-urchins and cucumbers, classified as Echinodermata; the wheel animalcules and their repulsive allies; the almost indescribable Crustacea, with every other order demonstrate beyond the power of refutation the unity of design and identity of operation. Man, at the head of both divisions of the animal kingdom, while humbling himself with the thought that he is merely a mammal, must yet glory in the fact that the all-wise Creator has endowed him with attributes possessed by no other animals; while consideration of the peculiar structure of the organs of his frame will afford proofs of their being constructed with reference to faculties of a higher and more extensive range than those of any. even the most favoured species, of the brute creation.

RECREATIVE SCIENCE.—IX.

AMUSING OPTICAL INSTRUMENTS ILLUSTRATING THE LAWS OF REFLECTION AND REFRACTION—THE CAMERA OBSCURA (*continued*).

THE rise and progress of any special art demanding the aid of science is always an instructive theme for the youthful student —the beginning and the end seem to be so utterly different and widely separated. When the artist constructed with elaborate care his travelling camera obscura, and sketched upon the little table the picture painted by the aid of his optical apparatus, he little thought that the time would come when the same light that caused the picture to appear upon the ground glass or sheet of paper would leave its own silent impress on the medium carefully prepared by chemical means, and that light might save the would-be limner the trouble and time required for art-studies, and do for him more than the most delicate hand, skilled in elaborate tracings, could possibly perform. One of the foundations of the beautiful art of photography was the "camera obscura." The desire to fix the pretty, and at that time evanescent, picture must from an early period have engaged the attention of thoughtful minds. And here the construction of a complete travelling camera obscura and dark box, invented by Gravesande and described by Jean Étienne Montucla, is interesting, because we have its parallel in the dark tent and more portable travelling equipage of the photographer. In his essay on "Perspective," Gravesande thus describes his camera obscura: "This machine is shaped almost like a 'sedan chair;' the top of it is rounded off towards the back part, and before it swells out into an arch at about the middle of its height."

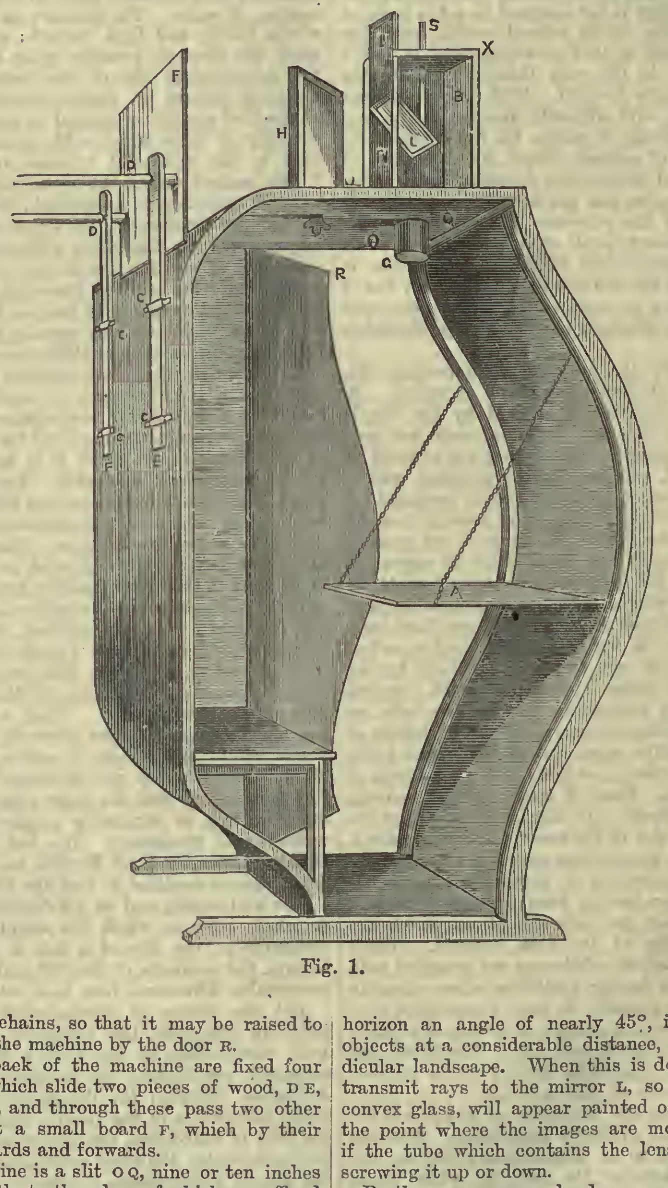


Fig. 1.

1. The board A in the inside (Fig. 1) serves as a table; it turns on two iron hinges fastened to the fore part of the machine, and is supported by two small chains, so that it may be raised to allow the operator to enter the machine by the door R.

2. On the outside of the back of the machine are fixed four small staples, C, C, C, C, in which slide two pieces of wood, D E, D E, three inches in breadth, and through these pass two other pieces, serving to keep fast a small board F, which by their means can be moved backwards and forwards.

3. At the top of the machine is a slit O Q, nine or ten inches in length, and four in breadth, to the edges of which are affixed two rules in the form of a dovetail; between these slides a board of the same length having a round hole, of about three inches in diameter, in the middle, furnished with a nut, that serves to raise and lower a tube, G, about four inches in height, which has a screw corresponding to the nut. This tube is intended for a convex glass lens.

4. The movable board, above described, supports a square box X, about seven and a-half inches in breadth and ten in height, the fore part of which can be opened by a small door, B. and in the back part of the box, towards the bottom, is a square aperture N, of about four inches in breadth, which may be shut at pleasure by a sliding board, I.

5. Facing this square aperture, N, is a slit which occupies the whole breadth of the box. It serves for fixing on the box a plain mirror, H, which slides between two rules, so that the angle it makes with the horizon towards the door is $112\frac{1}{2}$ degrees, or four-fifths of a right angle.

6. The same mirror, when necessary, may be placed in a direction perpendicular to the horizon, as represented at H, by means of a small iron plate adapted to one of its sides, and which may be screwed fast by means of a nut.

7. Within the box X is another small mirror, L, fixed a little above the slit O G, and which, being drawn up or pushed down by the small rod S, may be inclined to the horizon at any angle whatever.

8. That the machine may be supplied with air, a tube of tin plate or other metal, bent at both ends, may be fitted into one of the sides, and this will give access to the air without admitting light. But if this should not be sufficient, a small pair of bellows to be moved by the foot may be placed below the seat, and in this manner the air may be continually renewed.

The different uses to which this camera may be applied are thus described:—

(1.) *To represent objects in their natural situation.*—When objects are to be represented in this machine, extend a sheet of paper on the table, or, rather, stretched on a frame; or you may employ a piece of strong card, and fix it in such a manner as to become immovable. In the tube G (Fig. 1) place a convex lens, the focus of which is nearly equal to the height of the machine above the table; open the back of the box X, and, having removed the mirror H, as well as the board F, and the rods D E, D E, incline the movable mirror L till it makes with the horizon an angle of nearly 45°, if you intend to represent objects at a considerable distance, and which form a perpendicular landscape. When this is done, all those objects which transmit rays to the mirror L, so as to be reflected on the convex glass, will appear painted on the paper on the table A; the point where the images are most distinct may be found, if the tube which contains the lens be lowered or raised, by screwing it up or down.

By these means any landscape, view of a city, etc., may be exhibited with the greatest precision.

(2.) *To represent objects in such a manner as to make that which is on the right appear on the left, or vice versâ.*—The box X being in the situation represented in Fig. 1, open the door B, and having placed the mirror H in the slit, and in the situation already mentioned at No. 5, raise the mirror L till it makes with the horizon an angle of $22\frac{1}{2}$ degrees; if the fore part of the machine be then turned towards the objects to be represented, which we have supposed to be at a considerable distance, they will be seen painted on the paper, but *transposed from right to left.*

It may be sometimes useful to make a drawing when the objects are transposed in this manner: for example, in the case where it is intended to be engraved, for as the impression of the plate will transpose the figures from right to left, they will then appear in their natural position.

(3.) *To represent in succession all the objects in the neighbourhood and quite round the machine.*—Place the mirror H in a vertical position, as seen in Fig. 1, and incline the mirror L at an angle of 45 degrees; if the former be then turned round vertically, the lateral objects will be seen painted in succession on the paper, *in a very pleasant manner.*

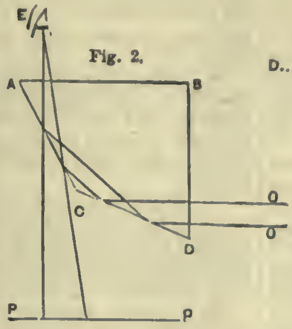


Fig. 2.

It must here be observed, that it will be necessary to cover the mirror H with a kind of box made of pasteboard, open towards the objects, and also towards the aperture N of the box X; for if the mirror H were left entirely exposed it would reflect on the mirror L a great many lateral rays, which would considerably weaken the effect.

In the arrangement of the photographic camera every care is taken to exclude lateral rays, so as to allow only those to enter the camera which come direct from the object intended to be delineated; so also in obtaining a sharply-defined picture, the whole aperture of the lens is not left open, but carefully closed by stops of various sizes. All these niceties, which might be thought to belong only to the modern practice of photography, were perfectly understood and made use of by Gravesande, who describes them in the following paragraph:—

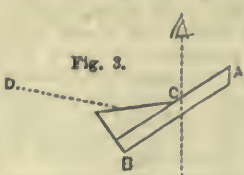
(4.) *To represent the image of paintings or prints.*—Affix the painting or print to the side of the board F which is opposite to the mirror L, in such a manner that it may be illuminated by the sun. But as the object in this case must be at a very small distance, the tube should be furnished with a glass, having its focal distance nearly equal to half the height of the machine above the paper; if the distance of the painting from the glass be then equal to that of the glass from the paper, the figure of the painting will be represented on the paper exactly of the same size. Some attention is necessary in regard to the aperture of the convex glass. In the first place, it may have the same opening as that of a telescope of the same length. Secondly, the opening must be diminished when the objects are very much illuminated, and *vice versâ.* It will, therefore, be proper to have different circles of copper or of blackened pasteboard, to be employed for altering the size of the aperture according to circumstances.

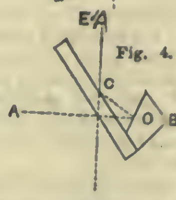

Fig. 5.

Had Gravesande been born in more modern times, he would no doubt have made his name celebrated by constructing a camera for photographic purposes quite as ingenious and complete as the one he devised only for those who used no chemicals, but worked laboriously with pencil and paint-brush.

The *camera lucida* is another optical contrivance by which the image of any object is projected on to a sheet of paper so as to enable an artist to make an accurate tracing from it. This instrument was invented, in the year 1807, by the famous Dr. Wollaston, and owes its usefulness to the internal reflection of light; it consists of a four-sided prism mounted on a brass frame.

In Fig. 2 the quadrangular-shaped prism is shown at A B D C; the angle B must be 90°, D 67½°, and C 135°: if an object O O be placed opposite the face B D the rays of light proceeding from O O will, after falling on D C, be reflected inside the glass to C A, and thence to the eye at E. There is no image actually formed on the sheet of paper placed below the prism at P P, like that on the ground-glass screen of the camera obscura; but, as all objects appear to come in a straight line from the point whence they are seen, the image will appear as far below the instrument as the object is before it, and it will, therefore, seem to be delineated on the paper P P. The prism is covered at the top with a metallic eye-piece, the hole of which lies half over the edge of the prism, and by this simple arrangement both the image and the paper become visible to the draughtsman, who would not otherwise be able to see his pencil and make the outline of the object depicted on P P.





Amici, an Italian philosopher, invented two other and more ingenious modifications of the original camera lucida. The first (Fig. 3) consists of a parallel piece of plate-glass, A B, joined to a metallic reflecting speculum, C, which is inclined to the surface of the glass A B at an angle of 135°. The rays from the object at D are reflected by the speculum to the glass at E, and this "ghost-like" reflection passes to the eye.

In Fig. 4 the rays pass through the plate-glass before they fall upon the metallic reflector. The ray from the object A passes in a straight line through the glass, and being reflected at O from the speculum B, it is again reflected in true "ghost fashion" from the surface of the plate-glass at C to the eye at E.

Amici's arrangement is most convenient to the artist, who will always be able to see the image, the paper, and his pencil, whereas with Wollaston's original instrument considerable patience and practice is required before the draughtsman can use it properly.

A very comprehensive work on "transparent mirrors" has been written by M. Lucas, an engineer of permanent ways and bridges in France, and he details some modifications of the "ghost illusion" combined with the effects of persistence of vision, by which singular optical illusions are produced. A clever abbreviated translation in the *Building News* describes what takes place.

Divide a circle into two *n* sectors, of which *n* has a central angle *a*, and *n* has a central angle *b*, the sectors *a* and *b* succeeding alternately. Cut out the sectors *b* so as to form spaces. A sort of star will remain, formed by the *n* sectors *a*, on which either silvered glass or, what is preferable, metallic plates, silvered over and polished, are to be placed. This apparatus being fixed vertically in front of an observer, he can perceive by the reflection produced by the silvered sectors his own image and generally those of other objects and persons situated in front of the star. He can also see through the open spaces persons and other objects placed behind. No optical illusion can result from this super-position of two visual phenomena, because the observer distinguishes the apparatus and becomes acquainted with its action. But supposing that this star takes, round an horizontal central axis, a very rapid movement of rotation, the reflecting sectors are no longer distinguishable from the vacant spaces. The observer will think that he sees only a plate of glass, almost invisible, like window-glass, and he will behold, not without astonishment, the images of the anterior objects superposed more or less confusedly on the objects behind; strange illusions must be the result.

Similar phenomena are produced by means of an unsilvered sheet of glass, when the images before the reflecting surface are strongly illuminated by the oxy-hydrogen light, whilst the real figures behind the glass are more moderately lighted by gas jets. The spectral figures seen behind the unsilvered glass are of a peculiar paleness, and yet their resemblance to the real figures is so great that many spectators cannot tell which is the ghost or which the real figure walking on the stage.

The transparent mirror described above will serve the same purposes as unsilvered glass, without requiring the same mode of lighting. M. Lucas constructed a small apparatus in which this arrangement was successfully carried out. There are four radiating sectors, and the means by which they are fixed and traversed by a geared shaft are hidden under the table. A slit parallel to the foremost edge gives passage for the metallic blades. By simple gearing the operator can obtain, by turning a handle, a rotation sufficiently rapid to produce the effect of an unsilvered vertical or semi-circular sheet of glass. The edge of this silvered glass apparatus is concealed by a wooden frame.

A person being placed *behind* the rotating mirror at a distance of six and a half feet from the vertical plane passing through the axis of rotation, another is placed in *front* of the mirror at the same distance of six and a half feet from the other side of the vertical plane, when the latter sees two persons side by side, one being the spectral reflection produced by the revolving radiating sector of silvered glass, and the other the real person. The mirror can be made of metal silvered and polished on both sides; the effect obtained is reciprocal, and the illusion is the same for the two persons.

Another effect was obtained by M. Lucas by placing a common mirror vertically at the distance of two and a half feet behind an unsilvered mirror. The reflected image is repeated a number of times at greater and greater distances, as is the case with an object placed between two mirrors. Yet while in the latter case the successive images are in reversed positions, those in the apparatus are face to face.

Fig. 5 represents the beautiful effect produced in any room by placing two looking-glasses opposite to each other—one over the chimney-piece, the other on the wall facing it; thus a chandelier in the centre is reflected over and over again, whilst the room being also multiplied gives the spectator the idea of endless apartments, all leading one into the other. At one of the theatres, where the manager was anxious to represent a magnificent room hung with mirrors, real ones were used, and it was only by the laughter of the audience that he discovered he had not taken sufficient precaution to exclude the reflection of the carpenters and scene-shifters, who were all shown up in the elegant apartment with the grandly-dressed "prima donna." Thus, upon the stage, a painted scene representing a mirror is more convenient than the real silvered glass, although, when laid at a slight angle on the stage, looking-glass has been used with remarkable success for the purpose of imitating the still water of a beautiful lake.

LESSONS IN ALGEBRA.—XXV.

Exercise 41.—Algebraical Problems (*continued*).

33. A, B, and C possess certain sums of money, such that, if A receive, in addition, half what B and C have, he will possess £a; if B receive, in addition, a third of what A and C have, he will possess £b; and if C receive, in addition, a fourth of what A and B have, he will possess £c. What sum has each?

34. All that is known respecting the co-efficients a, b, and the quantity c, in the trinomial expression $ax^2 + bx + c$, is, that when 4 is put for x, the value of the expression is 42; that when 3 is put for x, its value is 22; and that when 2 is put for x, its value is 8. What are the values of the co-efficients a, b, and the number c?

35. Five persons engage in play on the condition that he who loses shall give to each of the others as much as he already has. All lose in their turn, and yet at the end of the fifth game they all have the same sum, namely, £32. How much did each begin with?

36. Solve the general simultaneous equations to two unknown quantities, denoting the co-efficients of x and y in the first equation by a and b, and the absolute term by c; and the co-efficients of x and y in the second equation by d and e, and the absolute term by f; and let all the terms in both equations be positive.

37. A number consists of three digits, of which the difference between the first and second is the same as the difference between the second and third. If the number be divided by the sums of the digits, the quotient will be 26; but if 198 be added to it, the digits will be inverted. Required the number.

38. A person distributes a shillings among n persons, men and women: to the men he gives p pence each; to the women q pence each. Required the number of men and the number of women.

39. If from a vessel of wine containing a gallons, b gallons be drawn off, and the vessel then filled up with water, and this operation be repeated n times successively, find the quantity of wine remaining after these n operations are finished.

40. In a garrison of 2,744 men, there are two cavalry soldiers to twenty-five infantry, and half as many artillery as cavalry. Find the numbers of each.

41. A person dies worth £13,000; some of this he leaves to a charity, and twelve times as much to his eldest son, whose share is half as much again as that of each of his two brothers, and two-thirds as much again as that of each of his five sisters. Find the amount of the bequest to charity.

42. A farm of 270 acres is divided among A, B, and C: A has 7 acres to 11 acres of B, and C has half as much again as A and B together. Find the shares.

43. The length of a floor exceeds the breadth by 4 feet; if each had been increased by a foot, the area of the room would have been increased by 27 square feet. Find its original dimensions.

44. A sum of money was left for the poor widows of a parish, and it was found that if each received 4s. 6d. there would be 1s. over; whereas, if each received 5s., there would be 10s. short. How many widows were there, and what was the sum left?

45. There is a number consisting of two digits whose difference is two; and if it be diminished by half as much again as the sum of the digits, the digits will be inverted. Find it.

46. A person has travelled altogether 3,036 miles, of which he has gone *seven* miles by water to *four* miles on foot, and *five* miles by water to *two* on horseback. How many did he travel each way?

47. A cistern can be filled in 15 minutes by two pipes, A and B, running together: after A has been running by itself for 5 minutes, B is also turned on, and the cistern is filled in 13 minutes more. In what time would it be filled by each pipe separately?

48. A mass of copper and tin weighs 80 pounds, and for every 7 pounds of copper there are 3 pounds of tin. How much copper must be added to the mass that for every 11 pounds of copper there may be 4 pounds of tin?

49. A does $\frac{2}{3}$ of a piece of work in 10 days, when B comes to help him, and they take 3 days more to finish it. In what time would they have done the whole, each separately, or both together?

50. Divide £149 among A, B, C, and D, so that A may have half as much again as B, and a third as much again as B and C together; and D a fourth as much again as A and C together.

51. There are two silver cups, and one cover for both. The first weighs 12 ounces, and, with the cover, weighs twice as much as the other cup without it; but the second with the cover weighs a third as much again as the first without it. Find the weight of the cover.

52. A man could reap a field by himself in 20 hours, but with

his son's help for 6 hours he could do it in 10 hours. How long would the son be in reaping the field by himself?

53. A grocer bought tea at 6s. 6d. per pound, and a third as many pounds again of coffee at 2s. 6d. per pound. He sold the tea at 8s. and the coffee at 2s. 3d., and so gained 5 guineas by the bargain. How many pounds of each did he buy?

54. Find a number composed of three digits, each greater by unity than that which follows it, so that its excess above one-fourth of the number formed by inverting the digits shall be 36 times the sum of the digits.

55. A and B have each a sum of money given them, which will support their families for 10 and 12 days respectively; but A's money would support B's family for 15 days, and B's money would support A's family for 7 days, with 2s. 6d. over. What were the sums?

56. A person being asked how many ducks and geese he had in his yard, said, "If I had 8 more of each, I should have 8 ducks for 7 geese; and if I had 8 less of each, I should have 7 ducks for 6 geese." How many had he of each?

57. A man, woman, and child could reap a field in 30 hours, the man doing half as much again as the woman, and the woman two-thirds as much again as the child. How many hours would they each take to do it separately?

58. A merchant who allows £160 for his annual expenditure, increases his property every year by a fourth part, and at the end of two years is £900 richer than at first. What property had he at first?

59. A sold a certain number of tickets at a guinea each, and gave one-third of the produce to B; one-fourth of the remainder to C; and one-fifth of the last remainder to D; after which he had £210 remaining. How many did he sell?

LESSONS IN ENGLISH.—XLIII.

GENDER (*continued*).

MANY words give no indication as to *sex*, and may be used indifferently, as the sex requires, of either *males* or *females*. Such nouns have been called of the *common gender*; the appellation may pass, provided the reader bears in mind that, strictly speaking, there are in English only *two* genders, the *masculine* and the *feminine*.

NOUNS EITHER MASCULINE OR FEMININE.

Artist.	Enemy.	Friend.	Painter.	Slave.
Child.	Favourite.	Neighbour	Parent.	Sovereign.
Cousin.	Flatterer.	Novice.	Sage.	Thief.
Dancer.	Fool.	Orphan.	Servant.	Writer.

With these nouns, the *sex* is made known by some accompanying word. For example:—

He is my cousin.	My female cousins are dead.
She is my cousin.	My male cousins have married.

Child, or *infant*, is generally used in the neuter gender (except when you wish to mark the sex emphatically), until the person you speak of has grown to some degree of intelligence; thus, we say of a babe—

What a pretty child, and it is so good!

but we do not say—

What a bad child! it tells stories; or
It is a good boy, it has mastered its Latin lessons.

There are some *feminine* nouns of which masculine counterparts do not exist. For example:—

A blonde.	A dressmaker.	A shrew.	A termagant.
A brunette.	A mantuamaker.	A syren.	A scold.
A dowager.	A milliner.	A vixen.	A virago.

Some titles are *double feminines—the Queen Dowager*, that is, *the King's Widow; the Dowager Countess of Derby*, that is, *the Earl of Derby's Widow*.

Sex is sometimes attributed to inanimate objects. This attribution is very common in Latin and other languages in which the ending of nouns is one means of determining the sex; thus, gladius, *a sword*, is of the masculine gender, because it ends in *us*. Sometimes *sex* may be ascribed to things without life, from a regard to the nature of the functions which such objects perform. Those which exert active functions may thus be spoken of as *masculine*; those which receive influences may thus be spoken of as *feminine*. In general, active and quickening energy is viewed as *male*, passive and producing power is viewed as *female*. But the rule is not of universal application. What is more active and quickening than the sun? In English, the *sun* is *masculine*, but in German the *sun* is *feminine*. With us, too, agreeably to the rule, the *moon* is *feminine*; but with the *Germans*, contrary to the rule, the *moon* is *masculine*.

Little more in this case can be done than to study and follow usage. As an aid, I subjoin instances of what, as the latitude is chiefly taken by poets, may be called the *poetic gender*:—

POETIC GENDER.—MASCULINE.

Anger.	Love.	Time.	The Elephant.	The Leopard.
Danger.	Sleep.	The Ocean.	The Horse.	The Panther.
Death.	The Sun.	Tyranny.	The Dog.	The Names of
Fear.	Terror	War.	The Lion.	Trees and
Laughter.	Thunder.	Winter.	The Tiger.	Rivers.

POETIC GENDER.—FEMININE.

Affection.	Devotion.	Fortune.	Misfortune.	Reason.
Ambition.	Discord.	Freedom.	The Moon.	Religion.
Art.	Earth.	Habit.	Morning.	Republic.
Astronomy.	Echo.	Happiness.	Muse.	Science.
Autumn.	England.	Heaven.	Music.	Ship.
Avarice.	Envy.	Hope.	Nature.	Silence.
Beauty.	Eternity.	Hour.	Necessity.	Soul.
Benevolence.	Etna.	Humility.	Night.	Spring.
Charity.	Experience.	Justice.	Paris.	Summer.
Chastity.	France.	Law.	Patience.	Tongue.
Church.	Faith.	Liberty.	Peace.	Treason.
Commerce.	Fame.	Life.	Pleasure.	Truth.
Compassion.	Fancy.	London.	Plenty.	Vanity.
Conscience.	Fate.	Melancholy.	Poesy.	Vice.
Contemplation.	Flattery.	Memory.	Pride.	Virtue.
Darkness.	Folly.	Mind.	Prose.	Wisdom.

Ship is of the feminine gender; yet a ship intended for warlike purposes is called a *man-of-war*; nevertheless, *a man-of-war* is spoken of as feminine.

The *gender* of Greek and Latin proper names, and the *poetic gender* of other classical nouns, must be learnt from classical authorities; thus *Venus*, the goddess of beauty, is *feminine*, and *Oceănus*, the god of the sea, is *masculine*.

This *poetic gender* has its basis in what is called prosopopeia, or *personification*. These two words represent the same thing, the former indicating a direct address to an inanimate object as if it were animate, and the latter indicating the ascription to an inanimate object of personal qualities. Prosopopeia, called also *apostrophé*, does not, however, always convert the *neuter* into the *masculine* or *feminine*; in the ensuing fine instance of apostrophé, *sword* retains its natural gender:—

"O thou sword of the Lord, how long will it be ere thou art quiet? put thyself up into thy scabbard, rest, and be still! How can it be quiet, seeing the Lord hath given it a charge against Ashkelon, and against the sea-shore?"—Jer. xlvii. 6.

Personification is a figure of larger comprehension than *apostrophé*, for, in general, it is to be recognised wherever things are spoken of, or spoken to, as if they were persons or animals. In English, the employment of personification is easy, inasmuch as you have only to use a *masculine* or *feminine* pronoun instead of a pronoun in the *neuter* gender; as,

"Haste! haste! Death lies in wait; *he's* at the door."

Being easy, this figure is apt to become common, and should be frugally, not to say sparingly, employed. *Personification* is the peril of young writers and young speakers, especially those who have aught of the poetic temperament.

NUMBER.

Regard to *number* causes nouns to undergo a change. *Number* relates to the question whether a noun indicates *one* object, or more objects than *one*. If a noun indicates *one* object, it is said to be in the *singular* number; if a noun indicates *more* objects than one, it is said to be in the *plural* number. The word *singular* comes from the Latin singularis, *one only*, and has its representative in our term *single*; as, *a single star*, *a single city*, *a single act*. For example:—

"No single man is born with a right of controlling the opinions of all the rest."

The word *plural* comes from the Latin plus, *more*, that is, *more than one*. The Greek, and some other languages, have what is called a *dual* number—a form, that is, which specifically signifies *two*.

The *plural* is formed by either a *change* in the noun, or by an *addition* to the noun.

1. *Plural formed by a Change in the Noun.*—For example, man, men; woman, women (pronounced *winmen*). The changing of *a* in man into *e* in men, and the changing of *o* in *wo* into *i* in *wi*, are agreeable to the usages of the German idiom, which changes *a*, *o*, *u*, in the singular, into *ä* (ae), *ö* (oe, e, i), *ü* (ue), in the plural; as, man, *a man;* männer, *men.*

Words compounded with *man*, if of English origin, take *men* in the plural. For instance:—

Singular.	*Plural.*	*Singular.*	*Plural.*
Englishman.	Englishmen.	Frenchman.	Frenchmen.
Scotchman.	Scotchmen.	Churchman.	Churchmen.
Dutchman.	Dutchmen.	Statesman.	Statesmen.

There are, however, some exotic (or foreign) words ending in *man*, which take their plural in *s*. For example:—

Singular.	*Plural.*	*Singular.*	*Plural.*
Cayman (an alligator).	Caymans.	Norman.	Normans.
		Ottoman.	Ottomans.
German.	Germans.	Roman.	Romans.
Mussulman (Moslem).	Mussulmans (Moslems).	Talisman.	Talismans.

The reason why these last-mentioned nouns change *man* into *mans*, and not into *men*, is, that in them *man* is not the noun *man*, but merely a terminating syllable. You may ascertain whether or not the man is a terminating syllable by sundering it from what precedes, and considering whether the part from which it is sundered is an independent word, that is, has signification in itself. If it is an independent word, then the plural form is *men;* if it is not an independent word, the plural form is *mans.* For example: the plural form of *German* is *Germans*, because *ger* gives no sense; but the plural form of *Frenchman* is *Frenchmen*, because *French* has a meaning.

The following are other nouns which form their plural by a change in the body of the word. For example:—

Singular.	*Plural.*	*Singular.*	*Plural.*
Brother	brethren.	Louse	Lice.
Cow	kine (cows).	Mouse	Mice.
Foot	feet.	Tooth	Teeth.
Goose	geese.	Die	Dice.

Brethren has another form, namely, *brothers;* the former is employed in sacred subjects, the latter is employed on ordinary occasions.

Brethren is a double plural; one form is *brether* (now obsolete) (in German brüder), to this is added *n*, making a second form in brethre*n*. A similar formation is found in childre*n*, thus: *child*, *child-er* (still in use in the north of England), *child-er-n*.

The termination *n* or *en*, occurring in ox*en*, brethr*en*, childr*en*, was once common in English, and is still common in German and Anglo-Saxon. Ben Jonson, in his English Grammar, makes a separate (his second) declension of nouns which form their plural by taking *n* at the end. He gives, as examples, *oxe*, *oxen;* *hose*, *hosen.* Other nouns had in his time the termination *n*, which, however, seems then to have been yielding to *s*, as he states that both forms were in use, namely—

Singular.	*Plural.*	
House	houses	housen.
Eye	eyes	eyen.
Shoe	shooes	shooen.

2. *Plural formed by Addition to the Noun.*—Instances have already been given in which nouns form their plural by taking a letter or two letters at their end. Other instances have been given, in which the plural is indicated in the two specified manners, that is, by change in the word, and by addition to the word.

The ordinary addition for the plural is the letter *s*, having the hard sound of *z*. For instance:—

Singular.	*Plural.*	*Singular.*	*Plural.*	*Singular.*	*Plural.*
Sofa	sofas.	Book	books.	Cake	cakes.
Dog	dogs.	Rope	ropes.	Table	tables.

E final was formerly not as now silent, but pronounced with a soft sound as a distinct syllable, as in these lines from Chaucer:—

"So pray I to God that none mis-writé thee."
"The Revé was a slender cholerlike man."

In some words the *e* is in the plural still pronounced. We say *cage* in one syllable, but *cages* is a dissyllable:—

WORDS MONOSYLLABIC IN THE SINGULAR, DISSYLLABIC IN THE PLURAL.

Singular.	*Plural.*	*Singular.*	*Plural.*	*Singular.*	*Plural.*
Cage	cages.	Rose	roses.	Pledge	pledges.
Face	faces.	Maze	mazes.	Nose	noses.

If the singular ends in *ch*, *sh*, *s*, *ss*, or *x*, the plural takes *es* instead of *s*. For example:—

Singular.	*Plural.*	*Singular.*	*Plural.*	*Singular.*	*Plural.*
Church	churches.	Chorus	choruses.	Glass	glasses.
Arch	arches.	Wish	wishes.	Fox	foxes.

In some words of Greek origin the *ch* is pronounced like *k;* these words form their plural in *s*. Thus:—

Singular.	*Plural.*	*Singular.*	*Plural.*
Monarch	monarchs.	Patriarch	patriarchs.
Hierarch	hierarchs.	Eunuch	eunuchs.

Nouns ending in *o* have either *s* or *es*. The following, with others, take *s:*—

Singular.	*Plural.*	*Singular.*	*Plural.*	*Singular.*	*Plural.*
Domino	dominos.	Seraglio	seraglios.	Octavo	octavos.
Tyro	tyros.	Folio	folios.	Quarto	quartos.

From this, the general usage, the following deviate by forming the plural in *es:*—

Singular.	*Plural.*	*Singular.*	*Plural.*	*Singular.*	*Plural.*
Buffalo	buffaloes.	Grotto	grottoes.	Negro	negroes.
Cargo	cargoes.	Hero	heroes.	Potato	potatoes.
Echo	echoes.	Manifesto	manifestoes.	Volcano	volcanoes.

The *e* in the plural is for the most part a relic of an *e* formerly used in the *singular;* this is still ordinarily retained in woe. Latham is not borne out by fact when he says that the *e* in the plural is "an orthographical expedient for the sake of denoting the length of the vowel *o;*" for *o* is as long in *folios* as in *potatoes*.

The ensuing fifteen words ending in *f*, *ff*, and *fe*, change the hard *f* into the soft *v* before adding the *s*. This change is required by euphony; it would be difficult to pronounce *loafs*, therefore we say *loaves:*—

Singular.	*Plural.*	*Singular.*	*Plural.*	*Singular.*	*Plural.*
Beef	beeves.	Leaf	leaves.	Shelf	shelves.
Calf	calves.	Loaf	loaves.	Staff	staves.
Elf	elves.	Life	lives.	Thief	thieves.
Half	halves.	Self	selves.	Wife	wives.
Knife	knives.	Sheaf	sheaves.	Wolf	wolves.

Other nouns in *f*, *ff*, and *fe*, are regular, that is, they form their plural in the ordinary manner by taking *s*. For example:—

Singular.	*Plural.*	*Singular.*	*Plural.*
Roof	roofs.	Chief	chiefs.
Ruff	ruffs.	Fife	fifes.

Nouns ending in *y*, immediately preceded by a consonant, change the *y* into *ie* before they take the *s* of the plural. For example:—

Singular.	*Plural.*	*Singular.*	*Plural.*
Lady	ladies.	City	cities.
Fly	flies.	Penny	pennies, pence.

These nouns formerly had their singular in *ladie*, *flie*, *citie*, and thus formed their plural simply by *s* according to analogy.

Y after a vowel remains unchanged, and in the plural takes the usual *s*. For example:—

Singular.	*Plural.*	*Singular.*	*Plural.*
Boy	boys.	Attorney	attorneys.
Key	keys.	Journey	journeys.

The statement that words of more than one syllable change *y* into *ies* in the plural is not well founded, and instead of *gallies*, *vallies*, *monkies*, the forms should be *galleys*, *valleys*, *monkeys*.

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